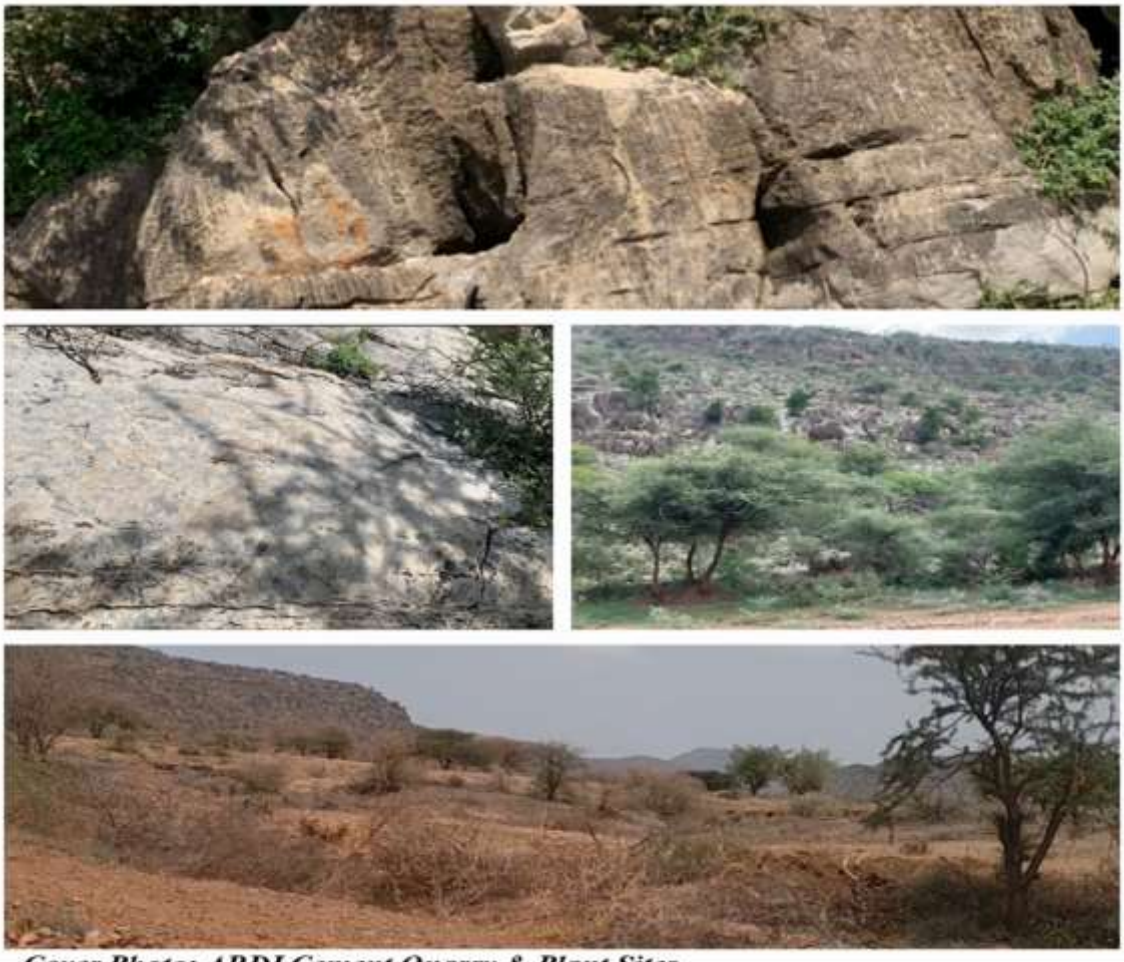
ARDI CEMENT PLC

Feasibility Study

for Establishment of 5,000 TPD
Greenfield Cement Project and Operation of
Captive Mines at Hula Hulul Village, Dire Dawa
Administration, Federal Democratic Republic of Ethiopia



Cover Photo: ARDI Cement Quarry & Plant Sites

Submitted to: Development Bank of
Ethiopia (DBE), Dire Dawa

July 2024

Contents

0. Executive Summary

0.1. General

This Feasibility Study is prepared with the objective of establishing a new cement manufacturing plant of capacity 5,000 TPD, based on Dire Dawa limestone deposit in Ethiopia.

The project is proposed by ARDI Cement PLC, a new Private Limited Company established by the alliance of highly qualified Ethiopian Diasporas from Australia.

Ordinary Portland Cement (OPC) will be manufactured at the ACPLC Plant. The limestone quarry and plant site, secured by the company for this project at Hula Hulul Rural Kebele, has got easy access to the required facilities such as water, electric power, road and communication which are very vital for the smooth operation of the plant.

Therefore, with an emphasis on the technical, financial, and environmental considerations, this feasibility report seeks to provide an in-depth analysis of the elements that contribute to the success of building a 5000 TPD cement plant in Ethiopia, under the current and future likely circumstances.

0.2. About the Company

ARDI Cement PLC is a subsidiary Company of ARDI Real Estate PLC, a Private Limited Company established by the alliance of highly qualified Ethiopian Diasporas from Australia.

The company has been focused on real estate investment in promising areas, aiming to generate above-average returns for its shareholders and contribute to economic progress. Headquartered in Addis Ababa City Administration, specifically in Woreda 2, Bole Sub City area, the company is now prepared to invest on establishing a cement manufacturing plant with an impressive annual production capacity of 5,000 TPD in Dire Dawa City, under the supervision of the Dire Dawa Administrative Council.

0.3. Project Description

The shortage of cement in Ethiopia has been causing severe setbacks to development in the country. The government, due to its foreign exchange crunch, as a rule, does not allow import of cement into the country.

There are inadequate numbers of cement producing factories in the country, working on average, at 50% of their installed capacities. Induced by all these, ACPLC proposes to tackle the shortage of cement at national level by supporting the investment for the development of a new 5,000 TPD cement plant ("New Plant") at Hula Hulul rural kebele of Dire Dawa Administration, located at about 18kms from Dire Dawa city and 510km North East of Addis Ababa.

The site has been primarily selected based on an economic source of limestone and availability of a convenient land for cement plant installation and operation. Quarry sites for clay are also available in a 3 kms radius at melka jebdu kebele. Access to water, electric power and transportation facilities are also available.

Further, the cement plant is located at about 7.2 km from Dire Dawa Dry port and 8.1km from Free Trade Zone to the north west of Dire Dawa Administration.

0.4. Technical Feasibility

The proposed plant capacity is primarily based on market considerations and the availability of raw materials. The proposed location enjoys the twin advantage of proximity to raw material sources as well as to road and railway transport facilities.

The plant will achieve 100% capacity utilization in its 4^{th} year of operations. Limestone is excavated at a quarry conveniently located adjacent to the proposed cement plant site. Results of the detailed geological investigation conducted through the area for the intended purpose, indicated that the studied area has got high quality and huge quantity limestone. The total minable reserve estimated is about 48,650,000.00 m3, which is sufficient for 119 years operation of ARDI Cement PLC'S 5000 TPD Cement Plant.

The best available technology, which is the dry process, shall be used for manufacture of cement. Due to the highly automated nature of the technology to be employed by the project, the manpower requirement for its operation is estimated to be only 88 people.

0.5. Market Prospect

Our market study and prior experience in the industry show that there is a huge unsatisfied demand for Cement in Ethiopia and neighboring Countries. Cement demand in Ethiopia during the last 5 years has grown well, with an average annual growth rate of 6.17%. The average annual supply of cement for the year (2019-2023) is estimated to be 8.85million tonnes. The demand supply gap for cement has been estimated as given below.

Table: Demand Gap

Year	Supply (mt/a)	Demand (mt/a)	Demand gap (mt/a)
2025	10.54	16.86	6.32
2026	10.91	17.90	6.99
2027	11.30	19.01	7.71
2028	11.70	20.18	8.48
2029	12.11	21.43	9.31
2030	12.54	22.75	10.21
Average	**11.52**	**19.69**	**8.17**

0.6. Financing

The total investment cost of the project amounts to Birr 15,948,090,512.81, from which 50% shall be covered by owner's equity and the remaining 50% is expected to be financed by the project finance policy of the Development Bank of Ethiopia. More details are shown in the table below.

Table: Sources of Finance

No.	Description	Total Costs	Owners' equity		Bank Loan	
			Amount	%	Amount	%
1	**Land and infrastructure costs**	**136,045,000.00**	**68,022,500.00**	50%	**68,022,500.00**	50%
2	Machineries & equipment	13,274,836,893.84	6,637,418,446.92	50%	6,637,418,446.92	50%
3	Mining Machinery & Equipment Costs	1,593,928,317.06	796,964,158.53	50%	796,964,158.53	50%
4	Other Capital Goods	24,000,000.00	12,000,000.00	50%	12,000,000.00	50%
5	Vehicle	51,000,000.00	25,500,000.00	50%	25,500,000.00	50%
	Total	**15,079,810,210.90**	**7,539,905,105.45**	**50%**	**7,539,905,105.45**	**50%**
	Pre-operating Expenses	478,181,480.04	239,090,740.02	**50%**	239,090,740.02	**50%**
6	Working capital requirement	390,098,821.88	195,049,410.94	50%	195,049,410.94	**50%**
	Granfd Total	**15,948,090,512.81**	**7,974,045,256.40**	**50%**	**7,974,045,256.40**	**50%**

Overall, the results of the feasibility analysis indicate that the project will have a strong potential to be a successful venture. Once this financing request is approved by the esteemed Bank, the promoter has planned to repay the loan in ten (10) years period.

0.7. Financial Evaluation

Our financial evaluation results show that the project is financially viable with an internal rate of return (IRR) of 59% and a net present value (NPV) of Birr 85,846,431,662, discounted at 8.5 %.

Further, results of our break-even analysis indicate that the project should at least use 18% of its full capacity OR make a minimum annual sale of Birr 4,020,175,073 to avoid loss.

The investment cost and income statement projections were also used to estimate the pay-back period. Results indicate that the project will fully recover the initial investment and working capital within less than two years of operation.

0.8. Socio-economic Benefits

In addition to its financial viability and economic benefits, the project will generate revenue to the government in the form of taxes over the life of the project. The project provides 88 permanent workers with different job title upon starting operation.

The major positive impacts of the proposed project are mainly the economic and social benefits that can be acquired at the national, regional and local level.

0.9. Recommendation

Considering the technical/financial viability of the Project, the requested long-term loan is recommended.

1. Background

As a key element of the construction sector, the cement industry plays a significant role in the global economy. Cement, second most consumed material on the planet next to water, is an essential component of infrastructure development and most important input for construction industry, particularly in infrastructure and housing programs, which are necessary for the socioeconomic growth and development. Energy and capital intensity nature of the industry necessitate large investments that require a long-term perspective on financing and returns.

Nevertheless, the global cement production and consumption have continued to grow at a rapid pace, with emerging economies coming to the fore, in recent years. According to Global Cement Review (GCR), cement consumption in 2023 was estimated at 4.1 Billion tons.

A decade ago, global cement demand was largely influenced by the advanced economies, but, with growth, starting to decelerate across these economies given sluggish economic recovery, demand for cement is on a long-term decline in these countries and the global dynamics of cement consumption has drastically changed, with the center of gravity moving steadily to the developing economies from the West.

Thus, over the last couple of decades, increased demands is observed from emerging economies, with Asia mainly China and India accounting for more than half of the world's consumption. Population and GDP growth continue to be the drivers for consumption in these regions with cement demand directly linked to population growth as it spurs demand for housing and infrastructure.

The Ethiopian government has identified several strategic investment areas as a priority that deserves incentives in order to attract the private sector. One of the major areas that is currently enjoying a significant amount government incentives is the construction materials manufacturing sector.

It is therefore crucial to assess the technological and economic viability of cement plants as the need for infrastructure development rises. Consequently, with an emphasis on the technical, financial, and environmental considerations, this feasibility report seeks to provide an in-depth analysis of the elements that contribute to the success of building a new cement plant in Ethiopia, under the current and future likely circumstances.

2. Project Rationale

Construction Materials Manufacturing is an important industrial sector in the country. Over the last few decades, the Construction sector has been registering strong growth rates in the country.

The following important features have been considered by the promoter:

- Adequacy and availability of all infrastructure facility (transport, power, telecommunication and etc.
- Availability of access to project finances
- Availability of cheap labor force.
- Existence of related industries (forward and back ward linkage) and
- Adequacy and availability of all raw materials required by the project

In general considering the above stated opportunities and sound economic performance of the proposed project area, the promoter has commissioned the carrying out of this feasibility study with the aim of launching this project, by integrating capital, experience, knowledge, equipment and skill.

2.1. Key Drivers

Easily trainable and Abundant Manpower: Manpower is decisive for the production of quality product, to sustain production, for high productivity, to sustain the high profit margin, to create good working environment.

The country has easily trainable and abundant manpower. Currently, different governmental Universities and TVET colleges are providing trainings for students on technical and other related disciplines to fill the gap on trained manpower requirement.

Economic Growth: Despite the recurrent setbacks, Ethiopia is in the right path of development, registering an economic growth since the past few years. This continuous increase in the rate of economic growth will also increase disposable income of the population which enables to enhance the purchasing power of the people.

Favorable Investment Policy and Strategies: To encourage private investment, the Ethiopian government has developed a package of incentives under regulation No.84/2003 for domestic and foreign investors engaged in new enterprises and expansions, across a range of sectors.

Huge demand in the local market: This output has huge demand in the domestic market. Therefore, excess demand is the major key drivers for expansion and development of this sector.

2.2. Key Success Factors

Abundent Supply of Raw Material Secured: the raw material supply should be sustainable to create optimum working capacity of the plant.

Quality Product and Timely Delivery: product quality and timely delivery are the critical issue in customer satisfaction and getting reputation.

Technical/professional/ man power: All the production process operate and Machinery performance managed directly by the technical man power. So that to increase the productivity of the company i.e. increasing marginal productivity and decrease raw material wastage and to maintain product quality as well as to solve production problem and to create hospitable working environment, professionals play vital role.

Good business development Strategies: winning substantial market share and there by getting sustainable profits depends on the marketing strategy.

2.3. Project Objectives

The main objective of the project is aimed at to maximize the return on invested capital in the form of profit for the promoter. However, its implementation will benefit the employee, the consumer society and the government at different levels. In this respect the project is aimed to promote the following objectives:-

- To maximize the return on invested capital
- To raise the significance and importance of the sector and thereby raising its contribution to the national economic development,
- To distribute Cement products for customer markets at competitive prices,
- To provide gainful employment to a large segment of the population of the project area and augment earning capacity at the grassroots level,
- Increase government revenue through the different forms of taxes, which in turn used to facilitate social and economic development.

In general, the project is believed to have significant social and economic benefits that accrue to the society, the region and the country beyond the financial returns to its owner.

3. The Project Owner

A. Applicant Information:-

- **Name of owner : ARDI Cement PLC**
- **Business Type: Manufacturing**
- **Location:** Dire Dawa City Administration

B. Applicant Address:-

- **Region: -** Dire Dawa City Administration
- **Town: -** Dire Dawa
- **Mobile No:-** +251-936-996-553

C. Project Address:

- **Name of the project:** Cement manufacturing
- **Region**: Dire Dawa City Administration
- **Kebele:** Hula Hulul Rural kebele
- **Land Area:** 2,500 msq
-

D. Legal form of Business: Private Limited Company

E. Status of the project: New

ARDI Cement PLC is a subsidiary Company of ARDI Real Estate PLC, a Private Limited Company established by the alliance of highly qualified Ethiopian Diasporas from Australia.

The company has been focused on real estate investment in promising areas, aiming to generate above-average returns for its shareholders and contribute to economic progress. Headquartered in Addis Ababa City Administration, specifically in Woreda 2, Bole Sub City area, the company is now prepared to invest on establishing a cement manufacturing plant with an impressive annual production capacity of 5,000 TPD in Dire Dawa City, under the supervision of the Dire Dawa Administrative Council.

ACPLC's basic raw material inputs for clinker production are limestone and clay. Cement is produced through grinding and mixing clinker with a small quantity of gypsum to control hydration. Ordinary Portland Cement ("OPC") contains only clinker and gypsum (4% to 6%), while the addition of pumice (20% to 28%) to OPC produces the in-demand Portland pozzolana cement ("PPC"). All limestone, clay, gypsum and pumice raw material inputs are sourced from quarries within Ethiopia.

Limestone is excavated at a quarry conveniently located adjacent to the proposed cement plant site, with deposits sufficient for more than 100 years production. A mining license has been issued for the limestone quarry.

4. SWOT Analysis

- Strength
    - Secured high quality limestone raw materials in abundant quantities in the nearest distance
    - Other raw materials available
    - Huge market demand for cement in and out of the country
    - Future Export market
    - State of the art technology
- Weakness
    - Shortage of foreign currency in the Country
- Opportunities
    - The construction sector in booming in Ethiopia and in the neighboring countries
    - Access to project finances from DBE and international sources
    - Investors with huge capacities in cement technology
    - Government incentive including tax exemption for purchasing machineries
    - HUGE Work force in the market to supply the project
    - Plenty of room to expand & grow in reasonably short time
- Threat
    - New companies entering the market may induce competition in the future

5. Market Analysis

5.1. Industry Analysis

A decade ago, global cement demand was largely influenced by the advanced economies, but, with growth, starting to decelerate across these economies given sluggish economic recovery, demand for cement is on a long-term decline in these countries and the global dynamics of cement consumption has drastically changed, with the center of gravity moving steadily to the developing economies from the West.

Thus, over the last couple of decades, increased demands is observed from emerging economies, with Asia mainly China and India accounting for more than half of the world's consumption. Population and GDP growth continue to be the drivers for consumption in these regions with cement demand directly linked to population growth as it spurs demand for housing and infrastructure. With this brief background, this chapter focuses on some of the prominent global and regional sector trends, including consumption, trade flows, import and export and leading firm players.

World cement reports indicate that the total volume of cement production worldwide amounted to an estimated 4.1 Billion tones in 2023. Likewise, the world cement market was valued at $410.32 billion in 2023, making it one of the most consumed construction materials in the world. The cement demand around the globe is increasing in a rapid phase.

In general, reviews of available publications strongly confirm that both cement production and consumption are increasing in Africa. One of Africa's top 10 cement producing countries, Ethiopia's market has significant growth potential given current low utilization rates.

Valued at over $2.5 billion in 2022, the East African cement market is one to watch as the region readies itself to implement a number of infrastructure projects, from large-scale transport facilities to housing and commercial developments.

Three East African nations – Ethiopia, Kenya and Tanzania – feature in the lowest ranks among the continent's top 10 cement producers, a grouping which accounts for close to three-quarters of Africa's production capacity.

Regionally, Ethiopia is the top producer, at 7th on the continent, though production is less than 10% of that seen in Egypt, which tops the ranking. Recent investments in the sector as demand rises could see Ethiopia become a more significant player.

Table: Top 10 cement producers in Africa

No.	Country	Production (Mt/a)	Utilization rate (%)	Per capita consumption (kg)
1	**Egypt**	85	53	425
2	**Algeria**	41	62	522
3	**Nigeria**	26	48	126
4	**Morocco**	22	62	342
5	**Tunisia**	13	56	499
6	**South Africa**	11	55	180
7	**Ethiopia**	**8**	**50**	**84**
8	**Ghana**	7	-	215
9	**Kenya**	7	58	147
10	**Tanzania**	6	54	94

Source: Asoko Insight Source: ZYK Cement Created with Datawrapper, 2023

In Ethiopia, the per capita cement consumption is estimated to be 84 kg, which is way below than the global average per capita consumption of 500kg.

5.2. The Cement Industry in Ethiopia

With 13 companies operating 23 plants, Ethiopia's domestic cement market is led by a mix of international and local players, of which Derba Midroc Cement, Dangote, Mugher Cement, Messebo Cement, Habesha Cement and National Cement (parent company East African Holding), are the largest.

Production is concentrated in and around Addis Ababa, which is home to over 40% of plants, with the remainder spread among five of Ethiopia's 11 regions.

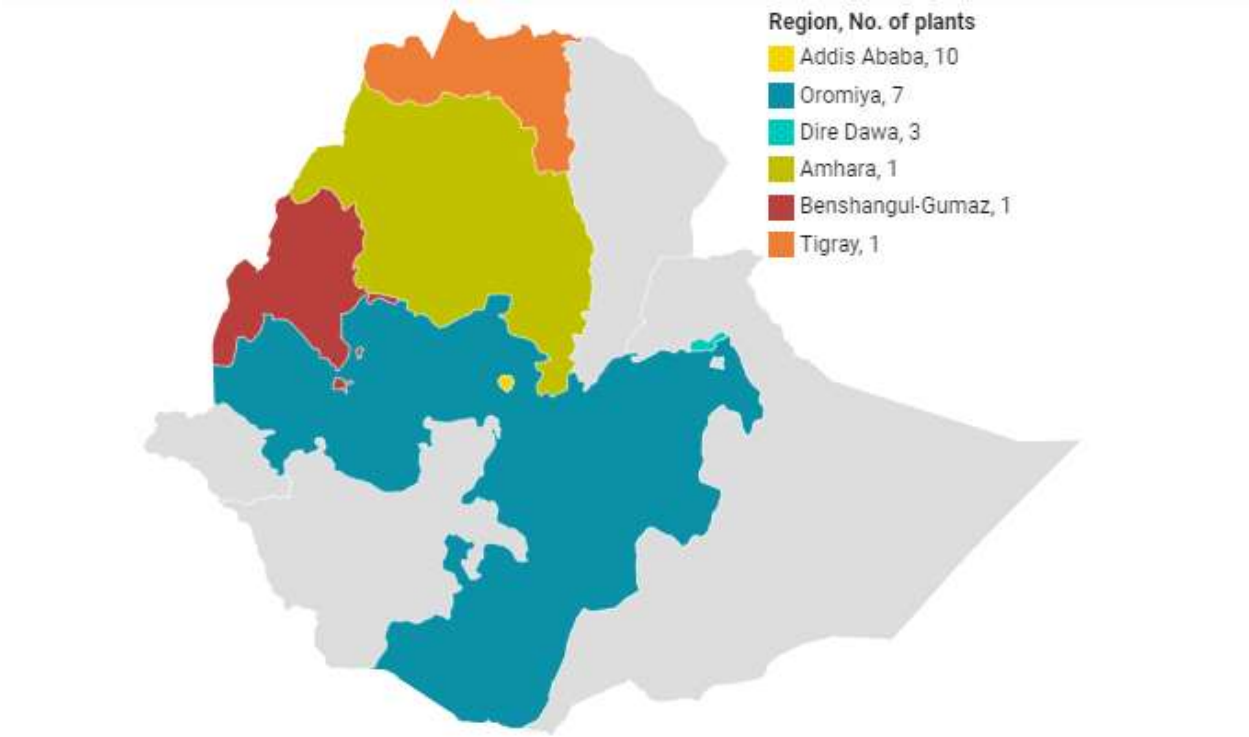


Figure: Cement plants by region

5.2.1. Market Dynamics

Ethiopia's cement sector has seen increased investment since 2020, after the government lifted a ban on FDI in the local cement industry. As in other parts of Africa, cement producers in Ethiopia struggle to meet the significant gap between supply and demand.

Studies indicate that cement production was 5.5 million tonnes short of domestic dema in the year 2021. In December 2022, the government announced it would be setting prices through mid-2023 in an attempt to regulate industry's supply and demand.

Efficiency is also a challenge for domestic cement manufacturers, which produce less than half of their installed capacity in a given year. Studies also show that total production was approximately 7.7 million tonnes per annum (Mt/a) during the 2020/21 fiscal year, despite 19.7 Mt/a of combined capacity. Across Ethiopia, producers face challenges such as limited access to machinery spare parts, forex, and electricity, which further restrict cement production and contribute to Ethiopia's low cement capacity utilisation rate.

The recent conflict in the Tigray region has also affected production, particularly through the closure of the Messebo Cement Factory during this time. Even since the signing of the Pretoria peace agreement, operations have continued to be disrupted. As of March 2023, the factory was operating at half capacity due to a lack of forex to replace damaged spare parts.

Despite these challenges, cement producers continue to add capacity to existing plants and construct new ones, including in Tigray.

On the bright side, a number of companies have announced plans to build new plants or expand their existing capacity in recent years. These investments, and continued demand suggest strong potential for sector growth should challenges be overcome.

5.2.2. Existing Supply & Demand Analysis

5.2.2.1. Existing Supply Analysis

The government, due to its foreign exchange crunch, as a rule, does not allow import of cement into the country since 2010. Therefore, the country's requirement of cement is entirely met through local production.

The data obtained from different sources on local production/supply are given in the following Table.

Table: Local production of Cement in Ethiopia (2019- 2023)

Year	Local production (mt/a)
2019	8.77
2020	8.62
2021	7.7
2022	9.35
2023	9.83
Average Supply	**8.85**
Average growth rate	**3.54%**

Source: Ministry of Trade & Ministry of Mines

As can be seen on the above table, all active cement manufacturers combined managed to produce only 7.7 million tons during the 2021 fiscal year, which is below half of the industries total installed capacity.

Actual production declined further in 2021 mainly because Messebo Cement Factory completely stopped production following the law enforcement moves in Tigray Region. This has reduced the cement supply by 2.1 million tonnes, according to the ministry of Trade. Further, while Messebo halted production, the remaining factories have also been producing below installed capacities. Mugher Cement Factory, for instance, stopped one of its production lines due to technical reasons. Additionally, the substitution of imported coal—used as a source of energy for the sector—with local varieties has also contributed to the low cement productivity and production in Ethiopia. As such, many agree that the long-term solution is to attract new investments.

5.2.2.2. Existing Demand Analysis

Cement demand in Ethiopia reached approximately 11.8Mt in 2019, but domestic cement producers are only providing about 8.8Mt of this total, according to the Chemical and Construction Inputs Development Institute (CCIDI). The same source also indicated that, in the year 2021, Ethiopia's cement demand was at 13.2 million tons, up from 11.8 in the previous year.

Table: Cement Demand in Ethiopia (2019- 2023)

Year	**Demand (mt/a)**
2019	11.80
2020	12.02
2021	13.20
2022	13.64
2023	14.96
Average Demand	**13.12**
Average growth rate	**6.17%**

Source: Chemical and Construction Inputs Development Institute (CCIDI)

As can be seen in the above table, the Country's demand for cement has shown an increasing trend during the last five years, despite the recurring political instabilities in the country. Among others, infrastructure boost has been the major factor contributing to the steadily increasing demand for cement in the country during the last decade.

5.2.2.3. Existing Demand & Supply Gap

Based on the above estimated supply and demand projections, the following table shows the demand gap that exists in the market for cement.

Table: Demand & Supply Gap

Year	**Demand (mt/a)**	**Supply (mt/a)**	**Demand gap (mt/a)**
2019	11.80	8.77	3.03
2020	12.02	8.62	3.4
2021	13.20	7.7	5.5
2022	13.64	9.35	4.29
2023	14.96	9.83	5.13
Average	**13.12**	**8.85**	**4.27**

Whenever demand is high, it is to be expected that the market usually responds by supplying more. But as shown in the above table, during 2021, supply of cement was 5.5 million tons below demand.

Though shortages began in 2018, major fluctuations have been seen in the years to come, owing to spare part and maintenance problems on one side, and political insecurity and war on the other—even to the extent of the full shutdown of Messebo Cement Factory in Tigray and its 2.1 million tons of production. Nonetheless, the fundamental and real reason for the cement price surge remains the widening gap between demand and supply.

5.2.3. Projected Demand & Supply Analysis

5.2.3.1. Projected Demand

The estimated average growth rate of annual demand for cement during the last five years (2019 – 2023) is employed to estimate the present apparent demand for the product. Accordingly, the present (2024) local demand for the product is estimated at 15.88 million tons. The following table shows projected demand, taking the average growth rates of 6.17%, estimated in the previous section, using the five years (2019- 2023) demand data for cement.

Table: Projected Demand for Cement

Year	Demand (mt/a)
2025	16.86
2026	17.90
2027	19.01
2028	20.18
2029	21.43
2030	22.75

5.2.3.2. Projected Supply

It is evident that Ethiopia's cement shortages have encouraged new investment in the cement sector. As such, a number of cement plant projects have been announced in Ethiopia over the last few years, although they appear to be taking quite a while to materialise.

In projecting the future supply, the estimated average growth rate of cement annual supply, during the last five years (2019 – 2023), is considered to reflect the present apparent demand for the product. Accordingly, the present (2024) local demand for cement is estimated at 10.18 million tons.

The following table shows projected demand, taking the average growth rates of 3.54%, estimated in the previous section, using the five years (2019- 2023) supply data for cement, as shown in the previous section.

Table: Projected Supply for Cement

Year	Supply (mt/a)
2025	10.54
2026	10.91
2027	11.30
2028	11.70
2029	12.11
2030	12.54

5.2.3.3. Projected Demand & Supply Gap

Based on the above estimated supply and demand projections, the following table shows the projected demand gap that exists in the market for cement.

Table: Demand Gap

Year	Supply (mt/a)	Demand (mt/a)	Demand gap (mt/a)
2025	10.54	16.86	6.32
2026	10.91	17.90	6.99
2027	11.30	19.01	7.71
2028	11.70	20.18	8.48
2029	12.11	21.43	9.31

2030	12.54	22.75	10.21
Average	**11.52**	**19.69**	**8.17**

As shown in the table above, an average demand gap of 8.17 million tons of cement is expected in the coming five years (2025-2030). Hence, it can well be concluded that the proposed project is feasible and can well serve in fulfilling the existing demand gap at least to some extent.

5.3. The Export Market

Both the actual and estimated cement consumption, in major cement producing countries in Africa, has shown increasing trend. Cement Factories in Ethiopia had started exporting cement to neighboring countries like to South Sudan, Djibouti, Kenya and Somalia, until exports were banned by the government.

Ethiopia's cement production is expected to show an increase in its production capacity not only because of the opening of new cement companies but also by the upgrading of old cement factories. Thus it is evident that Ethiopia shall become one of Africa's largest markets for the cement industry in the nearest future.

Therefore, it is expected that export option shall be present, as excess domestic cement production capacity grows in the future.

5.4. Price Analysis

Considering the current retail price of cement and margin for distributors and transportation cost, a factory-gate price of Birr 1,400 per quintal is recommended for the envisaged plant.

Table: projected cement price

prices	Year 1	Year 2	Year 3	Year 4
price/ton	14,000.00	15,400.00	16,940.00	18,634.00

9. Technical Study

9.1. Project Location

The proposed location of the quarries and cement production facility is located at at Hula Hulul rural kebele of Dire Dawa Administration, located at about 18kms from Dire Dawa city and 510km North East of Addis Ababa. There are a number of residential communities within 2km radius of the plant and limestone quarry site, including the community of Adiga Felema and Hula Hulul rural Kebele located at approximately 2km, and 1.6km away from the proposed cement plant and quarry area respectively.

The site has been primarily selected based on an economic source of limestone and availability of a convenient land for cement plant installation and operation. Quarry sites for clay are also available in a 3 kms radius at melka jebdu kebele. Access to water, electric power and transportation facilities are also available. The cement plant is located at about 7.2 km from Dire Dawa Dry port and 8.1km from Free Trade Zone to the north west of Dire Dawa Administration.

The total area of the potential quarry site studied for exploration under the current project framework is about 7.34 km2, in which, 6.03 km2 is the ARDI Cement PLC's license area. Results of the detailed geological investigation conducted through the area for the intended purpose, indicated that the studied area has got high quality and huge quantity limestone. The total minable reserve estimated is about 48,650,000.00 m3, which is sufficient for 119 years operation of ARDI Cement PLC'S 5000 TPD Cement Plant at Hula Hulul Village, Dire Dawa Administration.

To meet the requirement of land for the proposed cement plant a colony of 30 hectares land is available near the primary limestone deposit (Block A), which is located adjacent to the proposed plant site. The location of the areas for development is illustrated in the following Figures.

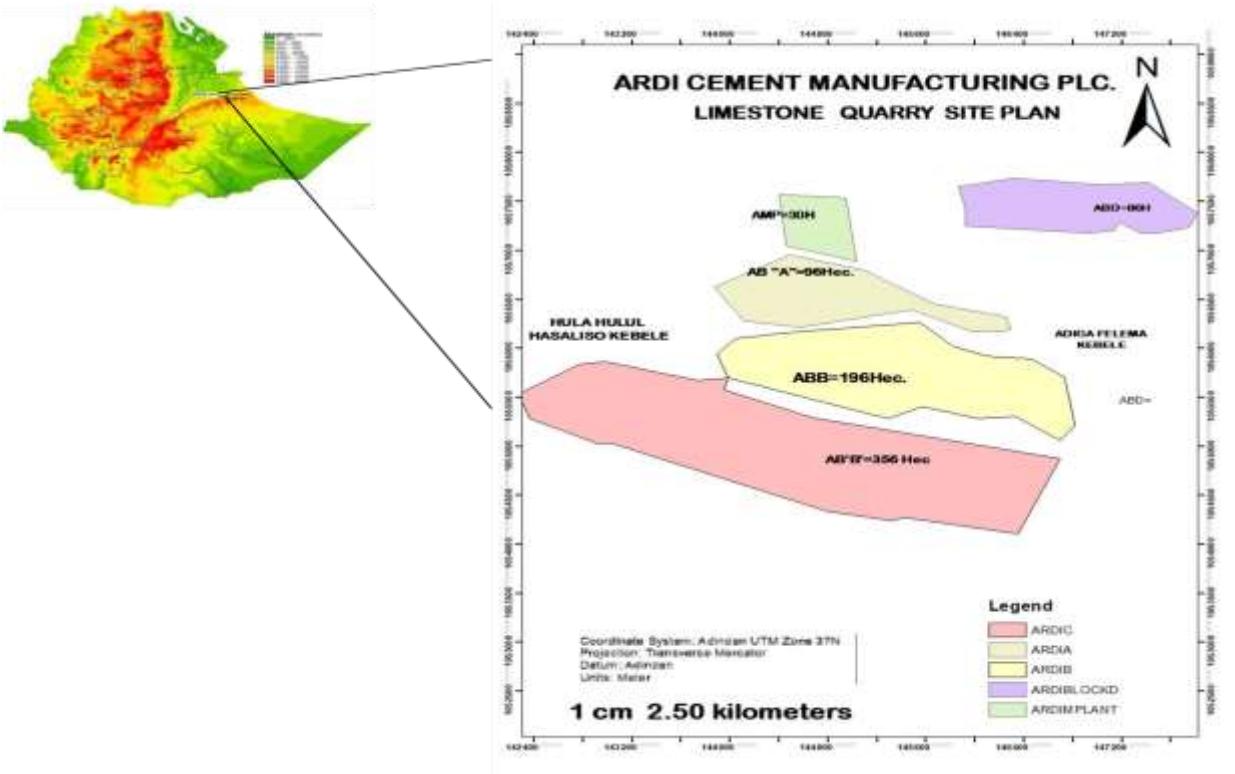


Figure: Map of Ethiopia with the Great Ethiopian rift, the location of the study area

9.2. Plant Capacity and Production Programme

9.2.1. Plant Capacity

Based on the market study indicated above, the envisaged plant for manufacturing of cement with a capacity of 5,000 TPD (1.5 million tons) per annum.

Table: Capacity Cement Production Plant

tons/day	tons/year
5,000.00	1,500,000.00

Table: Capacity of Cement packaging plant

package size (50kg)	packs/day	packs/year
	100,000.00	30,000,000.00

9.2.2. Production Program

The Cement Plant will start operation at a lower production capacity to allow time for market penetration and skill development to workers.

Thus, production will start at 50% of installed capacity during the first year of operation, and then will grow to 75%, 85% and 100% of full capacity in the fourth year, and third year and then after.

Table: Production programme

	Year 1	Year 2	Year 3	Year 4
Capacity	50.00%	75.00%	85.00%	100.00%
Cement	750,000.00	1,125,000.00	1,275,000.00	1,500,000.00

9.3. Utilities

Our machineries' supplier technical proposal indicates that it takes about 100 to 120 kilograms of standard coal to produce one ton of cement clinker. In addition, about 70 to 110 kWh of electricity is required. These energy consumptions are an important part of the cost of cement production, of which the cost of coal and electricity usually accounts for more than 60% of the total cost.

Cement companies usually have their own mines, so the cost of raw materials such as limestone is relatively low, while the fluctuation of coal and electricity prices has a greater impact on the cost of cement. Since cement companies use waste heat power generation technology, the proportion of self-generated electricity is about 50%, and the proportion of purchased electricity is less than 50%. Accordingly, the following tale shows annual utilities requirements and costs for the project.

Table: Utilities

No.	Description	cons/ton of cement	Annual Consumption	UOM	Unit Cost	Total Cost
1	Electricity	90.00	135,000,000	kWh	2.15	289,828,530
2	Coal	110.00	165,000	ton	9,000	1,485,000,000
	Total Annual Cost					**1,774,828,530**

9.4. Raw Material Requirements

Generally, limestone deposits which are the major ingredients for the production of cement are common in Africa. Ethiopia has a huge amount of reserve of raw materials for the production of cement. The major raw materials for the production of cement are limestone, clay, silica sand, gypsum, and pumice. A 2015 report on the Cement Industry in Ethiopia depicted that the reserve amount of limestone, clay, silica sand, gypsum and pumice is 171,000,000metric tons, 21,600,000 metric tons, 3,400,000 metric tons, 57,400,000 metric tons and many million tons respectively.

The measurement of cement elements is an important criterion for quality assurance of the cement powder. The raw mix for cement is a blend of calcareous (high in calcium) and argillaceous (rich in silica, alumina, and iron oxide) materials. This mix typically includes limestone as the primary calcareous material and clay as the main argillaceous component.

These raw materials, along with supplementary materials are finely ground and proportioned according to specific formulations to create the raw mix. Cement is a mixture of raw materials in which Ca, Si, Al and Fe are their major elements. And the cement chemical composition determines the quality and type of it.

Because the level of these elements in the raw material varies from plant to plant, the required weight of lacking elements must be added to balance the cement composition. This is possible by rigorous (permanent) testing of the intermediate and final product, with online analysis methods. Consequently, the measurement of cement elements at the production line is an enforceable task.

However, for the sake of financial analysis, in this feasibility study, the raw materials mix has been assumed to generally constitute Limestone 75%, Clay 20% and Gypsum 5%. Likewise, only Ordinary Portland Cement (OPC) is assumed to be manufactured by the plant.

Nevertheless, it has to be dully noted that this ratio may vary depending on the respective raw materials' richness in constituting the major elements that make up cement, which are calcium, silica, alumina, and iron oxide. Annex 3 provides more details about the raw material mix determination.

Table: Raw Material Mix

No.	Description	Proportion (%)	volume/day	volume/year (ton)	price/ton	value/year
1	Limestone	75.00%	3,750.00	1,125,000.00	0.00	0.00
2	Clay	20.00%	1,000.00	300,000.00	1,500.00	450,000,000.00
3	Gypsum	5.00%	250.00	75,000.00	2,000.00	150,000,000.00

	Total		**5,000.00**	**1,500,000.00**		**600,000,000.00**

Table: Packaging Materials

Description	**Quantity/year, pieces**	**Price/bag**	**Value, Birr /year**
Packaging material -50kg	30,000,000.00	50.00	1,500,000,000.00
Total	**30,000,000.00**	**50.00**	**1,500,000,000.00**

9.5. Machinery and Equipment

Plant machinery and equipment required, on a turnkey project basis, is presented in the following table.

Table: List of machinery and equipment

No	**Department**		**Price (USD)**
1.1	Offshore Works		84,947,113.00
1.2	Onshore Works		145,999.95
	TOTAL (EPC 5000tpd cement plant)		**230,947,058.00**
1	**Cement Production Line**		
No	**Ref**	**Department**	**Price (USD)**
Offshore Works (A+B+C+D)			84,947,113.00
A	Equipment Supply (FOB Basis)		76,878,513.00
1	Mechanical Equipment (1.1+1.2+1.3+1.4+1.5+1.6)		
1.1	Department 2: Raw Material Preparation		
	1.1.1	Limestone Crusher	1,545,926.00
	1.1.2	Limestone Transport	607.60
	1.1.3	Limestone Storage and Transport To Bins	1,230,870.00
	1.1.4	Corrective Crushing to Transport Storage	736,434.00
	1.1.5	Corrective Storage and Transport To Bins	933,164.00
1.2	Department 3: Raw Meal Preparation		
	1.2.1	Raw Material Feed Mill(S)	795,627.00

	1.2.2	Raw Material Grinding (VRM)	6,857,705.00
	1.2.3	Exhaust Gas Treatment	2,602,760.00
	1.2.4	Raw Meal Handling & Storage	1,106,030.00
1.3	Department 4 : Clinker Manufacture		
	1.3.1	Kiln Feed and Transport To PH	716,632.00
	1.3.2	Preheater & Precalciner	3,101,056.00
	1.3.3	Kiln System	2,568,003.00
	1.3.4	Cooler System	5,470,147.00
	1.3.5	Coal storage	988,273.00
	1.3.6	Coal grinding System	1,591,018.00
	1.3.7	Clinker Transport & Storage	1,243,057.00
	1.3.8	Non-Standard Parts & Pipelines	2,527,897.00
1.4	Department 5: Cement Manufacture		
	1.4.1	Clinker Transport to Cement Mill Bin	362,122.00
	1.4.2	Additive Crushing and Transport to Storage	78,343.00
	1.4.3	Additive Storage and Transport to Mill Bin	793.88
	1.4.4	Cement Mill Feed	1,096,816.00
	1.4.5	Cement Grinding	9,608,448.00
	1.4.6	Cement Transport to Silos	826,964.00
1.5	Department 6 : Packing And Dispatch		
	1.5.1	Cement Storage and Transport to Packers	863,525.00
	1.5.2	Cement Bulk Loading	283,779.00
	1.5.3	Packing Plant & Loading Systems	3,814,479.00
1.6	Plant Services		
	1.6.1	Compressed Air System	630,233.00
	1.6.2	Water Treatment and Distribution	1,081,146.00
	1.6.3	Refractory Bricks/Castable/lnsulation	1,493,758.00
	1.6.4	Grinding media	725,987.00
	1.6.5	Fire Fighting Systems	431,762.00
	1.6.6	Truck Weigh Bridge	80,113.00
	1.6.7	Elevators	804,332.00
	1.6.8	Mechanical and electrical workshop	692,909.00
2	Electrical, Control & Automation Systems		

2.1	Electrical Systems		
	2.1.1	Medium Voltage Level Distribution	1,753,520.00
	2.1.2	Low Voltage Distribution And MCC	3,642,680.00
	2.1.3	Lighting And Sundry Power Feed	520,584.00
	2.1.4	Motor Frcquency-Regulating And Control Device	1,540,223.00
	2.1.5	Cable & Installation Material	4,561,902.00
	2.1.6	Emergency Generator System	397,049.00
2.2	Control And Automation Systems		
	2.2.1	Instrumentation	868,712.00
	2.2.2	Plant Communication Systems	829,069.00
	2.2.3	Fire Detection & Alarm System	190,003.00
	2.2.4	Plant Security And Access System	132,537.00
	2.2.5	Office Network	44,933.00
2.3	Quality Control Systems		
	2.3.1	Sample Preparation And X Ray Analysis	463,925.00
	2.3.2	Laboratory System	383,525.00
B	Technical Services		
1	Know-How & Engineering And Design		1,370,961.00
2	Guide Construction For Civil, Steel Structure & Architecture Work At Site		448,989.00
3	Commissioning & Performance Test		808,867.00
C	Ocean Shipping & Insurance		8,068,600.00
No	**Ref**	**Department**	**Price (USD)**
Onshore Works			**145,999,945.00**
A	Civil & Structural Works (1+2)		122,611,378.00
1	Civil Works (1.1+1.4)		
1.1	Main Process Department		
1.1.1	Department 2: Raw Material Preparation		
	1.1.1.1	Limestone Crusher	1,228,912.00
	1.1.1.2	Limestone Transport	589,182.00
	1.1.1.3	Limestone Storage and Transport to Bins	4,697,053.00
	1.1.1.4	Corrective Crushing to transport Storage	1,301,574.00

	1.1.1.5	Corrective Storage and Transport to Bins	3,811,816.00
1.1.2	Department 3 : Raw Meal Preparation		
	1 .1.2.1	Raw Material Feed to Mill	1,339,774.00
	1 .1.2.2	Raw Material Grinding (VRM) & Exhaust Gas Treatment	4,544,408.00
	1.1.2.3	Raw Meal Handling & Storage	7,332,129.00
1.1.3	Department 4 : Clinker Manufacture		
	1.1.3.1	Kiln Feed and Transport to PH	395,469.00
	1.1.3.2	Preheater & Proclaimer (For 6 Stages)	2,449,739.00
	1.1.3.3	Kiln System	1,788,134.00
	1.1.3.4	Cooler System	2,296,616.00
	1.1.3.5	Coal preblending	287,082.00
	1.1.3.6	Coal mill	409,651.00
	1.1.3.6	Clinker Transport & Storage	13,899,263.00
1.1.4	Department 5: Cement Manufacture		
	1.1.4.1	Clinker Transport to Cement Mill Bin	784,191.00
	1.1.4.2	Additive Crushing and transport to Storage	1,033,047.00
	1.1.4.3	Additive Storage and transport to Mill Bin	384,270.00
	1.1.4.4	Cement Mill Feed	1,773,533.00
	1.1.4.5	Cement Grinding & transport to Silos	5,220,466.00
1.1.5	Department 6 : Packing and Dispatch		
	1.1.5.1	Cement Storage and Transport to Packers	9,764,207.00
	1.1.5.2	Cement Bulk Loading	150,778.00
	1.1.5.3	Packing Plant & Loading Systems	3,743,847.00
1.2	Electrical & Automation Systems		
	1.2.1	Limestone Crusher Substation/Electrical Room/Control Room	241,099.00
	1.2.2	Corrective Crushing Electrical Room	126,222.00
	1.2.3	Limestone Preblending Electrical Room	155,948.00
			45,446.00
	1.2.4	Raw Mill Substation/Electrical Room/Preheater Electrical Room	304,427.00
	1.2.5	Kiln & Cooler Substation/Electrical Room	258,189.00

	1.2.6	Cement Mill Substation/Electrical Room	214,823.00
	1.2.7	Cement Packing Electrical Room	151,351.00
	1.2.8	Auxiliary Electrical Room	126,795.00
	1.2.9	Electrical And Lighting and Earthing Collectivity	439,555.00
	1.2.10	Emergency Generator System	407,758.00
	1.2.11	CCR/LAB Building	3,365,285.00
1.3	Production Facilities		
	1.3.1	Compressed Air Station & Pipe Network	700,939.00
	1.3.2	Water Treatment, Raw Water Tank and Pump Room	1,436,557.00
	1.3.3	Circulating Water Tank & Pump Station	541,796.00
	1.3.4	Sewerage Treatment and Drainage	906,764.00
1.4	Infrastructure For Civil Construction & Erection and Auxiliary Section		
	1.4.1	Site Preparation	894,498.00
	1.4.2	Temporary Facilities, Fabrication & Establishments	5,110,753.00
	1.4.3	Roads & Drainage	8,834,887.00
2	Steel Structure Works (2.1+2.2+.....+2.7)		
2.1	Department 2 : Raw Material Preparation		
	2.1.1	Limestone Crusher	428,043.00
	2.1.2	Limestone Transport	974,673.00
	2.1.3	Limestone Storage and Transport to Bins	2,830,362.00
	2.1.4	Corrective Crushing to Transport Storage	373,234.00
	2.1.5	Corrective Storage and Transport to Bins	2,477,548.00
2.2	Department 3 : Raw Meal Preparation		
	2.2.1	Raw Material Feed to Mill	492,780.00
	2.2.2	Raw Material Grinding (VRM)	3,323,543.00
	2.2.3	Exhaust Gas Treatment	451,736.00
	2.2.4	Raw Meal Handling & Storage	1,048,708.00
2.3	Department 4 : Clinker Manufacture		
	2.3.1	Kiln Feed and Transport to PH	751,739.00
	2.3.2	Preheater & Precalciner	3,672,924.00
	2.3.3	Kiln System	152,813.00
	2.3.4	Cooler System	511,411.00
	2.3.5	Coal preblending	1,736,628.00

	2.3.6	Coal mill	593,948.00
	2.3.7	Clinker Transport & Storage	2,329,647.00
2.4	Department 5 : Cement Manufacture		
	2.4.1	Clinker Transport to Cement Mill Bin	448,386.00
	2.4.2	Additive Crushing and Transport to Storage	275,110.00
	2.4.3	Additive Storage and Transport to Mill Bin	285,282.00
	2.4.4	Cement Mill Feed	540,047.00
	2.4.5	Cement Grinding & Transport to Silos	2,035,029.00
	2.4.6	Clinker Transport to Cement Mill Bin	132,471.00
2.5	Department 6 : Packing And Dispatch		
	2.5.1	Cement Storage and Transport to Packers	899,083.00
	2.5.2	Cement Bulk Loading	67,848.00
	2.5.3	Packing Plant & Loading Systems	131,823.00
2.6	Others		
	2.6.1	Water Treatment System, Raw Water Tank and Pump	30,515.00
	2.6.2	Circulating Water Tank & Pump Station	20,342.00
	2.6.3	Sewerage Treatment & Drainage	66,055.00
	2.6.4	Mechanical/Electrical Workshops	1,086,863.00
2.7	Ocean Shipping and Insurance		4,375,945.00
B	Mechanical & Electrical Erection (1+2)		15,737,698.00
1	Mechanical Erection (1.1+1.2+.....+1.6)		11,031,248.00
1.1	Department 2 : Raw Material Preparation		
		Limestone Crusher	201,164.00
	1.1.2	Limestone Transport	149,582.00
	1.1.3	Limestone Storage and Transport to Bins	267,342.00
	1.1.4	Corrective Crushing to Transport Storage	122,113.00
	1.1.5	Corrective Storage and Transport to Bins	210,593.00
1.2	Department 3: Raw Meal Preparation		
	1.2.1	Raw Material Feed to Mill(S)	204,881.00
	1.2.2	Raw Material Grinding (VRM)	845,428.00
	1.2.3	Exhaust Gas Treatment	368,424.00
	1.2.4	Raw Meal Handling & Storage	122,566.00

1.3	Department 4 : Clinker Manufacture		
	1.3.1	Kiln Feed and Transport To PH	125,377.00
	1.3.2	Preheater & Precalciner (For 5 Stages)	637,464.00
	1.3.3	Kiln System	352,871.00
	1.3.4	Cooler System	595,053.00
	1.3.5	Coal preblending	405,054.00
	1.3.6	Coal mill	667,330.00
	1.3.6	Clinker Transport & Storage	271,437.00
	1.3.7	Non-Standard Parts & Pipelines	891,825.00
1.4	Department 5 : Cement Manufacture		
	1.4.1	Clinker Transport to Cement Mill Bin	64,365.00
	1.4.2	Additive Crushing and Transport to Storage	112,231.00
	1.4.3	Additive Storage and Transport to Mill Bin	87,845.00
	1.4.4	Cement Mill Feed	228,724.00
	1.4.5	Cement Grinding	1,476,751.00
	1.4.6	Cement Transport to Silos	111,506.00
1.5	Department 6 : Packing And Dispatc		
	1.5.1	Cement Storage and Transport to Packers	78,870.00
	1.5.2	Cement Bulk Loading	21,123.00
	1.5.3	Packing Plant & Loading Systems	258,277.00
1.6	Production Facilities		
	1.6.1	Compressed Air System	28,738.00
	1.6.2	Weighbridges	21,123.00
	1.6.3	Water Treatment and Distribution	102,168.00
	1.6.4	Refractory Bricks/Castable/lnsulation	1,785,355.00
	1.6.5	Fire Fighting Systems	13,507.00
	1.6.6	Mechanical/Electrical Workshops	149,309.00
	1.6.7	Elevators	52,852.00
2	Electrical & Automation Erection (2.1+2.2)		
2.1	Electrical Erection		4,706,450.00
	2.1.1	Limestone Crusher Substation/Electrical Room /Control Room	382,990.00
	2.1.2	Corrective Crushing Electrical Room	103,377.00

	2.1.3	Limestone Preblending Electrical Room	92,391.00
	2.1.4	Raw Mill Substation/Electrical Room/Preheater Electrical Room	785,510.00
	2.1.5	Kiln & Cooler Substation/Electrical Room	723,447.00
	2.1.6	Cement Mill Substation / Electrical Room	987,487.00
	2.1.7	Cement Packing Electrical Room	164,125.00
	2.1.8	Auxiliary Electrical Room	66,006.00
	2.1.9	Electrical And Lighting and Earthing	265,718.00
	2.1.10	Emergency Generator System	137,366.00
2.2	Automation Erection		998,033.00
C	Other Fee (1+2+3)		2,274,924.00
1	Construction & Erection Insurance		533,926.00
2	Financing Expense		944,819.00
3	Manpower Admittance Visa		796,179.00
D	Engineering Design Fee		1,000,000.00

9.6. Cement Production Process

The production process of Portland cement is representative in cement production. The main raw materials are limestone, clay, water slag or iron powder, and coal powder. After crushing, batching, and grinding, raw materials are made into raw materials, and then fed into cement. It is made by calcining clinker in a rotary kiln, and then grinding the clinkerwith an appropriate amount of gypsum (sometimes mixed with mixed materials or additives).

Raw material crushing and storage section

Large limestone → fed evenly by vibrating feeder → enters the jaw crusher by belt conveyor for coarse crushing → discharges more than ten centimeters of material and then enters fine jaw crusher by belt conveyor for medium crushing → discharges less than 5 cm by The number of belt conveyors entering the sand machine is finely crushed → the output material is less than 5mm and enters the limestone raw material warehouse for storage → the raw materials are stacked and stored in a balanced manner.

Raw material drying section

This is applicable for raw material that needs to be dried. The following shows the process, taking clay as an example.

Raw material wet clay→ sent in by belt conveyor→ dried by drum dryer→ discharged by hoist→ elevated to clay storehouse. Dryer heat source: natural gas. Exhaust gas from the dryer → entering the cyclone dust removal → spray tower → harmless treatment.

Raw material batching section

Limestone, clay, iron powder or water slag, coal powder are respectively lifted by the hoist to the respective corresponding warehouses.

According to a certain ratio, the four material warehouses are equipped with different metering feeders, and then the computer is equipped with a control system to control the output ratio of each material warehouse, and the material is discharged according to the ratio → the raw material mixture that comes out → is transported by a belt test machine to the hoist Warehouse installation → dust removal equipment to ensure environmental protection without dust.

Raw meal milling section

Elevator → lift the mixed raw meal powder to the silo → electromagnetic vibrating feeder at the bottom of the silo → feed evenly to the ball mill (raw meal mill) → after ball mill grinding → meet the requirements Raw meal powder → then lifted by the elevator to → raw meal homogenization warehouse. The raw material ball mill is equipped with a pulse dust collector to ensure that there is no dust in the grinding process.

Raw meal homogenization section

Grinded raw meal→ elevated by the hoist→ raw meal homogenization storage→ raw meal powder is fully mixed in the homogenization storage. The raw meal mixture is stored and stacked, and the raw material composition changes. It is also very large, and the homogenization storehouse can allow raw materials to be mixed and homogenized, and → the ingredients are stable. The purpose of raw meal homogenization is to eliminate or reduce the fluctuation of the

composition of the raw meal entering the kiln, so that the chemical composition of the raw meal is uniform and stable.

Raw meal preheating section

Homogenized raw meal→ elevated by the hoist→ five-stage cyclone preheater→ the cyclone preheater can use the high-temperature airflow accumulated and tumbling in the kiln→ adopt multi-stage circulation suspension preheating method→ use Full heat exchange between raw meal powder and red-hot airflow→ complete suspension preheating and partial raw meal decomposition→ prepare for raw meal to be calcined in the kiln.

Calcination section of rotary kiln

Raw material after preheating → fed from the high-end feeding pipe at the kiln tail → directly enters the cement rotary kiln → the material is calcined at high temperature in the cement rotary kiln → due to the inclination and gentleness of the kiln body Rotate slowly → make the material produce a composite motion that rolls along the circumferential direction → moves from high temperature to low end along the axial direction → the raw material is calcined at a high temperature of 1300~1450 ° C in the rotary kiln → decomposed and fired Wait for the process → after burning the cement clinker → unload from the bottom of the kiln shell.

Kiln tail dust removal (tail gas treatment) section

Rotary kiln tail gas → Gas enters the multi-cylinder cooler: the gas containing dust enters the multi-tube cooler through the pipeline to cool down → then enters the pulse dust collector → filtration: After the gas enters the dust collector. The dust is trapped by the filter bag. (The material of the filter bag is generally polyester fiber, acrylic fiber, etc.) →Cleaning: After the dust has accumulated to a certain extent on the filter bag, it needs to be cleaned. The cleaning methods include mechanical vibration, airflow cleaning and pulse cleaning. → Discharge of purified gas:

After filtering and cleaning, the dust in the gas is removed, and the purified gas is discharged into the atmosphere.

Clinker cooling section (grate cooler)

The high-temperature clinker coming out of the kiln enters → grate cooler → cools down through the grate cooler → discharge temperature: 65 ° C + ambient temperature → cooled clinker passes through the conveyor→ transported to Clinker storage shed for stacking. (The grate cooler is a kind of quenching cooler: after the clinker enters the cooler from the kiln, a material layer of a certain thickness is laid on the grate plate, and the cold air blown in moves through the grate bed in a direction perpendicular to each other. The solid material layer can quench the clinker, and the clinker can be quenched from 1300-1400°C to below 100°C in a few minutes)

Clinker crushing, clinker and auxiliary material storage and conveying section

Clinker is stacked in the storage area → sent to the vertical shaft sand making machine for crushing by the belt conveyor → crushed → lifted by the elevator to the batching bin.

Clinker batching system

Clinker, gypsum, mixed material, fly ash → respectively lifted by the hoist to their respective silos (clinker silo, gypsum silo, mixed material silo, fly ash silo) → these materials are respectively Quantitative feeding by belt scales, proportioning according to a certain ratio→ mixing→ elevating by elevator to→ the silo in front of the cement mill.

Cement milling section

The mixture is evenly fed by the vibrating feeder → enters the cement ball mill for grinding → equipped with a cyclone and dust collector → selects the cement of the finished mesh by the powder separator → is lifted by the hoist → to the finished cement silo..

Pulse dust collector, which can effectively reduce dust pollution in grinding operations, and ensure the cleanliness of the production environment and the health of workers.

Cement storage and transportation section

The finished cement from the cement ball mill → is lifted by the hoist to → the cement material warehouse, and the finished cement material warehouse is equipped with dust collectors, screw conveyors, etc.

Cement packaging and bulk section

Cement packaging stage: the finished cement coming out of the cement warehouse is conveyed from the screw conveyor → into the hoist→ lifted to the automatic cement packaging machine → packed cement in bags → palletized and transported to the finished bag by the palletizer Cement warehouse.

Cement bulk section

Equipped with discharge valves and other devices to control cement discharge according to demand. (Cement in bulk, after the cement is produced in the factory, it is directly transported to the transfer station or the user's packaging process with special equipment or containers).

9.7. Project Timing

1. Production line layout

After the contract is signed and the deposit is received within 15 working days, the supplier will send personnel to the buyer's factory for on-site survey, and provide the design site layout within 26-30 working days.

2. Equipment manufacturing

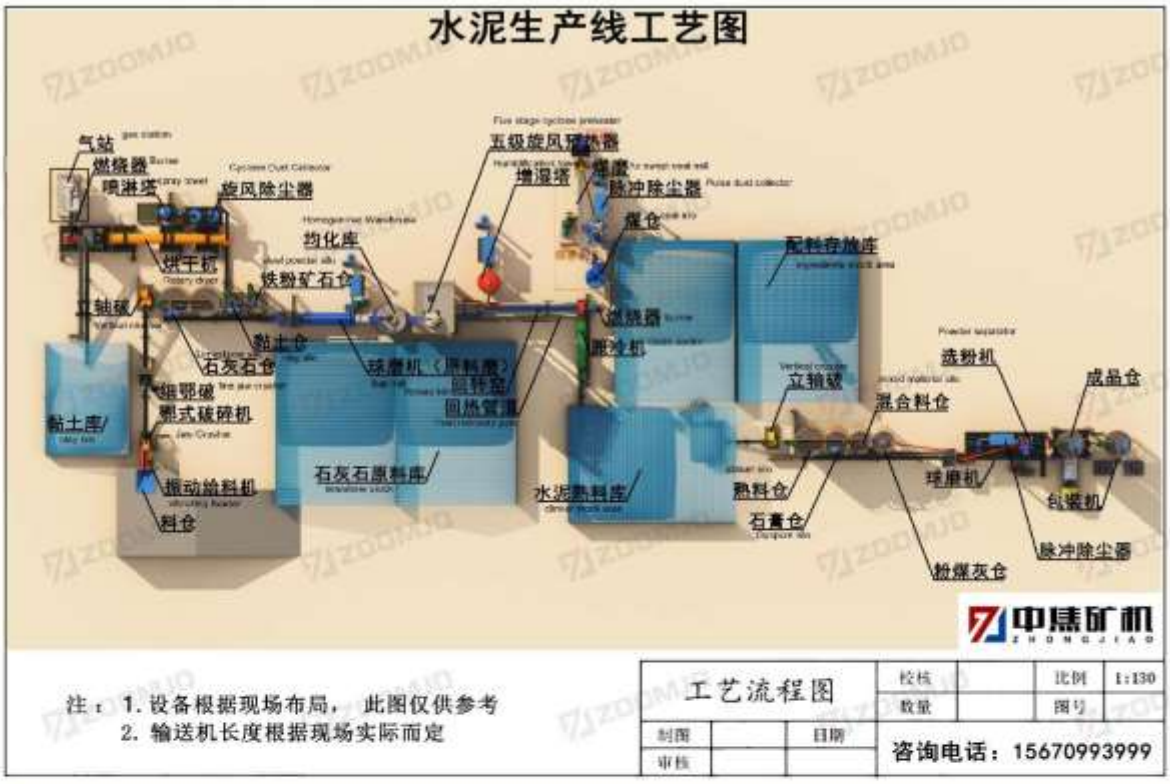
Equipment manufacturing cycle: About 100 working days.

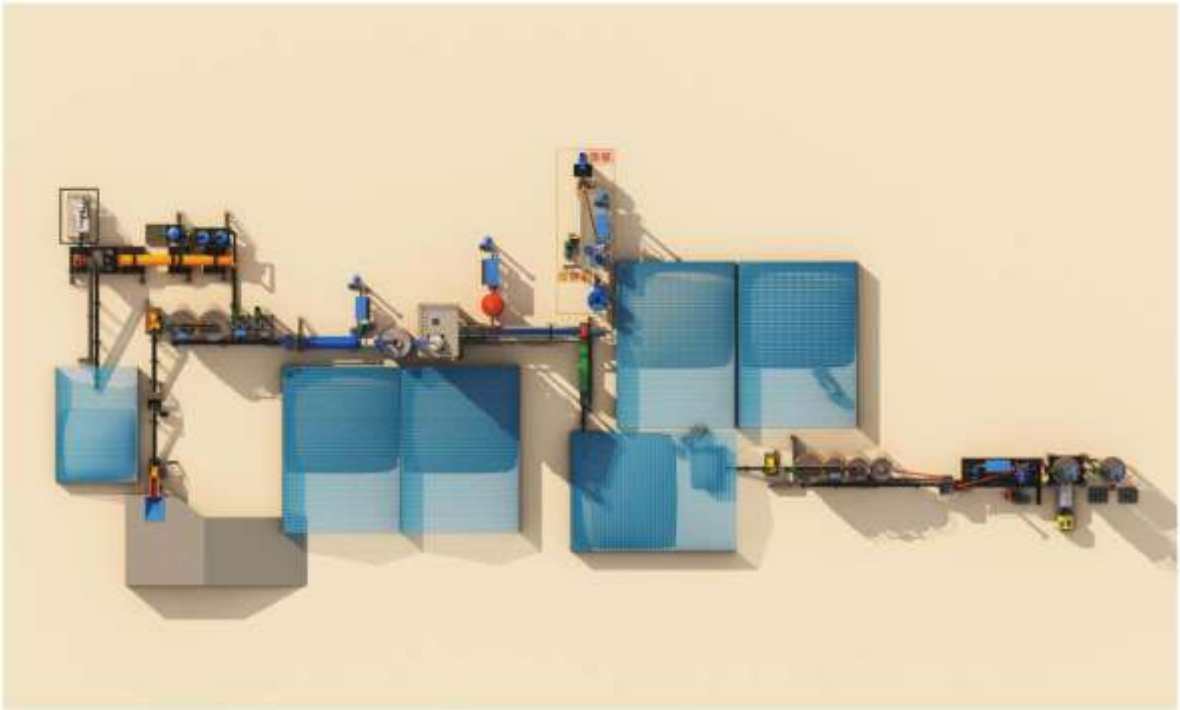
After the drawings are confirmed by both parties, they will be delivered in batches after 40 working days for installation.

3. Installation and commissioning cycle: about 120 working days.

The supplier needs to send technicians to the site to guide the installation and commissioning, and the buyer is required to provide personnel to assist in the installation, and the buyer is required to provide cranes and installation tools. Expenses such as food, lodging, air tickets, visa insurance, etc. for the personnel going by the supply side shall be provided by the demand side, and the wages shall be discussed separately.

9.8. Project Flowchart





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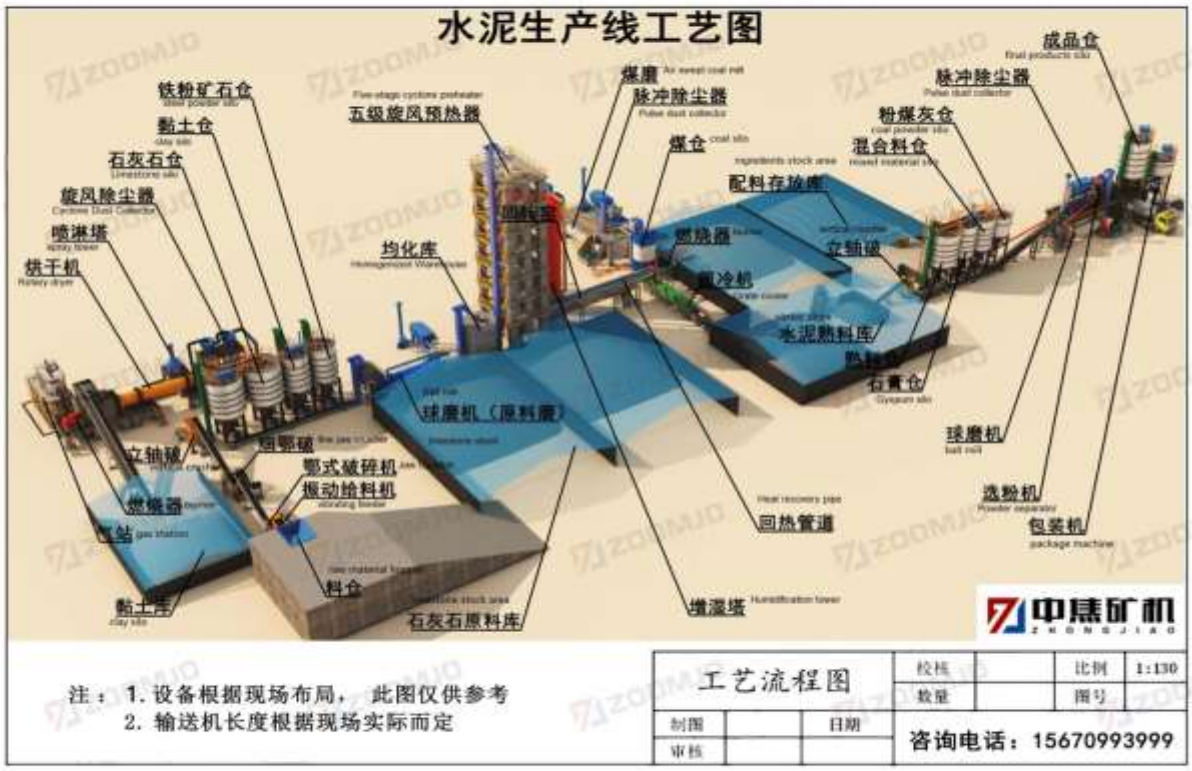

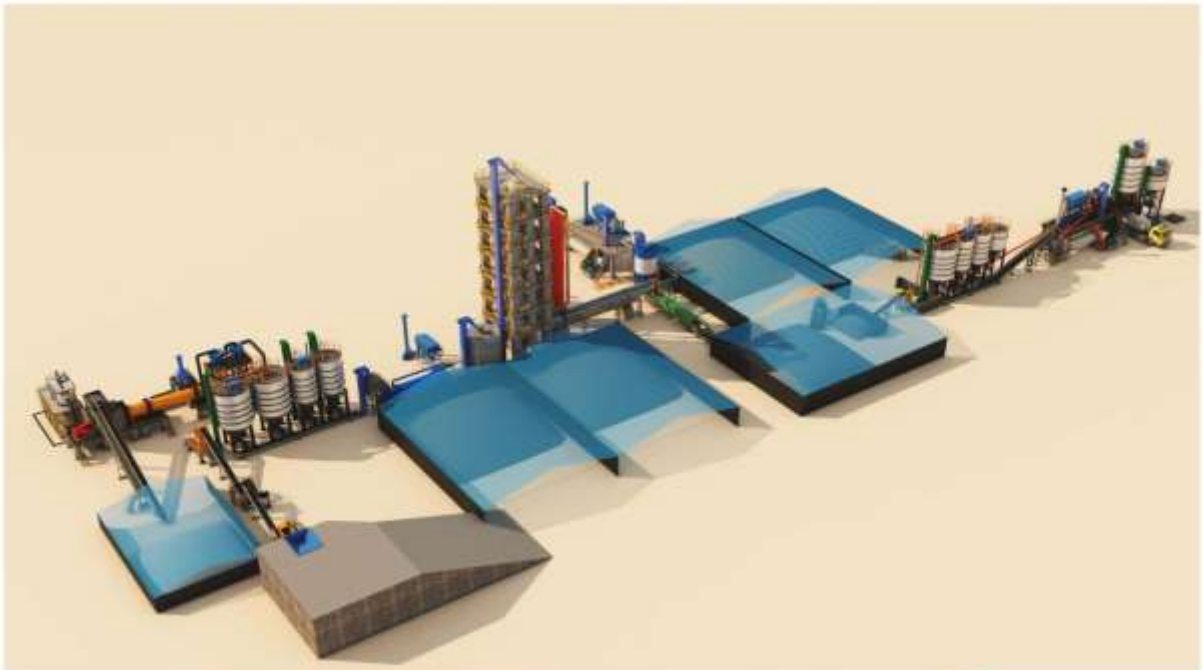

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10. Environmental Impacts

This section addresses potential impacts associated with the proposed project and measures for both mitigating (i.e. avoidance, reduction, or restoration of) negative impacts, and enhancing (i.e. improvements of) positive effects of the Cement Production project.

The major positive impacts of the proposed project are mainly the economic and social benefits that can be acquired at the national, regional and local level. Although reversible and localized, the adverse impacts of the proposed project arise from generation of dusts and employee's heath impact.

Cost-effective and environmentally sustainable techniques that can mitigate the adverse impacts should be well studied in the ESIA Study. In doing so, emphasis must be given in selection of best available techniques (BAT) and practices for preventing and reducing potential adverse impacts to the environment without compromising the economic and social benefits of the project.

10.1. Positive Impacts and Enhancement Measures

The establishment of this project will have a number of positive impacts both at national regional and local levels. Some of the major positive impacts include technological capacity building, economic development and creation of employment.

10.1.1. Macroeconomic Benefits

The implementation of the project has an array of economic benefits. It transforms raw materials to a higher value, provides consumer goods, generates employment, promotes skill development and disseminates technological changes.

As it is plainly stated in the previous sections of this feasibility study, the project developer will generate financial benefit in the forms profit that will be used for saving and family consumption when the project gets operational.

Enhancement Measures: Executing the proposed project in a manner that benefits the country at large (example: production of quality products, introduction of technologies that maximize the product yield as the same time by reducing the environmental burden of the production process) is the proposed benefit enhancement measure.

10.1.2. Microeconomic Benefits

10.1.2.1. Employment

The direct and indirect employment opportunities to be created for citizens are other economic benefits of the project beyond those economic outputs discussed above. The feasibility study of the project indicates that, the enterprise will create direct job opportunities for 88 workers, most of whom, are from local people residing near by the project area and from Dire Dawa town.

Thus, the project will be an opportunity for the town by lightening the brunt of unemployment in the town to some extent. Moreover, the building renovations phase of the project will have a short term employment opportunity particularly for the local laborers.

Enhancement Measures: Hiring professionals and service providers will be based on merits and yet on competitive base in order to get quality technical workers, it will enhance the benefits of project to give especial consideration for the people residing near by the project site to provide them with job as priority for those positions not requiring especial skill.

As there will be high demand for daily laborers during construction phase of the project, it will be twofold advantages to hire laborers from local people. First, the project promoter will reduce time of searching for laborers and save his money that is needed for transportation of laborers to project site. Second, fairly distributing the benefits of the project will enhance project social acceptability in general.

10.1.2.2. Local Livelihood Improvement

The employment opportunity to be created by the project will have a positive implication on the improvement of local livelihoods of the community residing nearby the project site. This local income generation related social benefit will have long term as well as cumulative benefits.

Enhancement Measures Utilization of the available labor force in the area enhances the benefits at local level. Out sourcing commercial activities like cafeteria services for local competitive service providers maximizes the social benefit of the project.

10.2. Adverse Impacts and Proposed Mitigation Measures

Although reversible and localized in their nature, employees' health hazard; and generation of solid wastes are found to be the main environmental impacts of the operation phase of the project. Generally, the proposed project is characterized with insignificant negative impacts of both construction and operation phases. This section of the report outlines these adverse impacts and presents the proposed prevention and mitigation measures.

10.2.1. Impact on Air Quality

Since the machineries in the production process are fully automated by electric power, there will be no air emission associated with the production process. Hence, there is no way that the potential pollutants like CO, NOx and Sox might arise in the production process. In this context, the operation of the cement manufacturing plant facility will actually contribute insignificantly to the overall air quality.

Mitigation measures: Control of the odors associated with the production process may be achieved by scrubbing exhaust fumes and, if necessary, incinerating the remaining volatile organic compounds (VOCs).

9.4.5. Impacts on Employee's Health & Other Risks

Since a work place is a potentially hazardous environment, workers encounters direct, indirect and long-term potential health problems during the operation of the proposed project.

Production and technical personnel have the exposure to continuous noise and vibrations created from machines electrical motors and machineries. Inhaling of the emissions results from operations of the production process are potential workers' health threat.

Interference of technicians and operators in running machine parts can cause body injury. Interference of individuals with electrical systems, failure from structures and failure due to slippery floor are other causes for injury. The main environmental risks are associated with the following activities:

Activities inside the repairs and mechanical workshop of the factories may cause oil contamination risks to the land. In addition, there may be risks to the workers, including exposure to fumes, injury with sharps etc.

General occupational health risks exist throughout the enterprise from noise, odors, or slippery floors.

Mitigation measures: Anticipation of potential hazards and risks in the work environment and implementing control methods to remove or reduce the hazard exposure of the worker is the proposed measures to mitigate the impacts under consideration:

The general control methods available for control of hazards include:

- Using local supply ventilation and natural ventilation systems to assure the comfort of operators in production areas
- Training workers regarding work area safety and hazardous control like the fire hazardous and controlling mechanisms; application of safety and hazard control

equipment; monitor the work area or the worker, good housekeeping, and preventive maintenance.

- Using personal protective equipment like: skin protections (gloves and aprons); eye protection (safety glass, goggles, face shield, and hood); ear protection (ear muffs); respiratory protection (air-purifying respirators); and safety shoes.

Besides the above; the following measures need to be considered regarding employees' health:

- Pre-employment and periodic health checkups for workers
- Insurance policy and procedures for work area caused damages

9.4.6. Impact on Energy Resources

The operation of the proposed project requires a considerable electrical energy resource for: running of machines, power for the enterprise buildings, etc. As the project uses a renewable energy source hydroelectric power the impact is not significant. However, from economical point of view the issue requires attention.

Mitigation Measures: Avoiding idle operation of machineries and implementation of proper power use practices are the mitigation measure for reducing electrical power consumption. Installation of less energy intensive equipment (like using florescent light rather than bulbs) reduces the energy consumption. Training and reminding workers to switch off lights when leaving offices is the other managerial proposed option for minimizing the problem.

Generally, the following measures help to reduce the impact:

- Train operators on operation of equipment in efficient way to minimize energy
- Supervise production processes in order to improve production efficiency
- Switch-off idle machines and unused bulbs
- Provide interlocked control system for the generator to sawed-off itself when external power returned
- Setup written procedures for production operations

- Avoid reprocessing and reworks

In summary, the implementation of the proposed project will have a pack of economic and social benefits. It plays a role on the country's economic development activity through creation of employment opportunities for citizens, generation of income for the local community, and it also paves the way for rural development in the area.

On the other hand, the proposed project has some associated environmental aspects that might cause adverse impacts. However most of these environmental effects can be reduced to acceptable levels with implementation of pollution prevention and control techniques. Therefore, it can be concluded that there will be no severe or irreversible adverse impacts that will prevent the implementation of the proposed pa[er products processing project.

To have minimal and acceptable residual environmental impacts, it is recommended that a detailed ESIA Study should be conducted for the project.

11. Implementation Schedule

Under the most favorable circumstances, the project is expected to take 1 year and 9 months for completion as per the below detailed implementation schedule.

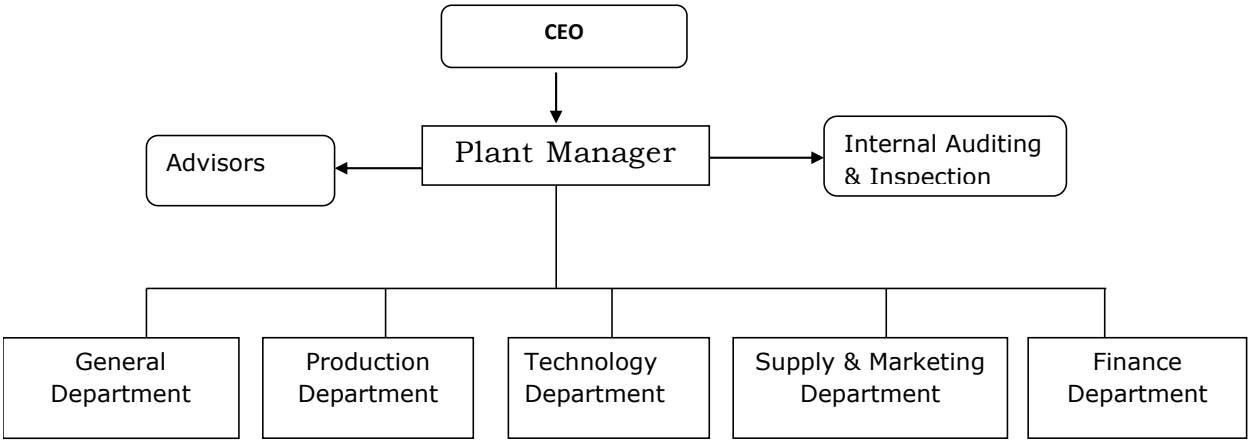
Table: Implementation schedule

Description	2024		2025				2026
	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1
Loan processing (July2024)	x	x	x				
Processing of machineries purchase				x	x		
Installation and Commissioning						X	
Recruitment of man power arranging for other works					x	X	
Start operation							x

12. Organizations and Management

12.1. Organizational Structure

The organizational structure of the project is designed by including all the necessary personal under the right division.



As clearly shown the organizational structure, project has a CEO and five Departments under the plant manager.

12.3. Personnel Plan

A total of 88 employees will run the project. Details of manpower required for the project's operations are given in the table below.

Table: Personnel plan

Item	Department	Total	Managers	Technicians	Production workers	Non-production workers
I	**Department Production**	**78**	**3**	**4**	**71**	
1	Production line	53	1	2	50	
2	central control room	7	1	1	5	
3	central laboratory	7	1	1	5	

4	Mechanical repair water supply , and drainage	9	1	1	7	
5	Total drop electrical instrument inspection and maintenance	5	1	1	3	
II	**Technology department**	**3**	**1**	**2**		
III	**Supply and Marketing Department**	**2**	**1**			**1**
1	material supply	2	1			1
2	sales business	3	2			1
3	cargo freight	1				1
IV	**Finance Department**	**2**	**1**			**1**
1	Financial Management	3	2			1
2	plan statistics	1				1
V	**General Department**	**3**	**1**		**1**	**1**
1	Personnel Education	2	1			1
2	Environmental protection, safety, fire protection	2	1		1	
	Total	**88**	**7**	**6**	**72**	**3**

13. Financial Study

Table: Total Investment

Description	**Total Costs**
Machineries & equipment	13,274,836,893.84
Mining Machinery & Equipment Costs	1,593,928,317.06
Other Capital Goods	24,000,000.00
Vehicle	51,000,000.00
Total	**14,943,765,210.90**
Pre-operating Expenses	478,181,480.04
Working capital requirement	390,098,821.88
Grand Total	**15,812,045,512.81**

Table: Land and infrastructure costs

Description	Value, Birr
Land Acquisition	67,545,000.00
Road to the plant	36,000,000.00
Electric power infrastructure works	20,000,000.00
Water supply borehole drilling	12,500,000.00
Total	**136,045,000.00**

Table: Turnkey project cost_5000 TPD Cement Plant

No.	**items**	**Value, USD**	**Value, Birr**
1	On shore works	84,947,113.00	4,882,760,055.24
2	Off shore works	145,999,945.00	8,392,076,838.60
	TOTAL Price	**230,947,058.00**	**13,274,836,893.84**

Table: Limestone Mining Machinery & Equipment Costs

No.	**Items**	**Unit price**	**Quantity**	**Value, USD**	**Value, Birr**
1	Dump Truck	46,730.00	4	186,920.00	10,744,161.60
2	Mixer Truck	66,450.00	4	265,800.00	15,278,184.00
3	boom pump	325,340.00	2	650,680.00	37,401,086.40
4	Air compressor with Driller	9,034,123.58	2	18,068,247.17	1,038,562,847.32
5	Loader	4,279,245.28	2	8,558,490.57	491,942,037.74
	Total Machinery & Equipment			**27,730,137.74**	**1,593,928,317.06**

Table: Vehicles

Vehicles	Quantity	Unit Price (Birr)	Total cost (Birr)
Delivery Vans	2	1,500,000	3,000,000
Sedan	2	2,500,000	5,000,000
Pick-up	2	5,000,000	10,000,000
Employee Service	2	3,000,000	6,000,000
Total	**8**		**24,000,000**

Table: Other Capital Goods

Items	Unit	TotaL Costs
Office Furniture and equipment	LS	6,000,000
Treatment Plant		45,000,000
Grand Total		51,000,000

Table: Total Fixed Investment

Description	**Value (Birr)**
Land and infrastructure costs	136,045,000.00
Plant machineries & construction	13,274,836,893.84
Mining Machinery & Equipment Costs	1,593,928,317.06
Vehicles	24,000,000.00
Other Capital Goods	51,000,000.00
Total Fixed Investment	**15,079,810,210.90**

Table: Depreciation

Description	**Service life**	**Original value (Birr)**	**Annual Dep. (Birr)**
Land and infrastructure costs	20.00	136,045,000.00	6,802,250.00
Plant machineries & construction	30.00	13,274,836,893.84	442,494,563.13
Mining Machinery & Equipment Costs	20.00	1,593,928,317.06	79,696,415.85
Vehicles	20.00	24,000,000.00	1,200,000.00
Other Capital Goods	20.00	51,000,000.00	2,550,000.00
Total Fixed Investment		**15,079,810,210.90**	**532,743,228.98**

Table: Repair and maintenance costs based on the standard rate

Description	**Percentage**	**Total investment**	**Repair & maintenance costs**
Land and infrastructure costs	3.00%	136,045,000.00	4,081,350.00
Machineries & equipment	3.00%	13,274,836,893.84	398,245,106.82
Mining Machinery & Equipment Costs	3.00%	1,593,928,317.06	47,817,849.51
Other Capital Goods	3.00%	51,000,000.00	1,530,000.00
Vehicle	5.00%	24,000,000.00	1,200,000.00
Total		**15,079,810,210.90**	**452,874,306.33**

Table: Sales at full capacity operation

Description	**Quantity/year, tons**	price/ton	sales
Cement	1,500,000.00	14,000.00	21,000,000,000.00

Table: prices

prices	Year 1	Year 2	Year 3	Year 4
price/ton	14,000.00	15,400.00	16,940.00	18,634.00

Table: Revenue Forecast

	Production Year			
Capacity utilization rate (%)	Year 1	Year 2	Year 3	Year 4
	50%	75%	85%	100%
Cement	10,500,000,000	17,325,000,000	21,598,500,000	27,951,000,000
Total	**10,500,000,000**	**17,325,000,000**	**21,598,500,000**	**27,951,000,000**

Table: Capacity cement plant

tons/day	tons/year
5,000.00	1,500,000.00

Table: Capacity packaging plant

package size (50kg)	packs/day	packs/year
	100,000.00	30,000,000.00

Table: Raw materials

No.	Description	Proportion (%)	volume/day	volume/year (ton)	price/ton	value/year
1	Limestone	75.00%	3,750.00	1,125,000.00	0.00	0.00
2	Clay	20.00%	1,000.00	300,000.00	1,500.00	450,000,000.00
3	Gypsum	5.00%	250.00	75,000.00	2,000.00	150,000,000.00
	Total		**5,000.00**	**1,500,000.00**		**600,000,000.00**

Table: Packaging Raw materials

	Description	Quantity/year, pieces	Price/bag	Value, Birr /year
	Packaging material - 50kg	30,000,000.00	50.00	1,500,000,000.00
	Total	**30,000,000.00**	**50.00**	**1,500,000,000.00**

Table: Direct costs of sales

No.		Production Year			
	Capacity utilization rate (%)	Year 1	Year 2	Year 3	Year 4
		50%	75%	85%	100.00%
1	packaging raw materials	750,000,000	1,125,000,000	1,275,000,000	1,500,000,000.00
2	cement raw materials	300,000,000	450,000,000	510,000,000	600,000,000.00
	total	**1,050,000,000**	**1,575,000,000**	**1,785,000,000**	**2,100,000,001.00**

Table: Projected Costs of sales

No.	Description	Year 1	Year 2	Year 3
	Capacity utilization	70.00%	85.00%	100.00%
Costs of sales		840,000.00	1,020,000.00	1,200,000.00

Table: Utilities

No.	Description	cons/ton of cement	Annual Consumption	UOM	Unit Cost	Total Cost
1	Electricity	90.00	135,000,000	kWh	2.15	289,828,530
2	Coal	110.00	165,000	ton	9,000	1,485,000,000
	Total Annual Cost					**1,774,828,530**

Table: Personnel plan

Position	Quantity	Salary	Total Salary
CEO	1	120,000.00	1,440,000.00
Plant Manager	1	60,000.00	720,000.00
Finance Manager	1	50,000.00	600,000.00
Marketing & sales manager	1	35,000.00	420,000.00
Import export manager	1	35,000.00	420,000.00
Purchasing Manager	1	25,000.00	300,000.00

Human Resources Manager	1	40,000.00	480,000.00
General services Manager	1	20,000.00	240,000.00
Engineering team leader	1	35,000.00	420,000.00
Production team leader	1	35,000.00	420,000.00
Head, quality control	1	35,000.00	420,000.00
Accountants	4	20,000.00	960,000.00
Maintenance planner	1	25,000.00	300,000.00
Operation supervisors	3	15,000.00	540,000.00
Quality supervisors	3	15,000.00	540,000.00
HR Supervisor	2	15,000.00	360,000.00
Purchasing supervisor	1	15,000.00	180,000.00
Secretaries	4	8,000.00	384,000.00
Machine Operators	12	7,000.00	1,008,000.00
Electrical Engineer	4	12,000.00	576,000.00
Mechanical Engineer	4	12,000.00	576,000.00
Mechanic	6	8,000.00	576,000.00
Electrician	6	8,000.00	576,000.00
Sales Team	4	7,000.00	336,000.00
securities	6	4,000.00	288,000.00
Environmental Specialist	1	30,000.00	360,000.00
Guarders	8	3,000.00	288,000.00
Drivers	8	6,000.00	576,000.00
Total			**14,304,000.00**
Employee benefits @ 20%			2,860,800.00
Grand Total	**88**		**17,164,800.00**

Table: Operating Expenses

	Total cost/year(birr)			
Description	1st year	2nd year	3rd year	4th year and after
Utilities	1,774,828,530.00	1,952,311,383.00	2,147,542,521.30	2,362,296,773.43
Maintenance and Repair	452,874,306.33	452,874,306.33	452,874,306.33	452,874,306.33
Uniforms & other supplies	1,200,000.00	1,320,000.00	1,452,000.00	1,597,200.00
Insurance @ 1% of revenue	105,000,000.00	105,000,000.00	105,000,000.00	105,000,000.00
Manpower Expenditures(Direct labor)	17,164,800.00	18,881,280.00	20,769,408.00	22,846,348.80
R&D @ 2% of revenue	210,000,000.00	231,000,000.00	254,100,000.00	279,510,000.00

Administration Costs*	2,400,000.00	2,640,000.00	2,904,000.00	3,194,400.00
Total Operating Costs	**2,563,467,636.33**	**2,764,026,969.33**	**2,984,642,235.63**	**3,227,319,028.56**

Table: Projected annual operating costs

	Production Year			
Capacity utilization rate (%)	Year 1	Year 2	Year 3	Year 4
	50%	75%	85%	100%
Total Operating Costs	**1,281,733,818**	**2,073,020,227**	**2,536,945,900**	**3,227,319,029**

Table: Working capital Determination

Working Capital Determination		
Direct costs	**Days of coverage**	**Required working capital**
Imported raw materials		
coal	6 month	72,457,132.50
spare parts	1 year	97,655,201.10
Sub total		**72,457,132.50**
Overhead working capital costs		
Wage and Salaries	60	2,860,800.00
Utilities	60	295,804,755.00
Administration Costs*	60	400,000.00
Miscellaneous (5%		18,576,134.38
Sub total		**317,641,689.38**
Total required working capital		**390,098,821.88**

Table: Pre-operating Expenses

Description	Value, Birr
Feasibility Study & Environmental impact assessment	800,000
Commission payment	1,449,143

Interest during construction (6 months)	453,161,791
miscellaneous @ 5%	22,770,547
Total	**478,181,480**

Table: Total Investment

No.	Description	Total Costs
1	**Land and infrastructure costs**	**136,045,000.00**
2	Machineries & equipment	13,274,836,893.84
3	Mining Machinery & Equipment Costs	1,593,928,317.06
4	Other Capital Goods	24,000,000.00
5	Vehicle	51,000,000.00
	Total	**15,079,810,210.90**
	Pre-operating Expenses	478,181,480.04
6	Working capital requirement	390,098,821.88
	Grand Total	**15,948,090,512.81**

Table: Source of Finance

			Owners equity		Bank Loan	
No.	**Description**	**Total Costs**	**Amount**	**%**	**Amount**	**%**
1	**Land and infrastructure costs**	**136,045,000.00**	**68,022,500.00**	50%	**68,022,500.00**	50%
2	Machineries & equipment	13,274,836,893.84	6,637,418,446.92	50%	6,637,418,446.92	50%
3	Mining Machinery & Equipment Costs	1,593,928,317.06	796,964,158.53	50%	796,964,158.53	50%
4	Other Capital Goods	24,000,000.00	12,000,000.00	50%	12,000,000.00	50%
5	Vehicle	51,000,000.00	25,500,000.00	50%	25,500,000.00	50%
	Total	**15,079,810,210.90**	**7,539,905,105.45**	**50%**	**7,539,905,105.45**	**50%**
	Pre-operating Expenses	478,181,480.04	239,090,740.02	**50%**	239,090,740.02	**50%**

6	Working capital requirement	390,098,821.88	195,049,410.94	50%	195,049,410.94	**50%**
	Grand Total	**15,948,090,512.81**	**7,974,045,256.40**	**50%**	**7,974,045,256.40**	**50%**

Table: Yearly loan repayment schedule

Year	**Loan Repayment**	**Interest (12.5%)**	**Outstanding Balance**
0			7,974,045,256
1	797,404,526	917,015,204	7,176,640,731
2	797,404,526	825,313,684	6,379,236,205
3	797,404,526	733,612,164	5,581,831,679
4	797,404,526	641,910,643	4,784,427,154
5	797,404,526	550,209,123	3,987,022,628
6	797,404,526	458,507,602	3,189,618,103
7	797,404,526	366,806,082	2,392,213,577
8	797,404,526	275,104,561	1,594,809,051
9	797,404,526	183,403,041	797,404,526
10	797,404,526	91,701,520	0

Table: Profit and Loss Statement

Description	**Project Years**									
	1	**2**	**3**	**4**	**5**	6	7	8	9	10
Sales	10,500,000,000	17,325,000,000	21,598,500,000	23,758,350,000	26,134,185,000	28,747,603,500	31,622,363,850	34,784,600,235	38,263,060,259	42,089,366,284
Direct cost of sales	1,050,000,000	1,575,000,000	1,785,000,000	1,963,500,000	2,159,850,000	2,375,835,000	2,494,626,750	2,619,358,088	2,750,325,992	2,887,842,291
Gross Profit	9,450,000,000	15,750,000,000	19,813,500,000	21,794,850,000	23,974,335,000	26,371,768,500	29,127,737,100	32,165,242,148	35,512,734,267	39,201,523,993
Gross margin(%)	90.00%	90.91%	91.74%	91.74%	91.74%	91.74%	92.11%	92.47%	92.81%	93.14%
Operational expense	1,281,733,818	2,073,020,227	2,536,945,900	2,714,532,113	2,714,532,113	2,850,258,719	2,992,771,655	3,142,410,238	3,299,530,750	3,464,507,287
Profit before tax and interest	8,168,266,182	13,676,979,773	17,276,554,100	19,080,317,887	21,259,802,887	23,521,509,781	26,134,965,445	29,022,831,910	32,213,203,517	35,737,016,706
Depreciation	532,743,229	532,743,229	532,743,229	532,743,229	532,743,229	532,743,229	532,743,229	532,743,229	532,743,229	532,743,229
EBITDA (Earning before tax, interest and depreciation)	8,701,009,411	14,209,723,002	17,809,297,329	19,613,061,116	21,792,546,116	24,054,253,010	26,667,708,674	29,555,575,139	32,745,946,746	36,269,759,935
Interest expense	917,015,204	825,313,684	733,612,164	641,910,643	550,209,123	458,507,602	366,806,082	275,104,561	183,403,041	91,701,520
Profit tax (35%)	0					8,039,955,230	8,986,760,245	10,029,609,040	11,178,334,635	12,443,764,783
Net profit	7,251,250,977	12,851,666,089	16,542,941,936	18,438,407,244	20,709,593,764	15,023,046,948	16,689,697,598	18,626,416,788	20,759,764,321	23,109,848,882

Table: Cash Flow Statement

	Production Year										
Cash in flow	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Owners' equity	7,974,045,256										
Existing Bank Loan	0										
Additional Bank Loan	7,974,045,256										

Net Profit	0	7,251,250,977	12,851,666,089	16,542,941,936	18,438,407,244	20,709,593,764	15,023,046,948	16,689,697,598	18,626,416,788	20,759,764,321	23,109,848,882
Depreciation		532,743,229	532,743,229	532,743,229	532,743,229	532,743,229	532,743,229	532,743,229	532,743,229	532,743,229	532,743,229
Total Cash in flow	**15,948,090,513**	**7,783,994,206**	**13,384,409,318**	**17,075,685,165**	**18,971,150,473**	**21,242,336,993**	**15,555,790,177**	**17,222,440,827**	**19,159,160,017**	**21,292,507,550**	**23,642,592,111**
Cash out flow											
Replacement		0	0	0	0	0	0	0	0	0	0
loan repayment		797,404,526	797,404,526	797,404,526	797,404,526	797,404,526	797,404,526	797,404,526	797,404,526	797,404,526	797,404,526
Capital Expenditure	15,079,810,211	-	-	-	-	-	-	-	-	-	-
Working capital	390,098,822	-	-	-	-	-	-	-	-	-	-
Existing Working capital	0										
Pre-operating expenses	478,181,480										
Total Cash out flow	**15,948,090,513**	**797,404,526**	**797,404,526**	**797,404,526**	**797,404,526**	**797,404,526**	**797,404,526**	**797,404,526**	**797,404,526**	**797,404,526**	**797,404,526**
Net Cash Flow	0	6,986,589,681	12,587,004,792	16,278,280,639	18,173,745,947	20,444,932,467	14,758,385,652	16,425,036,301	18,361,755,492	20,495,103,025	22,845,187,586
Cash balance		7,376,688,503	19,963,693,295	36,241,973,934	54,415,719,881	74,860,652,349	89,619,038,000	106,044,074,301	124,405,829,793	144,900,932,818	167,746,120,403

Table: Balance Sheet Statement

Description	**Investment**	**Production Year**									
ASSETS	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Current Assets											
Cash	390,098,822	**7,376,688,503**	**19,963,693,295**	**36,241,973,934**	**54,415,719,881**	**74,860,652,349**	**89,619,038,000**	**106,044,074,301**	**124,405,829,793**	**144,900,932,818**	**167,746,120,403**
Other Current Assets		0	0	0	0	0	0	0	0	0	0
Total Current Assets	**390,098,822**	**7,376,688,503**	**19,963,693,295**	**36,241,973,934**	**54,415,719,881**	**74,860,652,349**	**89,619,038,000**	**106,044,074,301**	**124,405,829,793**	**144,900,932,818**	**167,746,120,403**
Fixed Asset											

Land and infrastructure costs	136,045,000	129,242,750	122,440,500	115,638,250	108,836,000	102,033,750	95,231,500	88,429,250	81,627,000	74,824,750	68,022,500
Plant machineries & construction	13,274,836,893.84	12,832,342,331	12,389,847,768	11,947,353,204	11,504,858,641	11,062,364,078	10,619,869,515	10,177,374,952	9,734,880,389	9,292,385,826	8,849,891,263
Mining Machinery & Equipment Costs	1,593,928,317.06	1,514,231,901	1,434,535,485	1,354,839,069	1,275,142,654	1,195,446,238	1,115,749,822	1,036,053,406	956,356,990	876,660,574	796,964,159
Vehicles	24,000,000.00	22,800,000	21,600,000	20,400,000	19,200,000	18,000,000	16,800,000	15,600,000	14,400,000	13,200,000	12,000,000
Other Capital Goods	51,000,000.00	48,450,000	45,900,000	43,350,000	40,800,000	38,250,000	35,700,000	33,150,000	30,600,000	28,050,000	25,500,000
Total Fixed Asset	**15,079,810,211**	**14,547,066,982**	**14,014,323,753**	**13,481,580,524**	**12,948,837,295**	**12,416,094,066**	**11,883,350,837**	**11,350,607,608**	**10,817,864,379**	**10,285,121,150**	**9,752,377,921**
Total Asset	**15,469,909,033**	**21,923,755,484**	**33,978,017,048**	**49,723,554,458**	**67,364,557,176**	**87,276,746,415**	**101,502,388,837**	**117,394,681,910**	**135,223,694,172**	**155,186,053,968**	**177,498,498,324**
LIABILITIES											
Short term liability	-	-	-	-	-	-	-	-	-	-	-
Long term liability (Bank Loan)	7,974,045,256	7,176,640,731	6,379,236,205	5,581,831,679	4,784,427,154	3,987,022,628	3,189,618,103	2,392,213,577	1,594,809,051	797,404,526	0
Sub Total	**7,974,045,256**	7,176,640,731	6,379,236,205	5,581,831,679	4,784,427,154	3,987,022,628	3,189,618,103	2,392,213,577	1,594,809,051	797,404,526	0
CAPITAL											
Owner's Equity	7,974,045,256	7,974,045,256	7,974,045,256	7,974,045,256	7,974,045,256	7,974,045,256	7,974,045,256	7,974,045,256	7,974,045,256	7,974,045,256	7,974,045,256
Retained Earnings	-478,181,480	6,773,069,497	19,624,735,586	36,167,677,522	54,606,084,766	75,315,678,530	90,338,725,478	107,028,423,076	125,654,839,864	146,414,604,186	169,524,453,068
Earnings		7,251,250,977	12,851,666,089	16,542,941,936	18,438,407,244	20,709,593,764	15,023,046,948	16,689,697,598	18,626,416,788	20,759,764,321	23,109,848,882
Sub Total	**7,495,863,776**	**14,747,114,754**	**27,598,780,843**	**44,141,722,779**	**62,580,130,022**	**83,289,723,786**	**98,312,770,735**	**115,002,468,333**	**133,628,885,121**	**154,388,649,442**	**177,498,498,324**
Total Liability & Capital	**15,469,909,033**	**21,923,755,484**	**33,978,017,048**	**49,723,554,458**	**67,364,557,176**	**87,276,746,415**	**101,502,388,837**	**117,394,681,910**	**135,223,694,172**	**155,186,053,968**	**177,498,498,324**
Net Worth	**7,495,863,776**	**14,747,114,754**	**27,598,780,843**	**44,141,722,779**	**62,580,130,022**	**83,289,723,786**	**98,312,770,735**	**115,002,468,333**	**133,628,885,121**	**154,388,649,442**	**177,498,498,324**

14. Financial Evaluation

14.1. NPV (Net Present Value)

It is a method of calculating the expected net gain or loss from project by discounting rate of all expected future cash inflow and outflows to the present point in time. The following table shows NPV.

Table: NPV

Year	Net Cash Flow	Discount Factor	NPV
0	-20,745,243	1.00	-20,745,243
1	5,458,126	0.92	5,005,102
2	7,867,266	0.84	6,624,238
3	10,276,407	0.77	7,933,386
4	12,566,503	0.71	8,897,084
5	15,069,577	0.65	9,795,225
6	11,158,274	0.60	6,650,332
7	12,677,247	0.55	6,934,454
8	14,534,222	0.50	7,296,179
9	16,598,246	0.46	7,635,193
10	18,891,091	0.42	7,972,040
		0	53,997,991

14.2. Payback Period (PBP)

The payback period is the amount of time required for a firm to recover its initial investment in a project, as calculate from cash inflow. The investment cost and income statement projection are used to project the pay-back period.

Table: Payback period

Item	**Year**		
	0	**1**	**2**
Investment cost	15,948,090,513		

Net profit		7,251,250,977	12,851,666,089
Interest		917,015,204	825,313,684
Depreciation		532,743,229	532,743,229
Profit		**8,701,009,411**	**14,209,723,002**

The payback period = 2 years.

14.3. IRR

The internal rate of the project is the rate of discount that radios the present value of the investigated project to zero.

Table: IRR

Year	Net Cash Flow	Discount Factor	NPV	**IRR**
0	-15,948,090,513	1.00	-15,948,090,513	59%
1	6,986,589,681	0.92	6,406,702,737	
2	12,587,004,792	0.84	10,598,258,035	
3	16,278,280,639	0.77	12,566,832,654	
4	18,173,745,947	0.71	12,867,012,130	
5	20,444,932,467	0.65	13,289,206,104	
6	14,758,385,652	0.60	8,795,997,848	
7	16,425,036,301	0.55	8,984,494,857	
8	18,361,755,492	0.50	9,217,601,257	
9	20,495,103,025	0.46	9,427,747,391	
10	22,845,187,586	0.42	9,640,669,161	
		0	85,846,431,662	

15. Conclusion and Recommendation

Conclusion: The Project is found to be operationally profitable & has significant socio-economic benefits. The income statement and other profitability indicators show that the project is viable. The project is believed to have significant social and economic benefits that accrue to the society beyond those financial returns to its owner. Therefore, **c**onsidering the technical/financial viability of the project, the requested long term loan is recommended.