الإتحاد للحديد والصلب
UNION IRON & STEEL

Life Cycle Assessment Report

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MADE IN UAE

EXECUTIVE SUMMARY

The iron and steel industry is a pillar industry of the national economy and an energy-intensive industry. Energy consumption accounts for an increasing proportion, accounting for about 15% of the country's total industrial consumption. This productivity inevitably imposes an environmental burden on the steelmaking sector. The steelmaking process must be analyzed in order to have a clear understanding of the main environmental impacts and may involve the implementation of circular economy solution.

At present, there are many researches on the environmental impact assessment of these industries, such as greenhouse gas emission reduction, air pollutant emission reduction, steel wastewater footprint and production capacity, resource and energy emissions, etc. It is very important to evaluate the environmental impact of a product in its life cycle (life cycle assessment, LCA). Steel products have a low environmental impact in the production and use phases, and have a high recovery rate and recyclability compared to other materials. Thus, their life cycle environmental impact including the recycling potential is very low. The calculation methodology including the recycling potential of steel products has been standardized by ISO. Global and regional life cycle inventory data of steel products including the recycling potentials are available. LCA is evaluated based on the contribution of the production process to the environment, including categories such as global warming potential (GWP), land acidification, land occupation, respirable organic, and human toxicity. Therefore, LCA can identify the unit processes with the greatest impact on the environment for targeted improvements.

The environmental impacts of a product occur at each stage of the product life cycle. Specifically, the phases include mining of natural resources, raw material production, material production, component production, final product production, use of the product, waste disposal, transportation, and recycling potential. The smaller the environmental impacts in each step, the better, but what is more important is the total of the impacts in all the phases, i.e., the environmental impacts in the entire life cycle of the product. This evaluation is called life cycle assessment (LCA).

UIS	Union Iron and Steel Company L.L.C
Environmental Aspect	Element of an organization's activities, products or services that can interact with the environment.
CO2	Carbon Dioxide
Functional Unit	Quantified performance of a product system for use as a reference unit.
GHG	Greenhouse Gas
Inpu	Product, material or energy flow that enters a unit process.
Life Cycle	Consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to final disposal
Life Cycle Assessment (LCA)	Compilation and evaluation of the inputs, outputs and the potential Environmental impacts of a product system throughout its life cycle.
Life Cycle Impact Assessment (LCIA)	Phase of life cycle assessment aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a product system throughout the life cycle of the product.
Life Cycle Interpretation	Phase of life cycle assessment in which the findings of either the inventory analysis or the impact assessment, or both, are evaluated in relation to the defined goal and scope in order to reach conclusions and Recommendations.
Life Cycle Inventory Analysis (LCI)	Phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle.
Output	Product, material or energy flow that leaves a unit process.
Process	Set of interrelated or interacting activities that transform inputs into outputs.
Raw Material	Primary or secondary material that is used to produce a product.
Rebar	Reinforcement Steel Bar
Releases	Emissions to air and discharges to water and soil.
System Boundary	Set of criteria specifying which unit processes are part of a product system.

INTRODUCTION

Union Iron and Steel (UIS) is a privately owned manufacturer of rebar (steel bars used for concrete reinforcement), based in the Industrial City of Abu Dhabi 1, United Arab Emirates. Established in 2006, UIS has built a reputation for delivering high-quality products and advanced technologies. The company's primary objective is to fulfill the region's demand for superior steel bars while minimizing dependency on imports. The production facility is equipped with the fully automated rolling mill technology by Vai Pomini (Siemens), enabling efficient and precise manufacturing. UIS produces steel bars ranging from 8mm to 40 mm in diameter, with a total annual production capacity of **421886.251** metric tons.

This study is a **Cradle-to-gate Life Cycle Assessment (LCA)** that examines all stages from the extraction of raw materials (cradle) to the finished product ready for dispatch from the steelworks (gate). The LCA is conducted in accordance with the requirements outlined in **ISO 14040:2006** (Environmental Management – Life Cycle Assessment – Principles and Framework) and **ISO 14044:2006** (Environmental Management – Life Cycle Assessment – Requirements and Guidelines).

The aim of this LCA is to quantify resource consumption, energy use, and environmental emissions associated with the manufacturing process at UIS from the extraction of raw materials to the point where the finished steel products are prepared for shipment from the factory gate.

Within the UIS facility, a reheating furnace is used to heat steel billets to predetermined temperatures, enabling their deformation and facilitating the rolling process.

The UIS plant holds certifications for **ISO 9001:2015**, **ISO 14001:2015**, **BS ISO 45001:2018**, **EPD** and the **Sustainable Constructional Steel (SCS) scheme (BS 8902:2009)**, in addition to product conformity certification from **UK Cares**.

While UIS does not fully control upstream activities such as iron ore extraction, transportation, and downstream usage or disposal of steel products, the company emphasizes sustainability measures within its operational boundaries where it has full control and decision-making authority. A comprehensive assessment of the entire supply chain is necessary to fully capture the carbon footprint associated with steel rebar production. However, such an extended supply chain analysis falls outside the scope of this study.

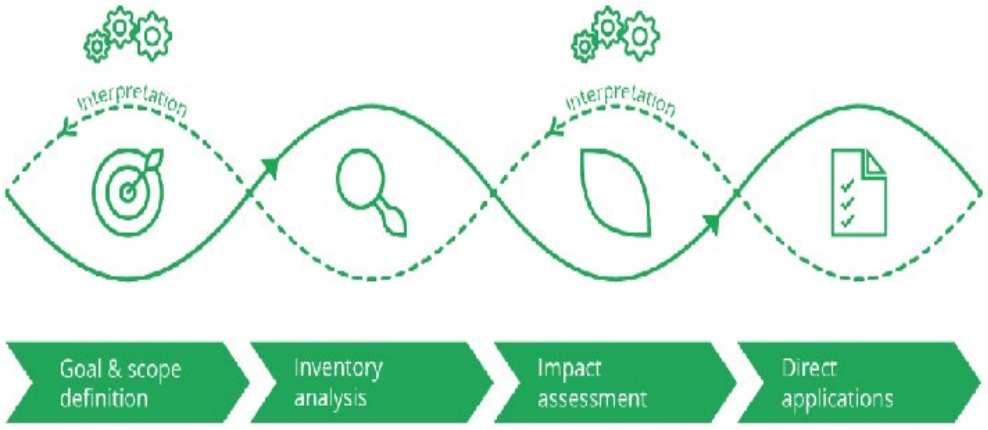
Data Collection and Methodology

This study was carried out in line with the requirements of ISO 14040:2006 Environmental management, principles and framework and Life cycle assessment – Requirements and guidelines. As per ISO 14044: 2006, LCA generally comprises four major components:

Goal and Scope Definition

- ***Life Cycle Inventory (LCI) Analysis:*** data collection and calculation of an inventory of materials, energy and emissions related to the system being studied;
- ***Life Cycle Impact Assessment (LCIA):*** analysis of data to evaluate contributions to various environmental impact categories; and
- ***Interpretation and Conclusion:*** where data are analyzed in the context of the methodology, scope and study goals and where the quality of any study conclusions is assessed.

Data for energy usage which includes consumption of natural gas, electricity and fuel (diesel) were directly measured from the plant. Moreover, consumption level data from daily logs recorded in UIS manufacturing plant are considered, while maintaining and verifying consistency and accuracy. For this Assessment, we will be following **the Cradle to Gate approach**.



Phases of LCA

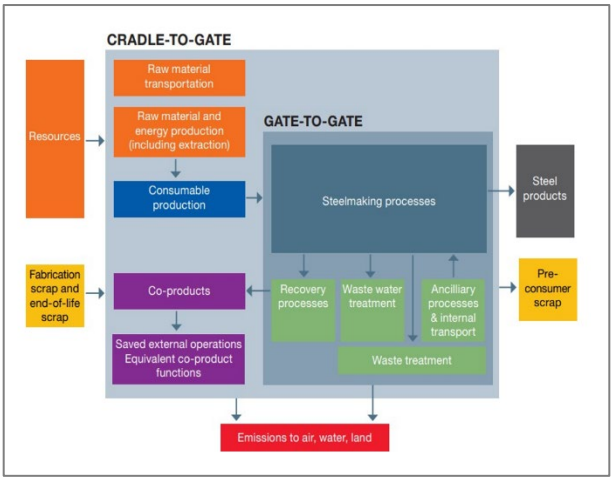
Process Overview

There is only one plant facility that UIS currently operates which is located in the industrial zone in Mussafah area in Abu Dhabi, UAE. Both steel bar manufacturing plant and facility office are in the same location and close proximity. The figure below describes the cradle to gate processes involved in the manufacture of steel bar.

No secondary or auxiliary services are existent since UIS plant facilities have offices within its proximity and geo-boundaries. In addition to this, UIS does not have any fleet rentals. Upon dispatch of the final product (steel rebar), it is the client's responsibility to arrange for the transportation, delivery or shipment of their purchase, from the plant to final destination.

Imported goods are sent as sea freight to the nearest port in UAE and transferred/delivered to UIs Facility via Road transportation.

Electricity is procured from the grid through Abu Dhabi Distribution Company (ADDC) and the main source of energy for the reheating furnace is from the natural gas supplied local company. All energy sources including gas and electricity are monitored on a daily basis for consumption. Abu Dhabi Water and Electricity Authority (ADWEA) provided water for the cooling process through metered mains. Water is treated at Water treatment plant and then reused. Domestic waste water is discharged into municipality sewage network.



Cradle to Gate

Disposal of all non-recyclable solid waste generated (general waste/food waste) is done as per the local regulations set by the Center of Waste Management – Tadweer (CWM).

GOAL AND SCOPE DEFINITION

Goal of the Study

- To assess the environmental impacts of producing rebar at UIS.
- To identify key processes contributing to energy consumption, emissions, and waste.
- To recommend mitigation strategies that enhance operational efficiency and reduce carbon footprint.

Functional Unit
The functional unit is defined as 1 metric ton of rebar produced at UIS's facility.

System Boundary (A1-A3)

The LCA covers information about the following processes:

- **Raw Material Extraction and Storage (A1, A2)**: Receipt and storage of billets.
- **Manufacturing Process (A3)**: Reheating, rolling, quenching, cooling, cutting, bundling, and tagging.
- **Waste Management**: Handling of process waste including slag and scale.
- **Energy Use**: Electricity and natural gas consumption.
- **Water Use**: Cooling water, processing water, and maintenance water usage.
- **End-of-life**: Recycling and disposal processes.

Excluded: Indirect activities such as transportation of raw materials beyond the facility and office operations.

Other exclusions include:

- Maintenance of roads, ports and airports involved in transportation
- Capital goods (machinery, transportation equipment etc.)
- Replacement of machinery parts used in the manufacturing of the rebar
- Carbon sequestration by natural products (e.g. timber)
- Packaging materials such as pallets, labels etc.

Limitations and Adaptations

For calculating emission factors during the billet production, this study utilized the emission factors as detailed in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Chapter 4: Metal Industry Emissions.

It is assumed that the steel rebar shall have negligible emissions from the product during its usage life, after it is manufactured. Most of the factory specific data such as natural gas, electricity and gas were directly derived from the data available at the plant.

It is important to take into account that results of this LCA are limited to production of steel rebar at UIS plant and is not an indicative of the carbon impact of other steel products manufactured in UAE as a whole.

INVENTORY ANALYSIS

Total Rebar Manufactured in 2024

Rebar Size	Total Production (Tons)
8mm DB	0
10mm DB	36765.198
12mm DB	106222.02
14mm DB	20713.257
16mm DB	112216.894
18mm DB	0
20mm DB	75594.439
25mm DB	46210.314
32mm DB	24164.129
40mm DB	0
Total	**421886.251**

- ***Total rebar produced in 2024: 421886.251 Tones.***
- ***Dominant sizes: 12mm, 16mm, 20mm***

Production & Waste 2024

Stream	Annual Volume	Disposal Route
General waste	37300 kg	Landfill
Wood waste	17,380 kg	Recycled
Concrete waste	23250 kg	Landfill
Mill scale	4,301.13 t	(By-Product)Recycled
Cobble	1,368.27 t	Recycled
Short length loss	2,188.12 t	Recycled
End cuts	2,699.47 t	Recycled
Scrap rolls	90.52 t	Recycled
Used oil	2,562.56 kg	Recycled
Metal chips	13.66 t	Recycled
Plastic waste	480 kg	Recycled
E-waste	600 kg	Recycled
Hazardous waste	640 kg	Incineration

Resource Consumption per MT

Scope	Type	Fuel / Source	Activity Data	Total GHG Emissions (tCO_2e)
Scope 1	Stationary Combustion	Natural Gas	586,184.89 GJ	32,884.97
Scope 1	Mobile Combustion	Diesel	1,028.26 GJ (7,804 gal)	76.19
Scope 2	Electricity	Purchased electricity	37,216,165.44 kWh	15,039.05
Scope 3	Upstream (Fuel WTT + Elec. T&D)	NG WTT, Diesel WTT, Elec. T&D	Various sources	6,128.84
Scope 3	Business travel +Employee travel	As per UIS transport data		34.38
Total Emissions				**54,163.43**

GHG Emissions Data

Resource	Total Annual Use	Per MT Average	Conversion Factor	Total Energy (GJ)
Natural Gas	555596 MMBTU	1.32 MMBTU/MT	1 MMBTU = 1.055 GJ	586184.89GJ
Electricity	37216165.44 kWh	89.24 kWh/MT	1 kWh = 0.0036 GJ	133978.20GJ
Diesel	7804 gallons	0.0186 gal/MT	1 gal = 0.13176 GJ	1028 GJ
Water	75979 m^3	0.17 m^3/MT	-	-
Total Production	421886.251 MT	-	-	-

LIFECYCLE IMPACT ASSESSMENT

Total Rebar Production	*4,21,886*	*metric tons (t)*	*From UIS production data*
GHG Emissions (Scope 1)	*32961.16*	*metric tons CO2e*	*From natural gas combustion*
GHG Emissions (Scope 2)	*15,039.05*	*metric tons CO2e*	*From electricity use*
GHG Emissions (Scope 3)	*6163.22*	*metric tons CO2e*	*From Business travel + employee commute + upstream sources*
Total GHG Emissions for Rebar Production	*54,163.43*	*metric tons CO2e*	
Emission Intensity (A3)	*0.128*	*t CO2e per ton of rebar*	*Total emissions divided by total production*
A1 Stage Emissions	*1.56*	*t CO2e per ton of rebar*	*Total emissions from Raw material manufacturing (Billets)*
A2 Stage Emissions	*0.00472*	*t CO2e per ton of rebar*	*Total emissions for transportation of Raw material to the manufacturing facility.*
Total Water Consumption	*75,979*	*cubic meters (m^3)*	
Water Use Intensity	*0.17*	*m^3 per ton of rebar*	*Average water use per ton produced*
General Waste (Landfill)	*37300*	*kg*	*Solid waste sent to landfill*
Concrete Waste (Landfill)	*23250*	*kg*	*Construction and demolition waste landfill*
Recycled Waste Total	*>80% of total solid waste*	*Percentage*	*Includes mill scale, cobble, end cuts, scrap, oils, etc.*
Hazardous Waste (Incinerated)	*640*	*kg*	*Hazardous waste treatment*
Energy Consumption (Natural Gas)	*5,55,596*	*MMBTU*	*Total natural gas consumed*
Energy Consumption (Electricity)	*3,72,16,165*	*kWh*	*Total electricity consumption*
Energy Consumption (Diesel)	*7,804*	*gallons*	*Total diesel fuel consumed*

INTERPRETATION AND CONCLUSION

The cradle-to-gate Life Cycle Assessment (LCA) of Union Iron & Steel Company (UIS) reveals that the environmental footprint of rebar production is primarily driven by energy-intensive upstream processes. Specifically, the manufacture of steel billets accounts for the majority of greenhouse gas emissions, contributing approximately 92.4% of the total carbon footprint per metric ton of rebar. This is followed by emissions from electricity use, natural gas combustion, and diesel-powered internal logistics at UIS facility.

Key findings include:

- Total GHG emissions for Rebar Production: 54,163.43 metric tons CO_2e for the year 2024
- Water use intensity: 0.17 m^3 per ton of rebar
- Recycled waste: >80% of solid waste diverted from landfill
- Hazardous waste: Minimal, with proper incineration protocols

The study highlights that while UIS's operations are relatively efficient, there is significant opportunity for carbon reduction through supply chain optimization, particularly by:

- Sourcing billets locally, if possible, to reduce transport emissions
- Improving energy efficiency in reheating and rolling processes
- Enhancing water reuse and waste segregation systems
- Implementing a carbon offset strategy and sustainable procurement policy

The LCA study demonstrates that UIS's manufacturing processes, while energy-intensive and resource-intensive, have significant potential for improvement through targeted interventions. Implementing the recommended strategies and integrating these recommendations will enable UIS to reduce its environmental footprint, enhance operational efficiency, align with UAE's sustainability goals and reinforce its leadership in responsible steel manufacturing.