



## Executive Summary

Bhutan's ferroalloy industry, led by ferrosilicon production, is one of the country's largest export earners and a cornerstone of industrial growth. Over the past decade, the industry generated a total of BTN 128.84 billion in export earnings, growing from BTN 7.06 billion in 2015 to BTN 18.58 billion in 2024, accounting for over 40% of the country's total exports. While ferrosilicon remains the primary product, the industry has shown promising diversification, with growth in ferro silico manganese and inoculant productions. The industry benefits from Bhutan's comparative advantages in terms of affordable hydropower, geographic proximity to the primary export market (India) and preferential trade agreements. However, the industry faces structural vulnerabilities owing to its heavy reliance on the Indian market for over 90% of its exports and a high dependency on imported raw materials such as quartz and charcoal.

Global and regional dynamics present both opportunities and risks. India's steel industry, supported by the National Steel Policy 2017 and the Production-Linked Incentive (PLI) scheme, is projected to expand significantly, sustaining demand for ferroalloys. At the same time, competition from larger exporters, price volatility, and India's push for self-reliance highlight Bhutan's exposure to external shocks. Beyond India, growing European and Asian markets, coupled with increasing demand for sustainable "green" alloys, provide avenues for diversification.

This report provides a comprehensive analysis of the market feasibility of Bhutan's ferroalloy industry, broken down into key sections:

1. *Introduction:* This section of the report provides a high-level overview of the industry and outlines the study's specific objectives, scope, and research questions.
2. *Production and pricing analysis:* This section details the production capacity and pricing trends of Bhutan's ferroalloy industry over a 10-year period, with a specific focus on different product compositions. It also assesses the supply and dependency on key raw materials, such as quartz and charcoal, highlighting potential vulnerabilities in the supply chain.
3. *Export trend analysis:* This section evaluates the industry's export performance from 2015-2024, examining the relationship between export volume and value, and calculating the growth rates to identify key trends.
4. *Global market analysis:* This section covers the global and regional market landscape, identifying key players, competitors, and major market trends to understand the competitive environment.

5. *Indian market analysis:* This section highlights that India's steel industry, supported by the National Steel Policy 2017 and the Production-Linked Incentive (PLI) scheme, is projected to expand significantly, sustaining demand for ferroalloys.
6. *Overall assessment and recommendations:* This section provides an in-depth look at the industry's Strengths, Weaknesses, Opportunities, and Threats, (SWOT) providing a crucial framework for strategic planning and recommends strategies to sustain the ferroalloy industry.

The study concludes that Bhutan's ferroalloy industry is feasible and competitive in the medium to long term, as demonstrated by past trends, but its sustainability will depend on strategic diversification of its export markets, variety of product composition, and adoption of energy-efficient and environmentally responsible practices.

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## 1. Introduction

Bhutan's ferroalloy industry, led by ferrosilicon production, stands as one of the country's top export commodities and a key driver of national revenue. Between 2015 and 2024, ferroalloys contributed BTN 128.84 billion in export earnings, with ferrosilicon accounting for BTN 113.48 billion (88%), ferro silico manganese for BTN 11.05 billion (8.5%), and other products such as micro silicon for BTN 4.3 billion (3.3%). This sector's importance extends beyond exports as according to the World Bank, the ferroalloy and silicon industry is among the main forces driving non-hydro industrial growth in Bhutan, alongside the construction sector<sup>1</sup>. The National Accounts Statistics 2025 further highlights that within the manufacturing sector's 6.62 percent share of GDP in 2024, the metal industry, dominated by ferroalloy production, generated 60 percent of the sector's Gross Value Added (GVA)<sup>2</sup>.

### 1.1. Overview of Bhutan's ferroalloy industry

As of August 2025, there are 24 licensed ferro alloy industries in the country, of which, 11 are fully operational, 2 have recently begun operations, 1 has halted operations in 2024 and 10 are under construction<sup>3</sup>.

Table 1: Operational status of the ferroalloy industries

Operational Status	Number of Ferroalloy Industries
Fully Operational	11
Partially Operational/Recently Operational	2
Halted Operations	1
Under Construction/Yet to Initiate Construction	10
<b>Total</b>	<b>24</b>

All of the ferroalloy industries are situated in the southern region, with nearly half of them located in Pasakha (9 in the Pasakha Industrial Estate and 3 outside the Estate), Chukha, followed by 9 upcoming industries at Norbugang Industrial Park, Samtse and 3 industries in Phuntsho Rabtenling Industrial Park, Samdrup Jongkhar.

<sup>1</sup> World Bank. (2004). *Bhutan Country Economic Memorandum*.

<sup>2</sup> National Statistics Bureau. (2025). *National Accounts Statistics 2025*.

<sup>3</sup> Detailed list of the ferroalloy industries in Table 2.

Figure 1: Ferroalloy industries by location

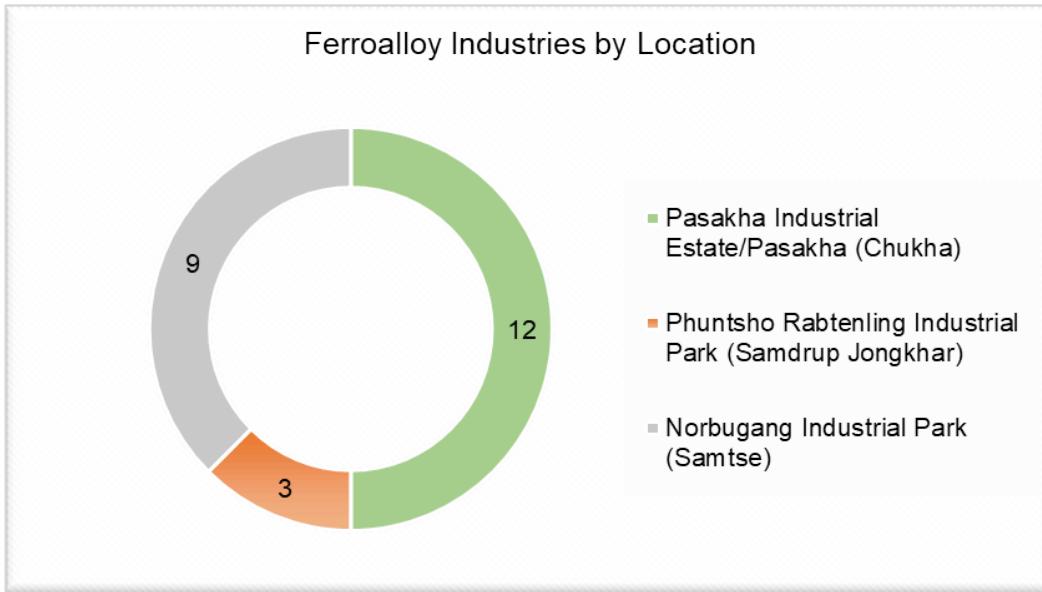


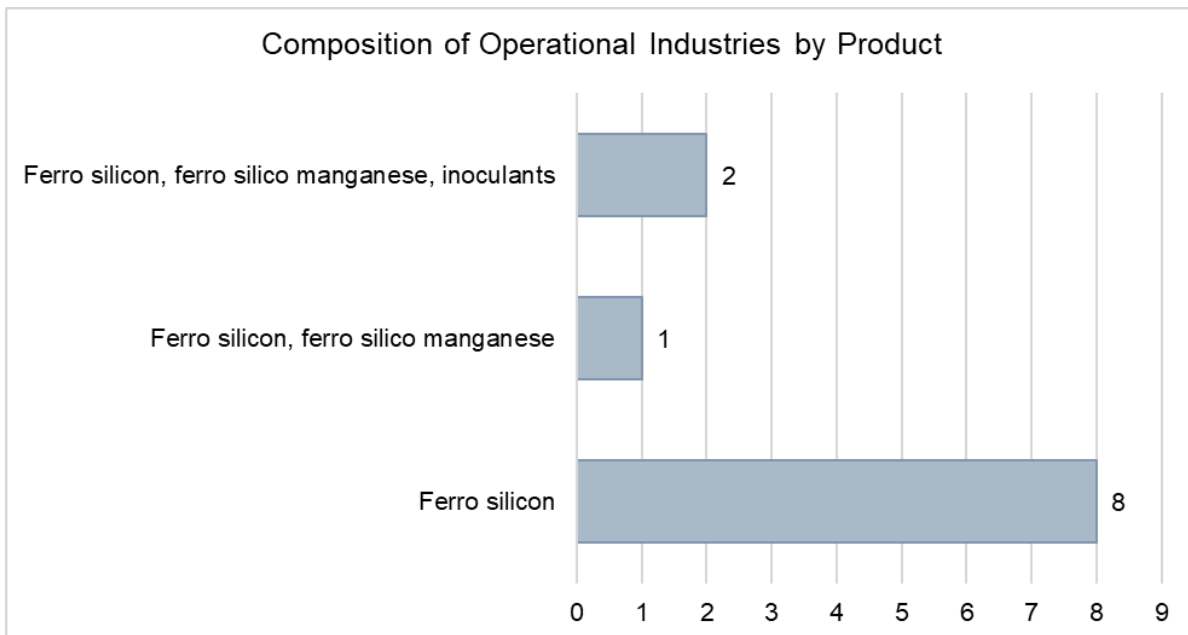
Table 2: List of ferroalloy industries in Bhutan

Sl. No.	Company Name	Approved Capacity	Operational Status
<b>Pasakha Industrial Estate, Chukha</b>			
1	Tashi Metals Private Limited	15 MVA	Operational
2	Ugen Ferro Alloys	18 MVA	Operational
3	Druk Wang Alloys	36 MVA	Operational
4	Druk Ferro Alloys	36 MVA	Operational
5	Pelden Enterprise Limited	18 MVA	Operational
6	Bhutan Alloys Casting Unit	1 MT	Non-operational
7	Samdrupling Metals Private Limited	1 MT	Operational
8	KK Steel Private Limited	2.25 MT	Operational
9	Kinshar Metals	1 MT	Partially Operational
<b>Pasakha, Chukha (Outside the Estate)</b>			
10	Bhutan Carbide Chemicals Limited	25.5MVA	Operational
11	Bhutan Silicon Metal Private Limited	13.5 MVA	Operational
12	Bhutan Ferro Alloys Limited	46.5 MVA	Operational
<b>Phuntshorabtenling Industrial Park, Samdrup Jongkhar</b>			

Sl. No.	Company Name	Approved Capacity	Operational Status
13	S.D East Bhutan Ferro Silicon Private Limited	28 MVA	Operational
14	Chukha Ferro Alloys Private Limited	23 MVA	Partially Operational
15	Kinley Metals Private Limited	18 MVA	Under Construction
<b>Norbugang Industrial Park, Samtse</b>			
16	B.V Ferro Alloys Private Limited	60 MVA	Under Construction
17	DV Ferro Alloys Private Limited	60 MVA	Under Construction
18	Exalt Drul Environklens Pvt Ltd	36 MVA	Under Construction
19	Ace Himalayan Ferro Alloys Pvt Ltd	32 MVA	Under Construction
20	Aja Alloys Private Limited	18 MVA	Under Construction
21	BMML Ferro Alloys Pvt Ltd	36 MVA	Under Construction
22	Samtse Ferro Alloys Pvt Ltd	40 MVA	Under Construction
23	Green Ferro Alloys Pvt Ltd	26 MVA	Under Construction
24	Om Jigmeling Metallurgy Private Limited	22.2 MVA	Under Construction

A majority of the operational ferroalloy industries specialise in the production of ferro silicon (8 out of 11) with only 3 industries producing more than one product such as ferro silico manganese and inoculants in addition to ferro silicon.

Figure 2: Composition of operational industries by product



## 1.2. Objective of the study

The primary objective of the study is to assess the market feasibility and sustainability of Bhutan's ferroalloy industries against the backdrop of regional and global market dynamics. Specifically, the study aims to:

- Evaluate market feasibility by analysing the export performance, demand outlook, production capacity, cost competitiveness, and pricing trends for Bhutan's ferroalloys;
- Examine sustainability factors, including resource availability (power, raw materials, labour), environmental implications, and alignment with Bhutan's green growth policies;
- Understand Bhutan's position in the global ferroalloy market by identifying competitive advantages and vulnerabilities;
- Assess risks and opportunities arising from global price fluctuations, trade policies, and supply chain disruptions; and
- Recommend strategic directions to enhance the industry's resilience, profitability, and contribution to Bhutan's economic diversification.

## 1.3. Scope of the study

- The study covers the past decade (2015–2024) of ferroalloy industry performance, including trends in production, pricing and exports.
- It considers both quantitative aspects (export volumes, average selling prices, growth) and qualitative aspects (policy environment, sustainability practices, market access challenges).
- The analysis is global in scope with emphasis on Bhutan's primary export destinations such as India, while also accounting for broader international ferroalloy demand patterns.
- It incorporates short-term prospects (2025–2030) and long-term outlook (beyond 2030) to understand future opportunities and constraints.

## 1.4. Research questions

The study will attempt to answer the following:

- What is the market feasibility of Bhutan's ferroalloy industry in terms of competitiveness, demand, and export potential in regional and global markets?

- How sustainable is Bhutan’s ferroalloy industry with respect to resource use, environmental impact, and alignment with national green growth policies?
- What risks and opportunities will shape the future of Bhutan’s ferroalloy industry, and what strategies can ensure its long-term growth and resilience?

## 1.5. Methodology

This study adopts a mixed-methods approach, combining both primary and secondary data to assess the market feasibility and sustainability of Bhutan’s ferroalloy industry as follows:

- **Primary data**
  - Primary data on production capacity, product composition, pricing trends, and raw material consumption for the period 2015–2024 were obtained directly from operational ferroalloy industries in September 2025.
  - These industry-provided datasets form the core basis of the production and pricing analysis.
- **Secondary data**
  - Secondary data on export were sourced from official publications such as the *Bhutan Trade Statistics (2015–2024)*, supplemented by *National Accounts Statistics 2025*, and other relevant documents.
  - Global and regional market insights were drawn from research agencies including *Research and Markets (2025)*, *Precedence Research (2025)*, *Grand View Research (2024)*, and *OECD World (2025)*.

Analytical tools such as trend analysis, growth rate calculations, comparative market analysis, and a SWOT framework were applied to interpret the data. Charts and tables were used to illustrate patterns in production, pricing, and exports.

The study covers the period 2015–2024 and focuses on Bhutan’s key ferroalloy products, namely, ferrosilicon, ferro silico manganese, and inoculants. While the analysis relies on reported data from industries and official sources, cross-verification and triangulation were used to ensure accuracy and consistency.

## 2. Production capacity and pricing of Bhutan’s ferroalloy industries (2015-2024)

### 2.1. Overall ferroalloy production

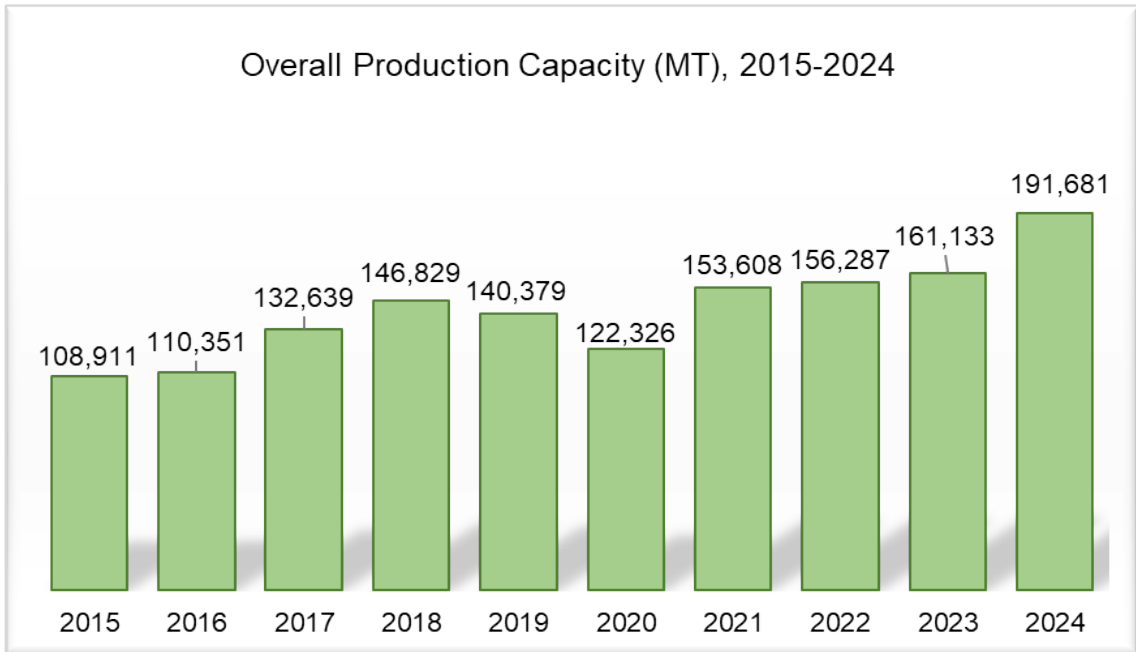
Bhutan currently has 11 fully operational ferroalloy companies that have been fully operational for more than five years. These operational industries have a combined installed capacity of approximately 240 MVA, producing over 191,681 tonnes of ferroalloys in 2024, constituting of 154,953.21 MT of ferro silicon (81%), 34,579.66 of

ferro silico manganese (18%) and 2,148.53 MT of inoculants (1%)<sup>4</sup>. This established base is further going to be increased by a substantial influx of new capacity of 371.2 MVA estimated to add 218,000 tons of ferro silicon and 50,000 tons of ferro silicon manganese<sup>5</sup>.

Between 2015 and 2024, Bhutan’s ferroalloy production capacity recorded a strong upward trajectory, despite some fluctuations in the middle years (2019-2020). Overall, the sector achieved a Compound Annual Growth Rate (CAGR) of approximately 6.5 percent, indicating robust long-term expansion and resilience.

The following figure shows the overall production capacity of Bhutan’s ferroalloy industry in the past decade.

Figure 3: Overall production capacity of Bhutan’s ferroalloy industry (2015-2024)



**Key observations**

- Capacity stood at about 108,911 MT in 2015 and grew steadily to almost 146,829 MT by 2018.
- There was a temporary contraction in 2019–2020, likely reflecting operational or market disruptions.

<sup>4</sup> Production figures (2015-2024) obtained primarily from the ferroalloy industries in September 2025

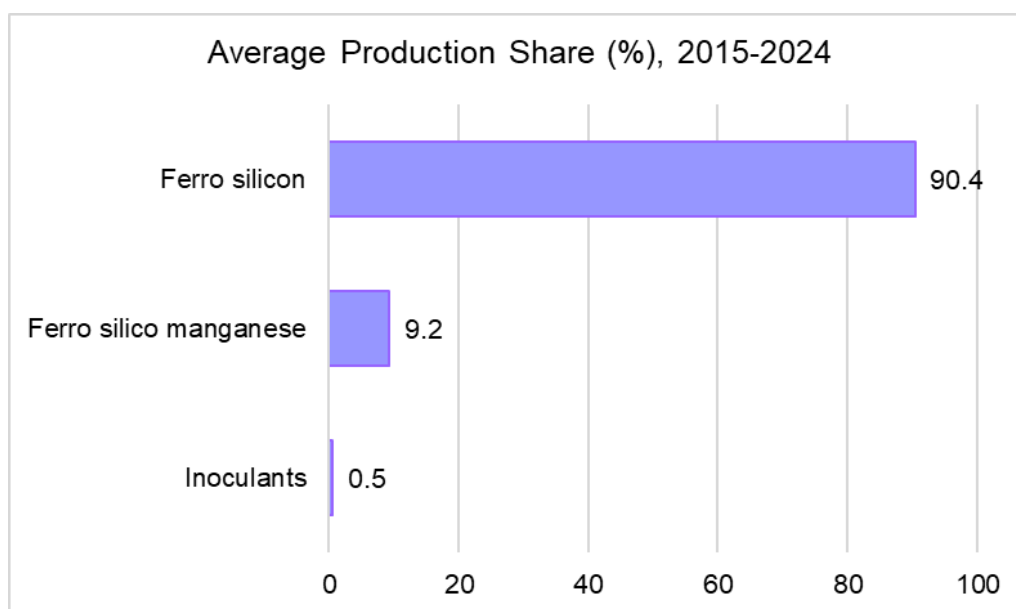
<sup>5</sup> The Bhutanese. (2025). *Is the Ferro Industry becoming too big to fail? Billions in investments and loans in 9 upcoming Ferro factories in Norbugang?*

- From 2021 onwards, the industry rebounded sharply, with capacity rising consistently to reach 191,681 MT in 2024, the highest level of the decade.
- Overall, the trend shows long-term growth despite short-term fluctuations.

## 2.2. Production capacity by products/composition

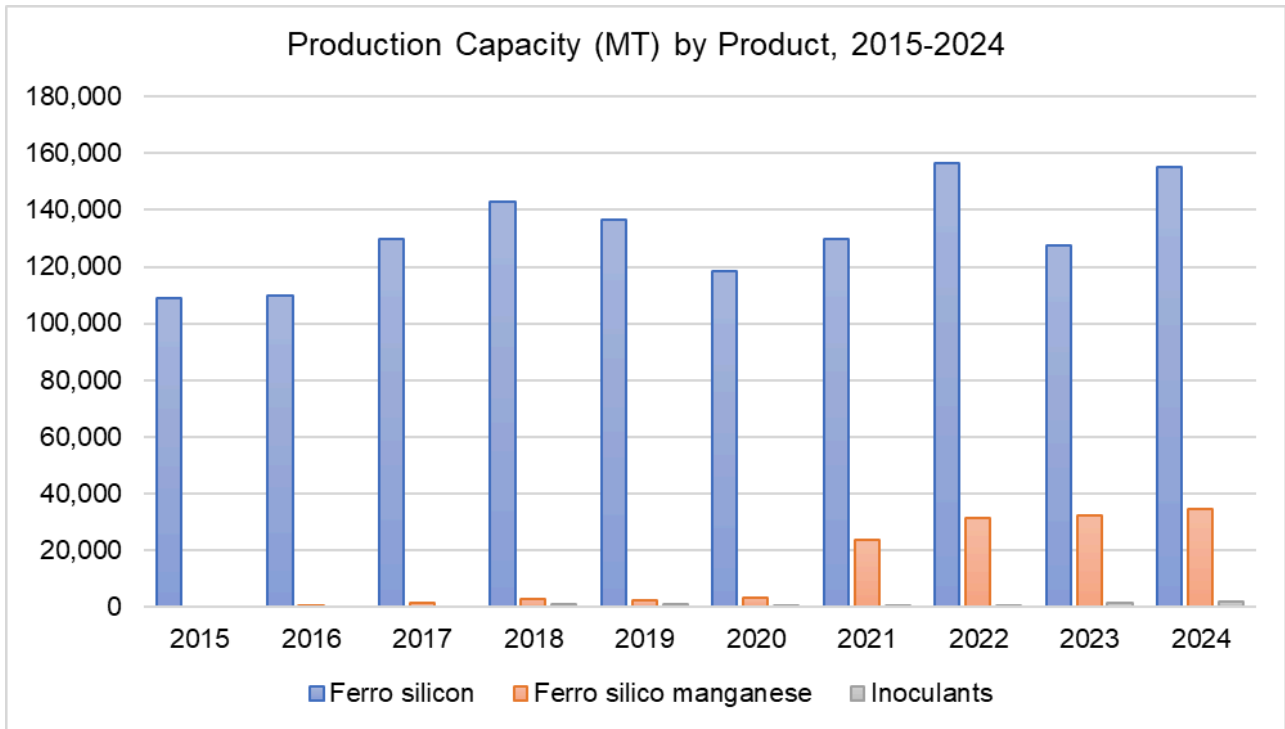
In terms of product composition, ferro silicon overwhelmingly dominates Bhutan’s ferroalloy industry, accounting for an average annual production of about 131,504 MT over the past decade which is 90.39% of the total output. In comparison, ferro silico manganese contributed a much smaller share, averaging 13,317 MT annually, which represents 9.15% of production. Inoculants remain a minor product line, with an average of just 668 MT per year, equivalent to 0.46% of total output, as seen in the graph below.

Figure 4: Average production share from 2015-2024



The following figure breakdown highlights the industry’s heavy reliance on ferro silicon as its core product, with ferro silico manganese emerging as a growing but still secondary segment, while inoculants play only a marginal role in Bhutan’s overall ferroalloy production mix. While there appears to be little diversification in the product line, it is observed that the ferro silico manganese production is growing at a rapid rate and inoculant production is also on a steady rise.

Figure 5: Production capacity by product, 2015-2024



### Key observations

- Ferro silicon has shown a generally upward but fluctuating trend. Starting at about 108,911 MT in 2015, it rose to a peak of 156,287 MT in 2022, though with notable downturns in 2019, 2020, and again in 2023 before recovering to 154,953 MT in 2024. This reflects modest but steady growth, with a compound annual growth rate (CAGR) of around 4.0 percent from 2015 to 2024.
- The notable downturn in 2020 could be attributed to lowered production during the COVID-19 pandemic. Based on primary data findings, one industry (Pelden Enterprise) stopped producing ferrosilicon from 2020 and switched to the sole production of ferro silico manganese while another industry (K.K. Steel) temporarily ceased ferro silicon production for the year, which could factor in the combined reduction in production by the overall industry.
- By 2021, ferrosilicon production picked up again. It is found that an additional ferroalloy industry (Samdrupling Metals) emerged and began operations in 2021 and the temporarily closed operations were resumed by another industry (KK Steel), which could have factored for the rise in production.
- In contrast, ferro silico manganese represents the most dynamic expansion within the sector. Introduced in 2016 with only 556 MT of capacity, its growth has been explosive, particularly after 2020. Capacity surged from just over 3,500 MT in 2020

to more than 23,500 MT in 2021, and continued expanding to 34,580 MT by 2024. This represents an extraordinary CAGR of about 67.6 percent, underscoring the industry's strategic diversification away from dependence on ferro silicon.

- Inoculants emerged later, with production capacity first recorded in 2018 at 961 MT. Although the segment experienced a temporary contraction in 2020, capacity has since expanded steadily, reaching 2,149 MT in 2024. This corresponds to a healthy CAGR of roughly 14.3 percent, reflecting gradual but consistent growth in a niche product line.

Collectively, the figures show that while ferro silicon continues to provide the foundation of Bhutan's ferroalloy production, the rapid scaling of ferro silico manganese and the steady growth of inoculants are diversifying the industry's profile. The overall trend highlights both resilience in established production and a clear trajectory of diversification that strengthens Bhutan's position in regional ferroalloy markets.

### **2.3. Price range (highest and lowest) of ferroalloys**

The price range of ferroalloys in Bhutan has shown significant fluctuations over the years, reflecting the influence of both domestic and global market conditions. As one of Bhutan's leading export commodities, ferroalloy prices are influenced by factors such as international demand, raw material availability, energy costs, and trade policies.

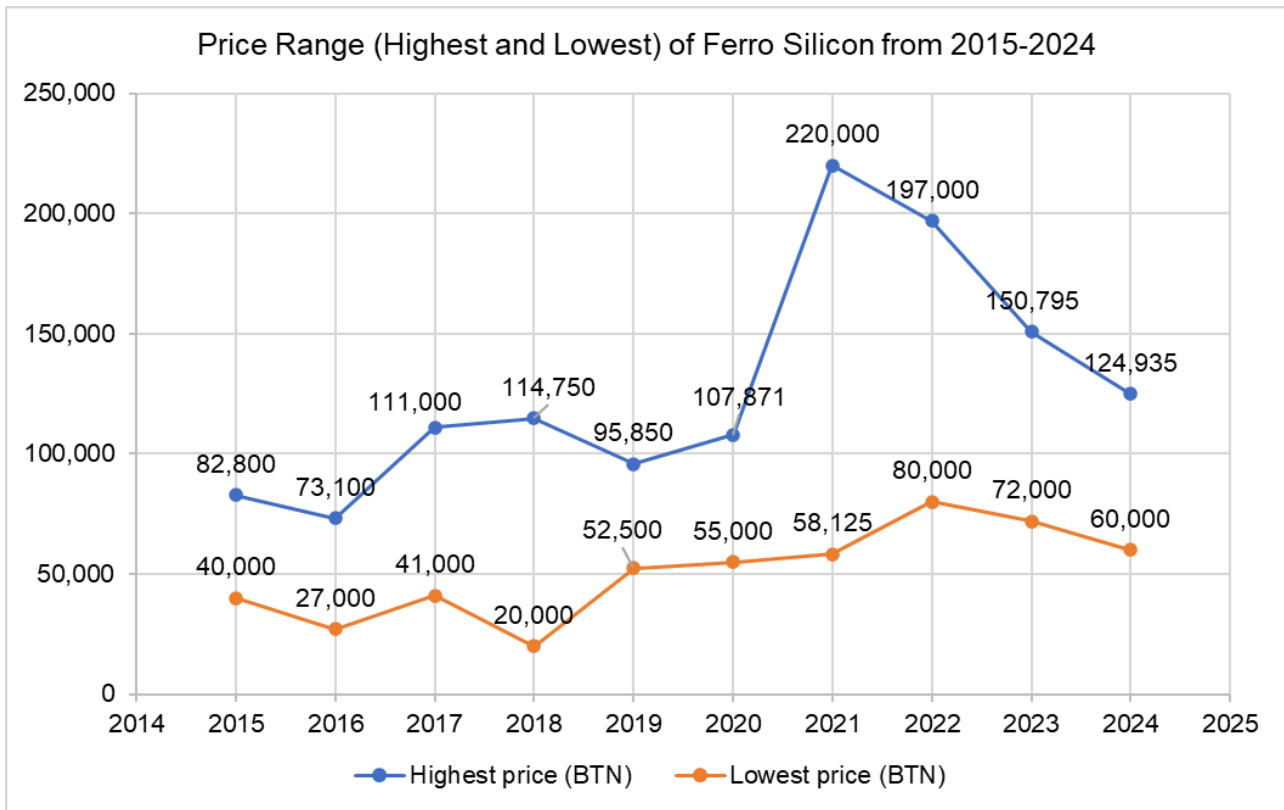
Periods of strong global steel production typically drive prices upward, while downturns in demand, rising input costs, or supply disruptions can lead to sharp declines. This volatility signifies the close link between Bhutan's ferroalloy industry and broader market dynamics, making price trends a key indicator of the sector's overall performance and competitiveness.

This report analyses the price range of the three major ferroalloy products of Bhutan's industry, which are ferrosilicon, ferro silico manganese and inoculants. The price is measured in BTN per MT.

#### **2.3.1. Ferrosilicon price range analysis (2015-2024)**

The graph below presents the highest and lowest price ranges for ferrosilicon recorded by Bhutanese industries over the past decade. The data reveals pronounced fluctuations, as the highest recorded price within the period was BTN 220,000 in 2021 and the lowest recorded price was BTN 20,000 in 2018. However, there was a trend of alternating phases of sharp escalation and correction, rather than a linear trend.

Figure 7: Price range (highest and lowest) of ferro silicon (BTN per MT) from 2015-2024



### Key observations

- There was an initial decline in the price range between 2015 and 2016 as the highest price fell from BTN 82,800 to BTN 73,100. Similarly, the lowest price fell from BTN 40,000 to BTN 27,000.
- From 2017-2018, the highest prices surged (BTN 111,000 in 2017 and BTN 114,750 in 2018), while the lowest price collapsed to BTN 20,000 in 2018, which is the decade's minimum. This unusually wide gap indicates market instability, possibly influenced by shifts in export demand or inconsistent raw material supply.
- The prices rebounded from 2019 to 2020, as the highest price stabilised around BTN 95,850 - BTN 107,871 and the lowest between BTN 52,500 - BTN 55,000, marking a relative balance compared to the extreme volatility of 2017-2018.
- In 2021, prices reached historic highs, with the maximum soaring to 220,000 and the minimum rising to 58,125. This surge coincides with global supply chain disruptions, rising energy costs, and post-pandemic recovery dynamics, which collectively pushed production costs and market demand upward.

- However, the prices gradually declined following the peak in 2021 as it came down from BTN 197,000 - BTN 80,000 range in 2022 to BTN 124,935 - BTN 60,000 in 2024. While trending downward, the price floor remains considerably higher than the pre-2021 baseline, indicating a structural shift in market fundamentals.

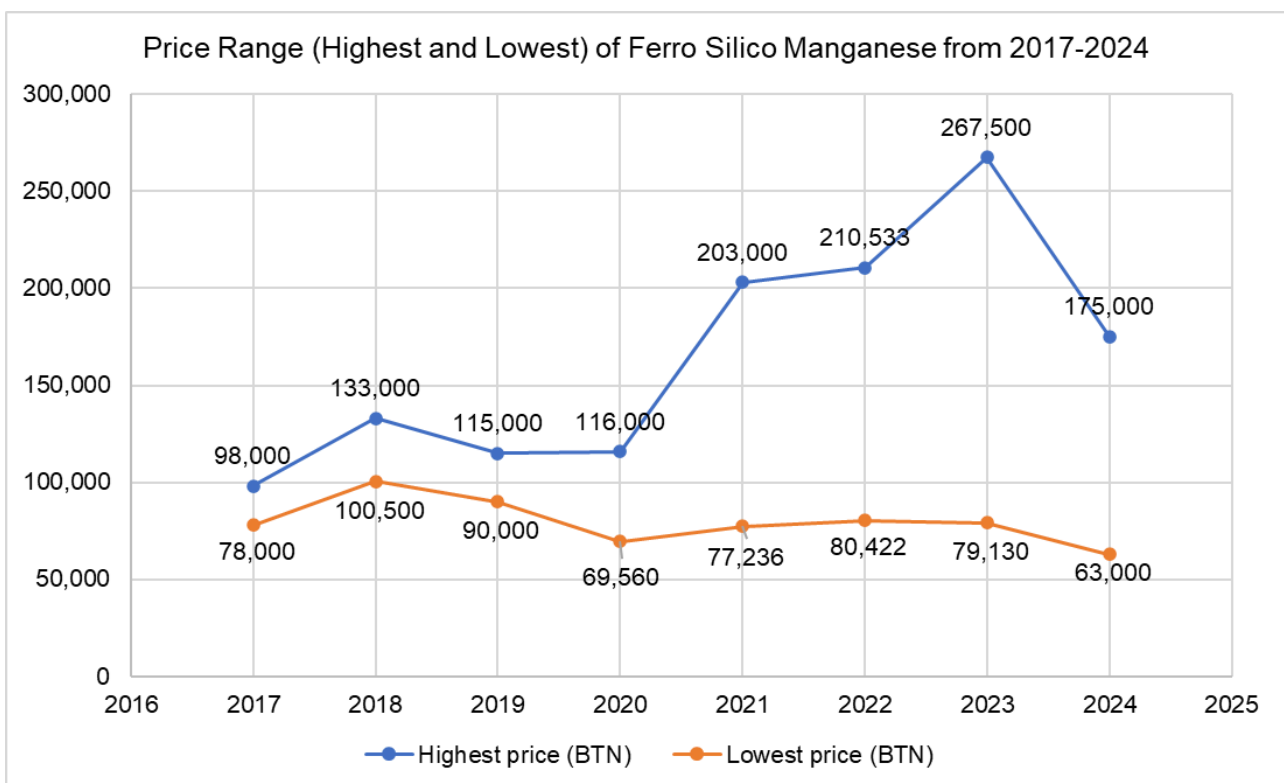
In general, greatest price stability was observed in 2015, with a relatively narrow spread of BTN 42,800 between the highest and lowest price points. The greatest volatility occurred in 2018, with a wide spread of BTN 94,750 between the highest and lowest price points. The post-2021 period suggests the establishment of a new baseline, as even the lowest prices remain elevated compared to the 2015–2020 range.

### 2.3.2. Ferro silico manganese price range analysis (2017-2024)

The following graph outlines the highest and lowest price ranges for ferro silico manganese recorded in Bhutanese industries over the past decade. As there are no records available for 2015 and 2016, the data begins from 2017.

The highest recorded price within the period was BTN 220,000 in 2021 and the lowest recorded price was BTN 20,000 in 2018. In general, the period shows a strong upward trajectory punctuated by short-term corrections.

Figure 8: Price range (highest and lowest) of ferro silico manganese (BTN per MT) from 2017-2024



## Key observations

- Strong early growth in prices is observed for ferro silico manganese as the highest price rose sharply from BTN 98,000 in 2017 to BTN 133,000 in 2018 and the lowest price increased from BTN 78,000 in 2017 to BTN 100,500 in 2018. The parallel rise in both ranges indicates strengthening demand and relatively stable market conditions.
- In 2019, the prices fell with the highest at BTN 115,000 and the lowest at BTN 90,000. Although the highest price slightly recovered to BTN 116,000 in 2020, the lowest dropped significantly to BTN 69,560.
- Prices spiked markedly in 2021, with the highest jumping to BTN 203,000, while the lowest was BTN 77,236.
- The uptrend continued in 2022, with the highest at BTN 210,533 and the lowest at BTN 80,422. These levels could indicate strong international demand, rising raw material costs, and energy price escalations during the global recovery period.
- The market reached its peak in 2023, with the highest price hitting BTN 267,500, which was the decade's maximum price, while the lowest remained elevated at BTN 79,130.
- By 2024, prices corrected significantly with the highest falling to BTN 175,000 and the lowest to BTN 63,000, the lowest point in the recorded series. This decline suggests easing global prices, possible oversupply, or moderated demand in key export markets.

In summary, the key insights show that the strongest stability occurred in 2017–2018, when both high and low prices rose simultaneously, minimizing volatility. The greatest volatility was observed in 2023–2024, with a dramatic fall from the peak of 267,500 to a low of 63,000 within a single year's span.

Unlike ferrosilicon, which peaked in 2021, FeSiMn prices continued to climb until 2023 before correcting, indicating different demand cycles and market drivers for the two products. Despite the 2024 correction, the overall price ceiling (BTN 175,000) remains significantly higher than pre-2020 levels, suggesting that long-term structural shifts have raised the value baseline for ferro silico manganese.

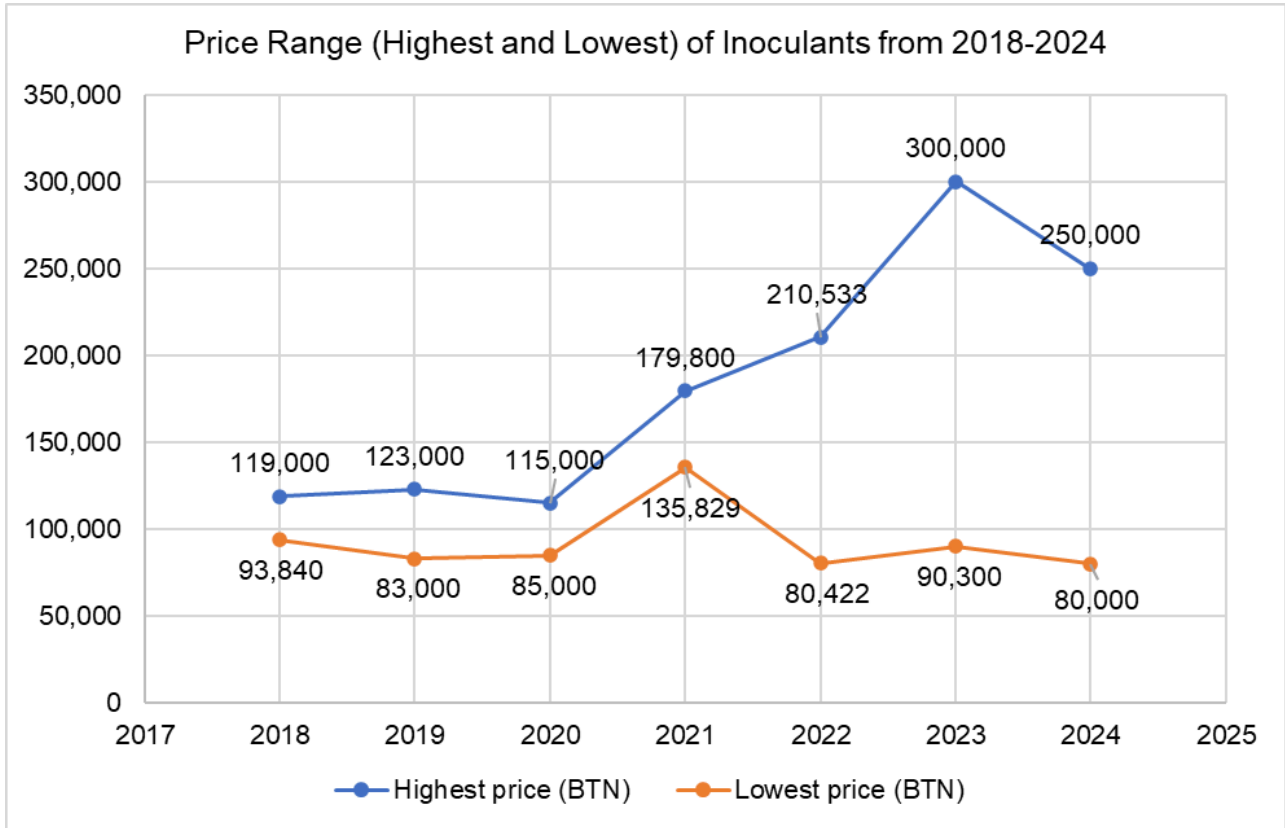
### 2.3.3. Inoculants price range analysis (2018-2024)

The following graph presents the highest and lowest price ranges for inoculants in Bhutanese industries over the past seven years. The data series begins from 2018 as that was the year the production information for inoculants became available. The highest

recorded price was BTN 300,000 in 2023, while the lowest price was BTN 80,000, observed in both 2022 and 2024.

Compared to ferrosilicon and ferro silico manganese, inoculants display a more dramatic price escalation, especially in the post-2020 period. Overall, the market for inoculants shows a pattern of steady growth, sharp spikes, and partial corrections.

Figure 9: Price range (highest and lowest) of inoculants (BTN per MT) from 2018-2024



**Key observations**

- The initial few years show stability with minor fluctuations as the highest price of BTN 119,000 for 2018 increased marginally to BTN 123,000 in 2019. Similarly, the lowest price declined from BTN 93,840 in 2018 to BTN 83,000 in 2019. The narrow price band indicates relatively stable market conditions with limited volatility.
- By 2020, the highest price fell to BTN 115,000 while the lowest price rose slightly to BTN 85,000.
- There was a strong upsurge in price in 2021, with the highest reaching BTN 179,800 and the lowest rising to BTN 135,829. The simultaneous increase in both ranges signals stronger, broad-based demand.

- The following years witnessed exceptional volatility and peak. A significant gap in price range was seen in 2022 where the highest price jumped to BTN 210,533, while the lowest fell sharply to BTN 80,422, reflecting widening price disparities and supply-demand imbalances.
- In 2023, the highest soared to BTN 300,000, the decade's peak, while the lowest stabilized at 90,300. This indicates premium pricing opportunities despite uneven baseline costs.
- By 2024, there was a partial correction of market price as the highest price declined to BTN 250,000, and the lowest returned to BTN 80,000.

In conclusion, the wide range of prices suggests continued volatility, with the market readjusting from the extraordinary highs of 2023. The greatest stability was observed in 2018–2020 where the price fluctuations remained within a narrow range. On the other hand, the greatest volatility occurred in 2022–2024 where the divergence between the highest and lowest price widened drastically, reaching as high as BTN 219,700 in 2023.

Compared to ferrosilicon and ferro silico manganese, inoculants show a sharper and more recent escalation, with peak prices achieved later (2023 vs. 2021 for ferrosilicon and 2023 for ferro silico manganese). The elevated levels of 2021–2023 suggest strong external demand drivers, possibly linked to steel industry cycles and global raw material shortages. Despite the 2024 correction, the highest price remains more than double the 2018 level, highlighting a structural upward shift in long-term value.

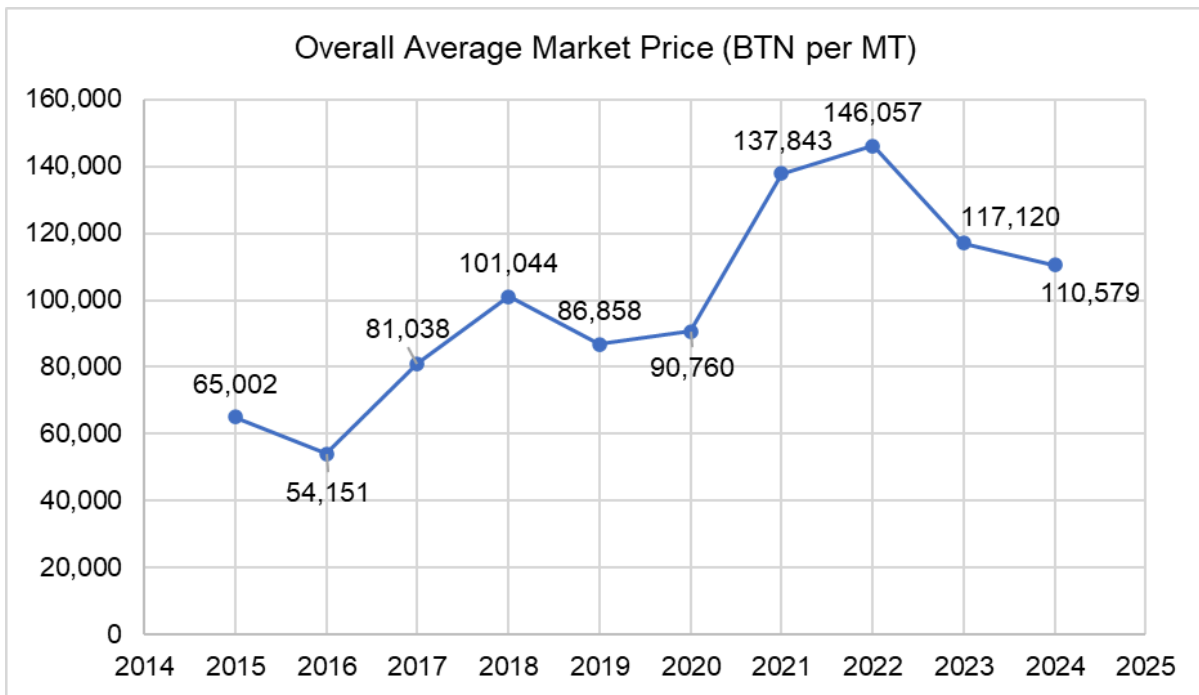
#### **2.4. Average pricing of ferroalloys**

The average market price of ferroalloys in Bhutan has shown considerable volatility over the past decade, reflecting changing market conditions and demand cycles, but there is an overall upward trend. The following figure shows the average market price for the past decade<sup>6</sup>.

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<sup>6</sup> Pricing figures (2015-2024) obtained primarily from the ferroalloy industries in September 2025

Figure 6: Average market price (BTN per MT) for 2015-2024



### Key observations

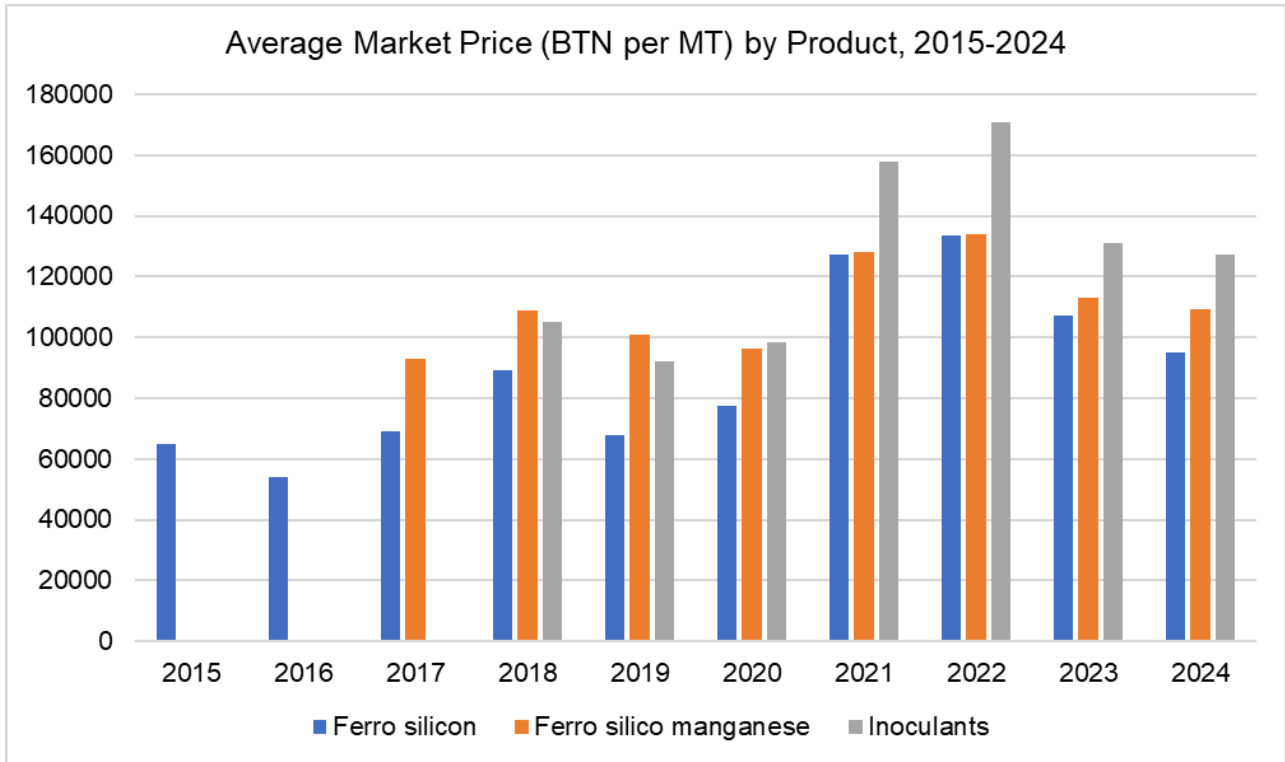
- In 2015, prices stood at about BTN 65,002, but fell sharply in 2016 to just over BTN 54,151, marking the lowest point of the decade.
- Since then, prices rebounded strongly, reaching BTN 101,044 in 2018, before reducing slightly in 2019, reaching BTN 86,858. Despite this dip, the market maintained relative stability around the BTN 85,000-90,000 range through 2019–2020.
- A sharp upward surge occurred in 2021-2022, when average prices climbed to nearly BTN 137,843 and then peaked at BTN 146,057, the highest point in the period. This spike was likely influenced by strong post-pandemic demand recovery and tight global supply.
- However, prices subsequently corrected in 2023 and 2024, falling back to BTN 117,120 and BTN 110,579, though still remaining well above earlier years.

Overall, the trend illustrates a cyclical pricing pattern with a long-term upward shift, suggesting that while ferroalloy prices are vulnerable to short-term global market fluctuations, Bhutan's producers have benefited from a substantial increase in average price levels compared to the mid-2010s.

## 2.5. Average pricing by product type

Over the past decade, pricing trends across Bhutan's ferroalloy products reveal both cyclical fluctuations and longer-term growth patterns, with notable differences between product categories. It is also observed that the average price of the products vary, with ferro silicon being priced lower than ferro silico manganese and inoculants.

Figure 10: Average market price (BTN per MT) by product for 2015-2024



### Key observations

- Ferro silicon has shown the most consistent long-term growth in value, with average prices rising from BTN 65,002 in 2015 to BTN 95,196 in 2024, reflecting a compound annual growth rate (CAGR) of 4.3 percent. This steady growth highlights its sustained demand and market resilience.
- Ferro silico manganese has consistently commanded higher prices over ferro silicon, starting at BTN 93,000 in 2017 (recorded available from that year) and reaching BTN 109,189 in 2024. However, its CAGR of 2.3 percent indicates more modest long-term growth, suggesting relative price stability despite short-term surges in 2021–2022.
- Inoculants, recorded from 2018, have remained the highest-value product, with prices peaking at BTN 170,666 in 2022 before moderating to BTN 127,353 in 2024.

Their CAGR of 3.3 percent underscores steady but less aggressive growth compared to ferro silicon.

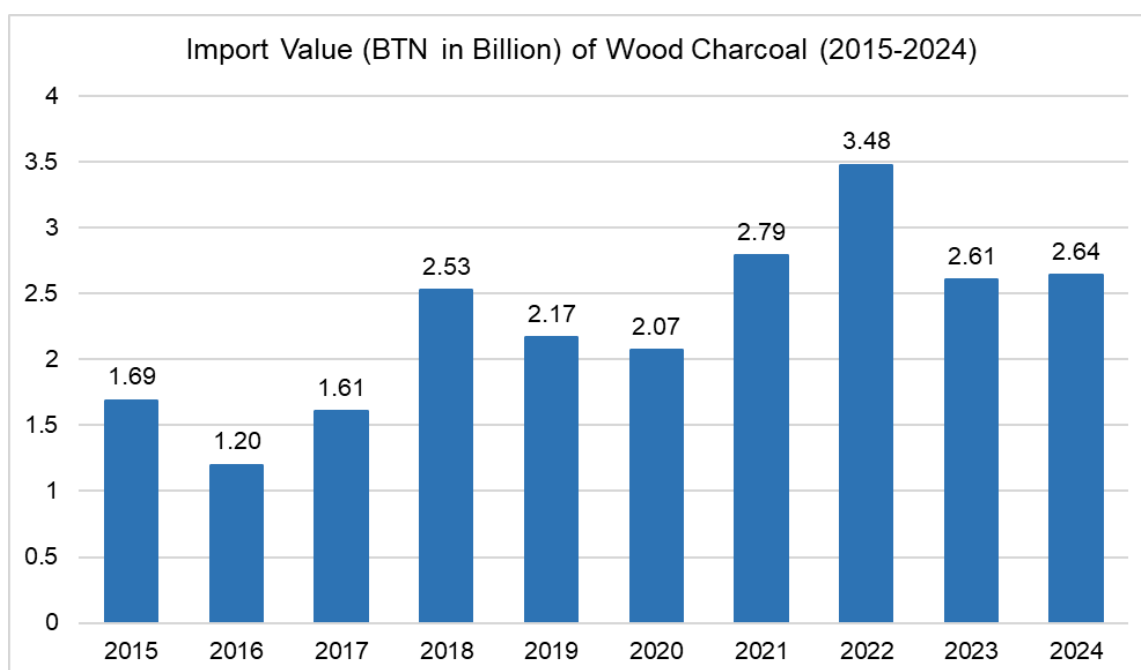
The data reveals a clear hierarchy in pricing, with inoculants leading as the most valuable niche product, ferro silico manganese occupying a mid-range position, and ferro silicon forming the price floor yet showing the strongest sustained growth momentum. This dynamic indicates both product diversification and differentiated value pathways within Bhutan's ferroalloy industry.

## 2.6. Raw material consumption

Ferroalloy production is resource-intensive and structurally dependent on energy and imported carbon materials. While the energy for Bhutan's ferroalloy industry is relatively low cost with hydropower, major raw materials components such as high quality quartz and charcoal are generally imported from India. As per the manufacturers, Indian quartz is preferred to domestic quartz owing to its superior quality and low slag generation. However, the industry has faced recurring shortages and cost escalations of Indian quartz, notably in 2017 when the West Bengal government closed down illegally operated mines in Bankura<sup>7</sup>.

Charcoal is another primary raw material for the ferroalloy industries that acts as a reducing agent during production. It remains one of the top imported commodities for Bhutan, as seen in the following figure, increasing from BTN 1.69 billion in 2015 to BTN 2.63 billion in 2024, peaking at BTN 3.47 billion in 2022 before coming down in 2023.

Figure 11: Import of wood charcoal (BTN in Billion), 2015-2024



<sup>7</sup> Business Bhutan. (2017). *Ferrosilicon industries face raw material shortage*.

The sustainability of raw materials is a defining challenge for Bhutan’s ferroalloy sector as heavy reliance on foreign sources exposes industries to supply disruptions, transport bottlenecks, and cost volatility.

### 3. Export trend analysis (2015-2024)

#### 3.1. Overall export performance

Bhutan’s ferroalloy exports have expanded significantly in the past decade, showcasing a gradual upward trend and accounting for more than 40% of the country’s total exports. Although there were periods of volatility, the exports grew steadily at a positive CAGR. From 2015 to 2024, the export volumes grew from about 105,000 MT to over 196,500 MT, while the export values rose from BTN 7.06 billion to BTN 18.58 billion<sup>8</sup>. Interestingly, while the volume of exports dipped in 2019-2020, it rebounded strongly from 2021 onward, with export values peaking at BTN 19.59 billion in 2022.

The detailed export figure is given in the following table.

Table 3: Ferroalloy export from 2015-2024

Year	Quantity (MT)	Value (BTN billion)	Rise or Decline (%) in Quantity	Rise or Decline (%) in Value
2015	105,448.99	7.06	-	-
2016	112,882.72	6.88	7.05	-2.55
2017	161,430.02	9.82	43.01	42.73
2018	209,735.18	13.56	29.92	38.09
2019	151,328.43	10.24	-27.85	-24.48
2020	108,023.60	7.95	-28.62	-22.36
2021	154,123.52	18.03	42.68	126.79
2022	149,482.05	19.59	-3.01	8.65
2023	169,179.56	17.13	13.18	-12.56
2024	196,485.31	18.58	16.14	8.46

#### Key observations

- The export performance of Bhutan’s ferroalloy industry over the past decade shows significant fluctuations in both quantity and value, closely tied to market dynamics and global demand.

<sup>8</sup> Export figures sourced from *Bhutan Trade Statistics 2015-2024*.

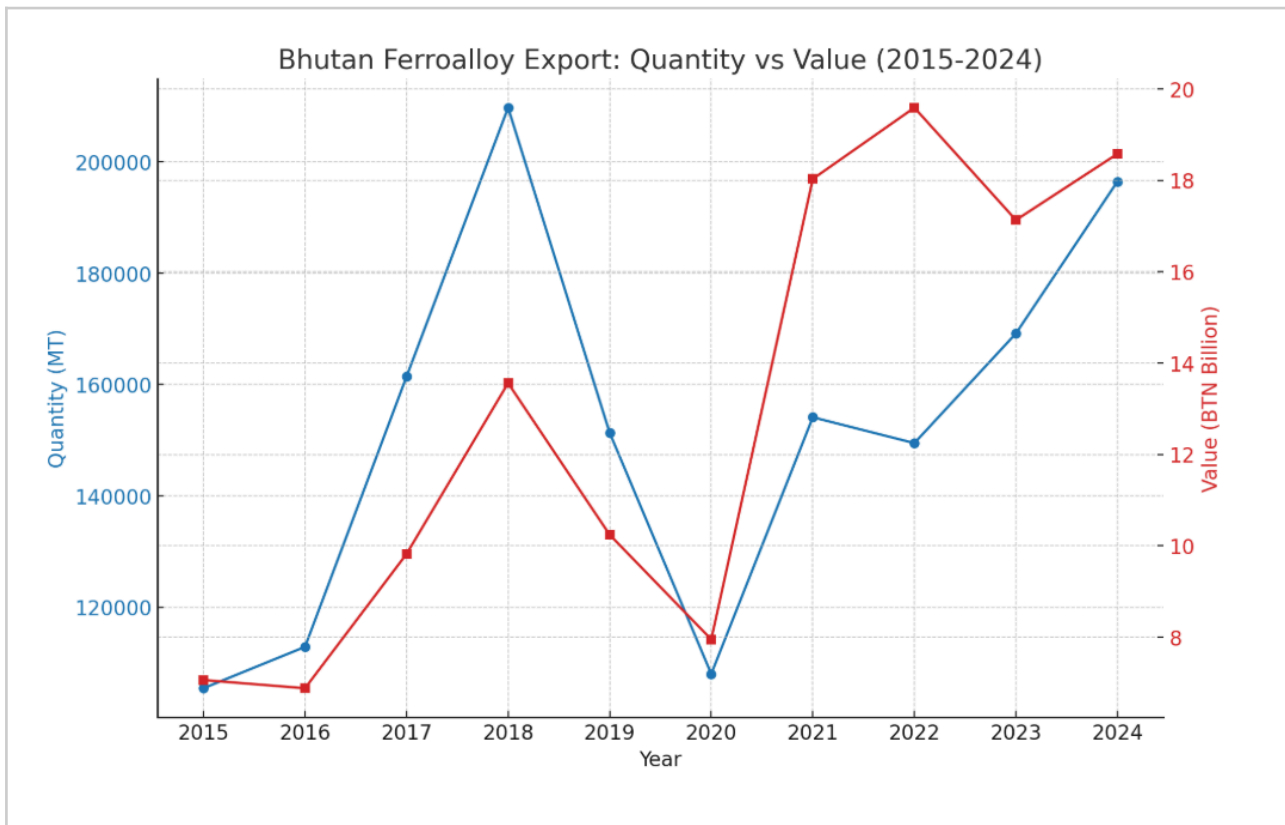
- In 2015, Bhutan exported 105,449 MT worth BTN 7.06 billion, which serves as the base year. Exports gradually increased in 2016, with a 7.05% rise in quantity, though the export value decreased slightly by 2.55%, showing that despite more quantity being exported, the value earnings were less, probably owing to lower pricing of the products.
- A strong upward trend followed in 2017 and 2018, with export quantities growing by 43.01% and 29.92%, while values surged by 42.73% and 38.09%, respectively, reflecting a period of robust market demand where the products attained competitive prices.
- However, 2019 and 2020 marked a downturn, with export quantities declining by 27.85% and 28.62%, and values falling by 24.48% and 22.36%, pointing to weakened global ferroalloy markets.
- A dramatic rebound occurred in 2021, when export volume rose by 42.68%, but more strikingly, export value jumped by 126.79%, suggesting a sharp increase in international prices.
- In 2022, export quantities slightly declined (-3.01%) but values still grew (8.65%), before facing another adjustment in 2023 with a 13.18% rise in volume but a 12.56% fall in value.
- By 2024, the industry recovered again, with quantities increasing by 16.14% to nearly 196,485 MT, and values improving by 8.46% to BTN 18.58 billion.
- Overall, the data highlights the volatility of ferroalloy exports, where export value is not always proportional to volume, reflecting the strong influence of global pricing trends and demand shifts on Bhutan's export earnings.

### **3.2. Relationship between export volume and value**

A comparison of the growth trajectory of export quantity and value illustrates that the export value does not always correspond to the fall and rise in export quantity. This highlights the importance of market pricing and product composition, as sometimes the market forces drive the price up and certain product compositions fetch higher prices per unit.

The following figure shows a visual representation of Bhutan's ferroalloy exports from 2015 to 2024, showing both quantity (MT) in blue and value (BTN in billion) in red.

Figure 12: Quantity (MT) vs value (BTN in billion) of ferroalloy export



### Key observations

- The chart clearly shows the overall upward trend in both quantity and value.
- From 2015 to 2018, both quantity and value rose together, reflecting stable prices and product composition.
- In 2019-2020, quantity and value both dropped proportionally, showing the expected correlation.
- From 2021 onward, value grew faster than quantity, peaking in 2022 despite lower volumes, pointing to stronger pricing or higher-value products.
- In 2023, quantity increased but the value fell, highlighting a temporary price correction, before both increased proportionately by 2024.

In summary, while Bhutan's ferroalloy exports show a clear long-term growth in both quantity and value, the relationship between the two is not perfectly linear. The anomalies, especially in 2021–2023, suggest market prices significantly influence export value, not just export volume.

### **3.3. Growth rate of export (CAGR vs AAGR)**

The expansion of Bhutan's ferroalloy export can be further assessed by computing its Compound Annual Growth Rate (CAGR) and Average Annual Growth Rate (AAGR), as shown in the following sections.

#### **3.3.1. Compound Annual Growth Rate (CAGR)**

The CAGR provides a measure of the average yearly growth over a period of time, smoothing out short-term fluctuations and offering a clearer picture of long-term trends in export performance. The ferroalloy export volumes grew at a CAGR of 7.16% on average, rising from about 105,000 MT in 2015 to over 196,500 MT in 2024.

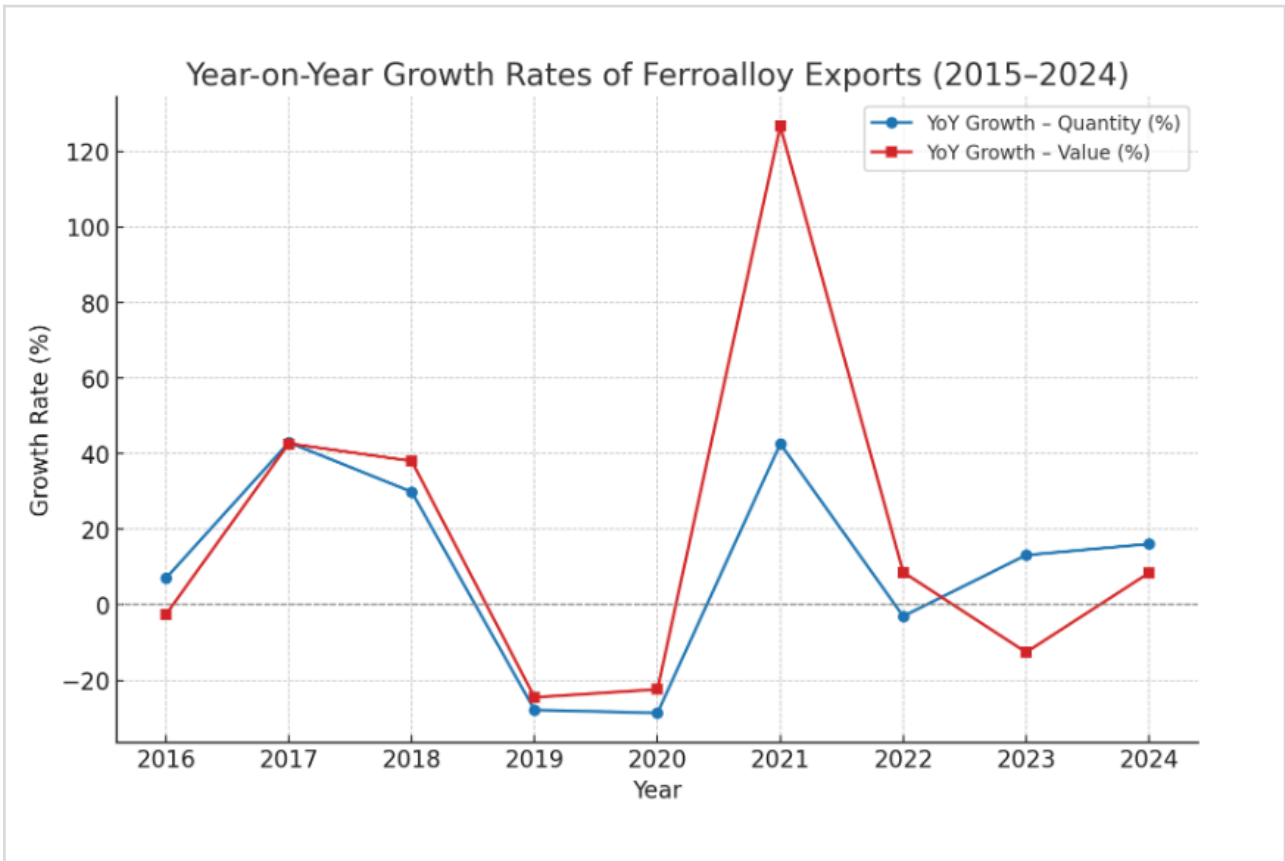
Similarly, export earnings increased even more rapidly, at a CAGR of 11.35%, growing from BTN 7.06 billion in 2015 to BTN 18.58 billion in 2024. This suggests a steady and sustainable long-term expansion of both export volume and earnings, with values rising faster than volumes due to favourable export prices and higher unit values.

#### **3.3.2. Average Annual Growth Rates (AAGR)**

Unlike CAGR, which smooths growth over time, the Average Annual Growth Rate (AAGR) captures the simple year-to-year average change, making it more sensitive to short-term fluctuations and market volatility. Between 2015 and 2024, export quantity grew at an average of 10.28% per year, while value grew at an average of 18.09% per year. This higher figure reflects the sharp year-to-year swings, such as the 2019–2020 downturn and the strong rebound in 2021–2022. Furthermore, this highlights high volatility, signaling that the sector is vulnerable to external shocks (such as price fluctuations and demand cycles in global steel markets).

The following graph illustrates the year-on-year (YoY) growth rates of Bhutan's ferroalloy exports (2016–2024), showing both export quantity (blue line) and export value (red line).

Figure 13: Year-on-year growth rate of ferroalloy export



### Key observations

- The above figure shows that the export values grew at a higher rate yearly than the export volume, experiencing a sharp spike in 2021. On the other hand, the export volumes experienced a comparatively lower yet steady growth rate.
- The year-on-year growth rates of ferroalloy exports between 2016 and 2024 reveal a highly volatile trend in both quantity and value. Exports grew steadily from 2016 to 2018, with growth peaking above 40% in 2017.
- However, 2019 and 2020 marked a sharp downturn, as both quantity and value recorded negative growth.
- A strong rebound followed in 2021, particularly in export value, which surged by more than 120% compared to a 42% increase in quantity, suggesting that global price movements played a significant role in boosting revenues beyond physical export volumes.
- From 2022 onward, growth in export quantity slowed, with near stagnation in 2022, a decline in 2023, and only modest positive recovery in 2024. Overall, while export volumes have shown fluctuations, export values remain more volatile, reflecting sensitivity to international price shifts in ferroalloys.

In a nutshell, the CAGR indicates that Bhutan’s ferroalloy export market has solid long-term growth potential, making it an attractive sector for investment and policy support. The AAGR, however, highlights high volatility in export quantity and value, signaling that the sector is vulnerable to external shocks (such as price fluctuations and demand cycles in global steel markets). Therefore, these indicators suggest that while Bhutan’s ferroalloy sector holds significant growth potential, its volatility poses challenges for predictable revenue generation, making stability-enhancing policies essential.

### 3.4. Export market composition by country/region

#### 3.4.1. Exports to India vs countries other than India (COTI)

India is the main export destination of ferroalloys from Bhutan, constituting 91.55% of the total ferroalloy export on average in the past ten years. India has remained Bhutan’s dominant ferroalloy market, consistently absorbing the bulk of exports exceeding 87% each year. Export quantities to India increased from 96,353 MT in 2015 to 174,883 MT in 2024, reflecting an overall upward trend despite some fluctuations. The value of exports also grew from BTN 6.36 billion in 2015 to BTN 16.37 billion in 2024, with a sharp jump in 2021–2022 corresponding to strong market demand and high global prices.

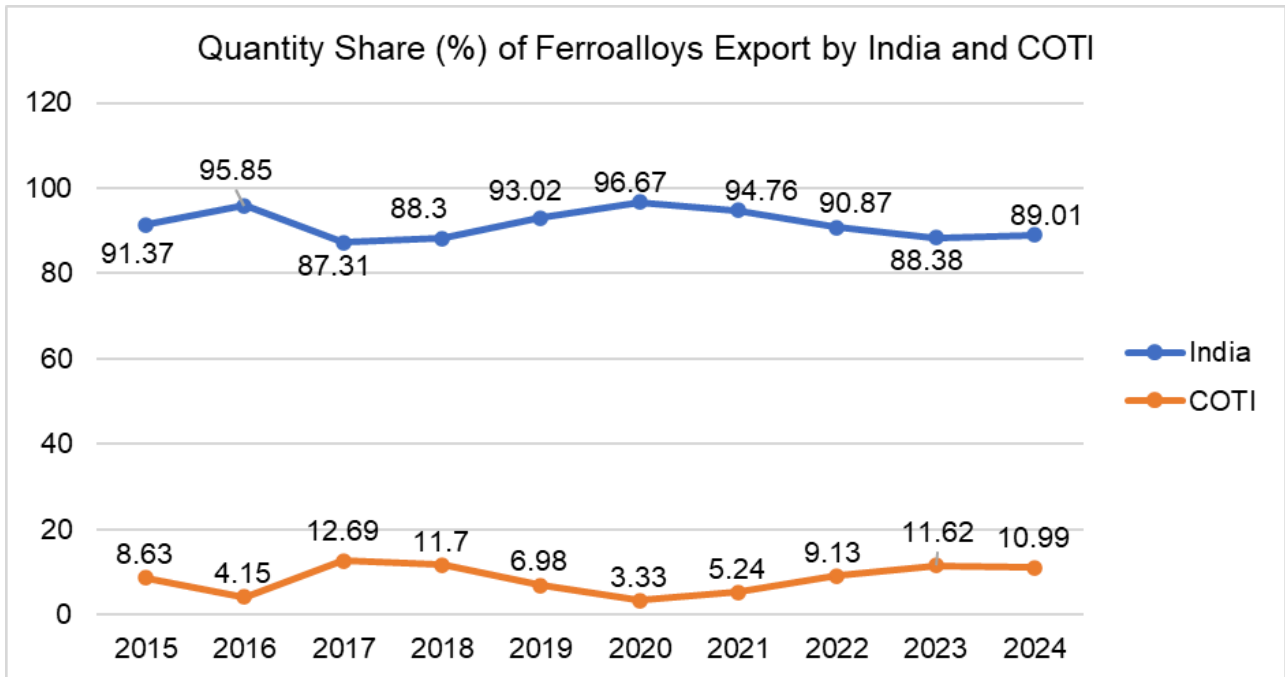
Table 4: Export composition by India and countries other than India (COTI)

	India			Country Other Than India (COTI)		
Year	Quantity (MT)	Value (BTN in billion)	% of Qty Export	Quantity (MT)	Value (BTN in billion)	% of Qty Export
2015	96,352.99	6.36	91.37	9,096	0.7	8.63
2016	108,196.86	6.57	95.85	4,685.86	0.3	4.15
2017	140,937.12	7.91	87.31	20,492.9	1.91	12.69
2018	185,190.31	9.96	88.30	24,544.87	3.6	11.70
2019	140,763.51	9.34	93.02	10,564.92	0.9	6.98
2020	104,423.00	7.65	96.67	3,600.60	0.29	3.33
2021	146,054.52	16.85	94.76	8,069	1.17	5.24
2022	135,838.32	17.32	90.87	13,643.74	2.28	9.13
2023	149,525.44	14.68	88.38	19,654.11	2.45	11.62
2024	174,882.91	16.37	89.01	21,602.40	2.22	10.99
<b>Average</b>	<b>138216.50</b>	<b>11.30</b>	<b>91.55</b>	<b>13595.44</b>	<b>1.58</b>	<b>8.45</b>

### 3.4.2. Share of ferroalloy exports to India (quantity and value)

India remains the primary destination, accounting for nearly nine out of every ten tonnes of Bhutan's ferroalloy exports. COTI exports, though smaller, are growing in significance, providing Bhutan with a hedge against overreliance on India. The trends suggest an opportunity for Bhutan to strategically expand COTI markets to stabilize revenues and reduce vulnerability to India-specific demand and pricing cycles.

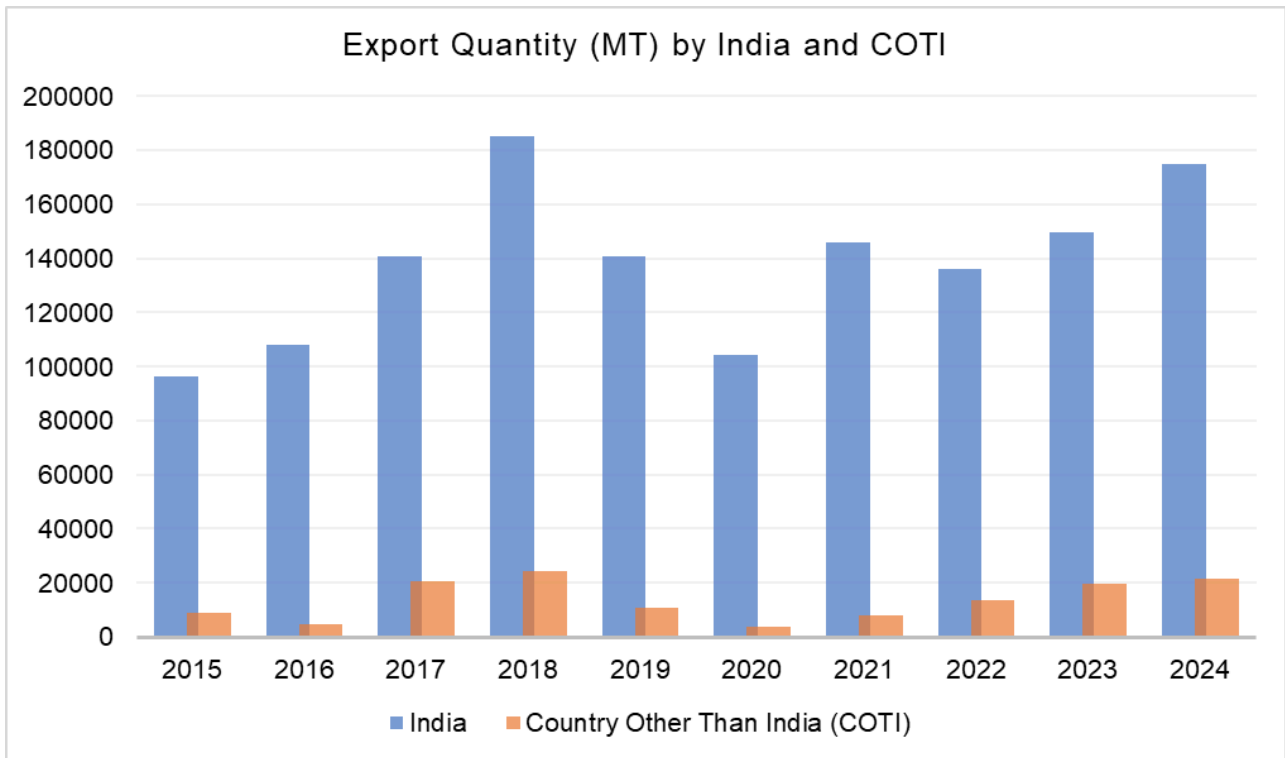
Figure 14: Comparison of India and COTI's quantity share of ferroalloys export (in%)



#### Key observations

- The share of exports to India peaked in 2020 at 96.67%, but gradually declined to 89.01% in 2024, suggesting a slight diversification towards other markets in recent years.
- Overall, India continues to be the anchor market, though reliance remains high, exposing Bhutan to demand and price risks linked to Indian consumption trends.
- COTI markets have historically been minor but increasingly important, with fluctuating shares between 3% and 13% of total exports. In the past decade, it constituted 8.45% of the total export on average.

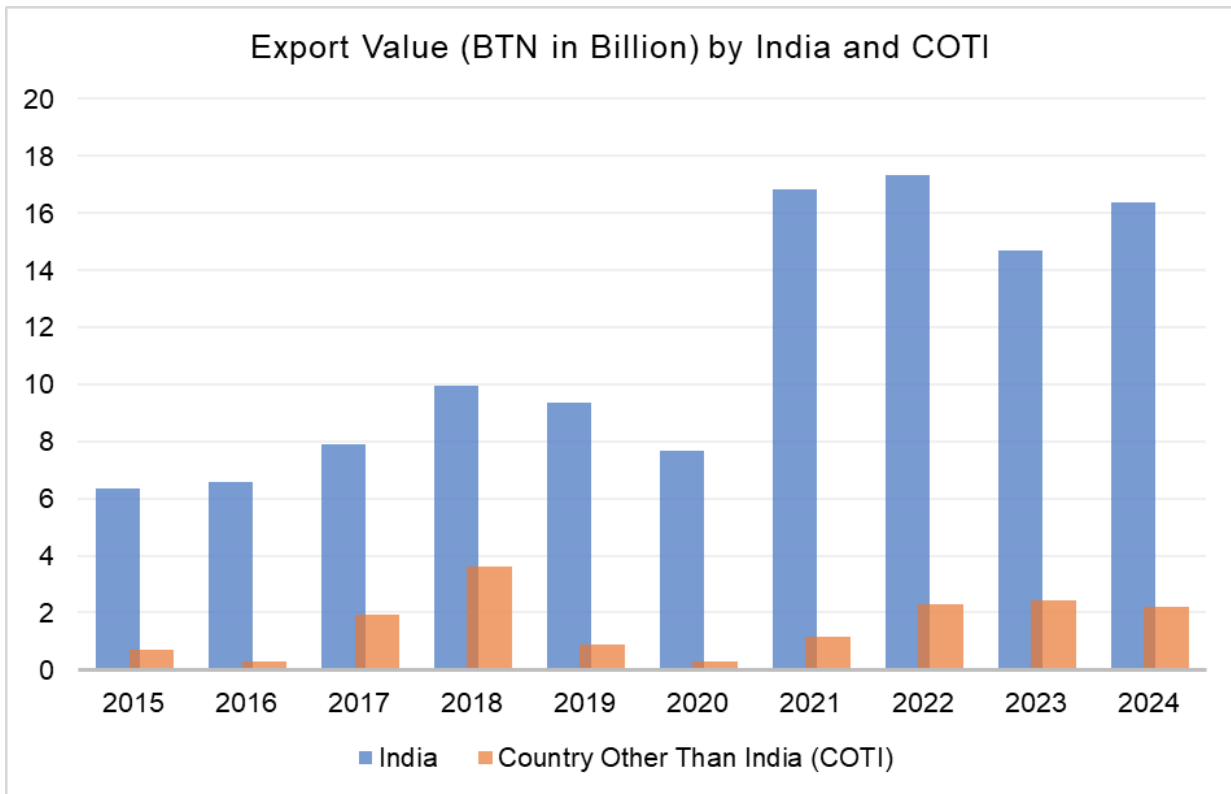
Figure 15: Export quantities to India vs COTI (2015-2024)



### Key observations

- Exports to India dominate overwhelmingly, averaging over 130,000 MT per year.
- COTI exports are much smaller in scale (mostly under 25,000 MT) but have shown growth in recent years, especially 2022–2024.
- Export quantities rose from 9,096 MT in 2015 to 21,602 MT in 2024, indicating gradual diversification despite volatility.
- Export value increased from BTN 0.70 billion in 2015 to BTN 2.22 billion in 2024, with notable peaks in 2017–2018 and 2022–2023 as Bhutan tapped into additional markets.
- Shares dropped to a low of 3.33% in 2020 but have since recovered, reaching around 11% in 2023–2024.
- The gap between India and COTI remains wide, but the rising orange bars in the last three years suggest a gradual diversification trend.
- This indicates that while India dominates, Bhutan is slowly building a secondary export base, which can help reduce dependence on a single market.

Figure 16: Export values to India vs COTI (2015-2024)



**Key observations**

- India consistently accounts for the bulk of export earnings, ranging from BTN 6 to 17 billion annually in the last decade.
- COTI’s contribution is small but not negligible: it peaked at BTN 3.6 billion in 2018 and remained above BTN 2 billion from 2022–2024, showing some resilience.
- Similar to quantity, the revenue gap between India and COTI is large, but the recent stability of COTI’s export value indicates a growing secondary market that helps reduce dependence on India.

**3.4.3. Growth rate of exports: India vs COTI**

An analysis of Bhutan’s ferroalloy export growth patterns reveals important differences between India and countries other than India (COTI). Exports to India grew at a compound annual growth rate (CAGR) of 6.8% in quantity and 11.1% in value between 2015 and 2024, reflecting steady long-term expansion. The average year-on-year (YoY) growth rates were slightly higher at 7.6% for quantity and 12.4% for value, indicating moderate fluctuations but overall stability in India-bound exports.

By contrast, COTI exports, though much smaller in scale, displayed faster growth. It grew at a CAGR of 9.7% in quantity and 13.1% in value over the same period. Their average

YoY growth was much higher, at 21.8% for quantity and 25.6% for value, indicating significant volatility and irregular market penetration. These findings suggest that while India remains Bhutan's primary market providing relative stability, COTI markets represent a high-growth but more unpredictable diversification opportunity that could be strategically nurtured to reduce overreliance on India.

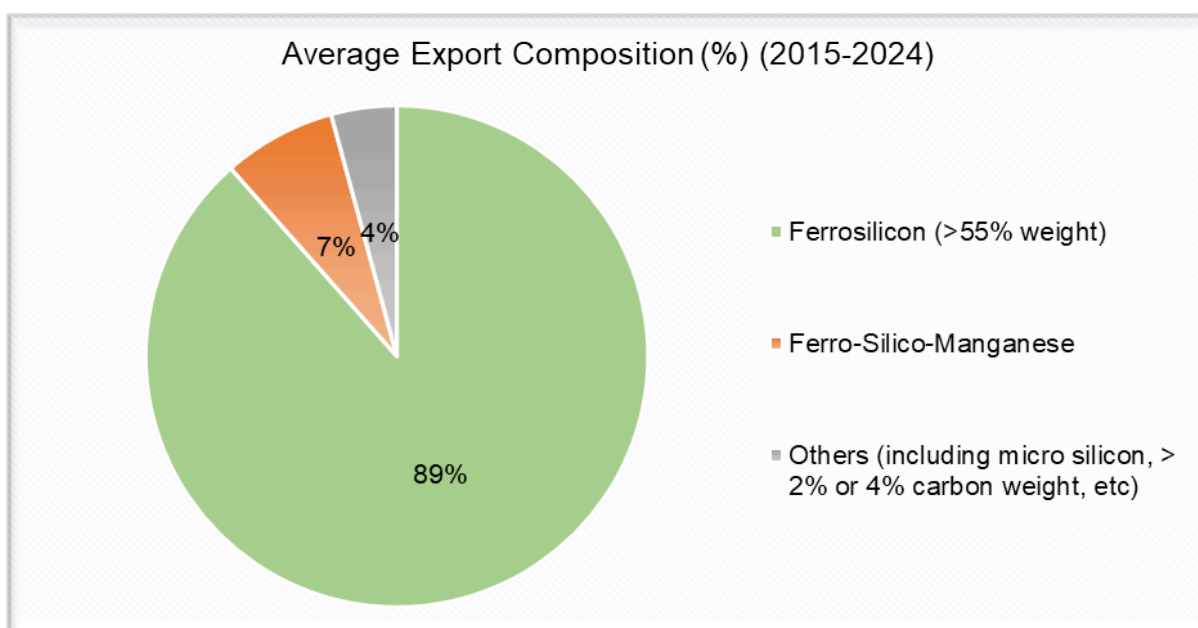
Beyond the dominant Indian market, Bhutan's ferroalloy exports have shown encouraging diversification. Strong growth trends are evident across Europe, particularly in Italy, the Netherlands, the United Kingdom, Spain, and Germany. Furthermore, since 2022, significant export growth has been seen in South Korea, the United Arab Emirates, the United States and Canada, signaling the emergence of new and expanding markets in the Asia-Pacific and North American regions.

### 3.5. Export by product composition

#### 3.5.1. Ferroalloy export product types

Bhutan's ferroalloy export is composed of three major types of ferro products, namely, ferrosilicon with more than 55% weight (>55%), ferro silico manganese, and other ferroalloys that also include microsilicon and alloys with more than 2% or 4% carbon content. In the last decade, ferrosilicon (>55%) dominated the export mix by accounting for 88.49% of the total exports, followed by ferro silico manganese making up for a much smaller share at 7.29%, while other ferroalloys constituted only 4.22%.

Figure 17: Average product composition of ferroalloy export (2015-2024)

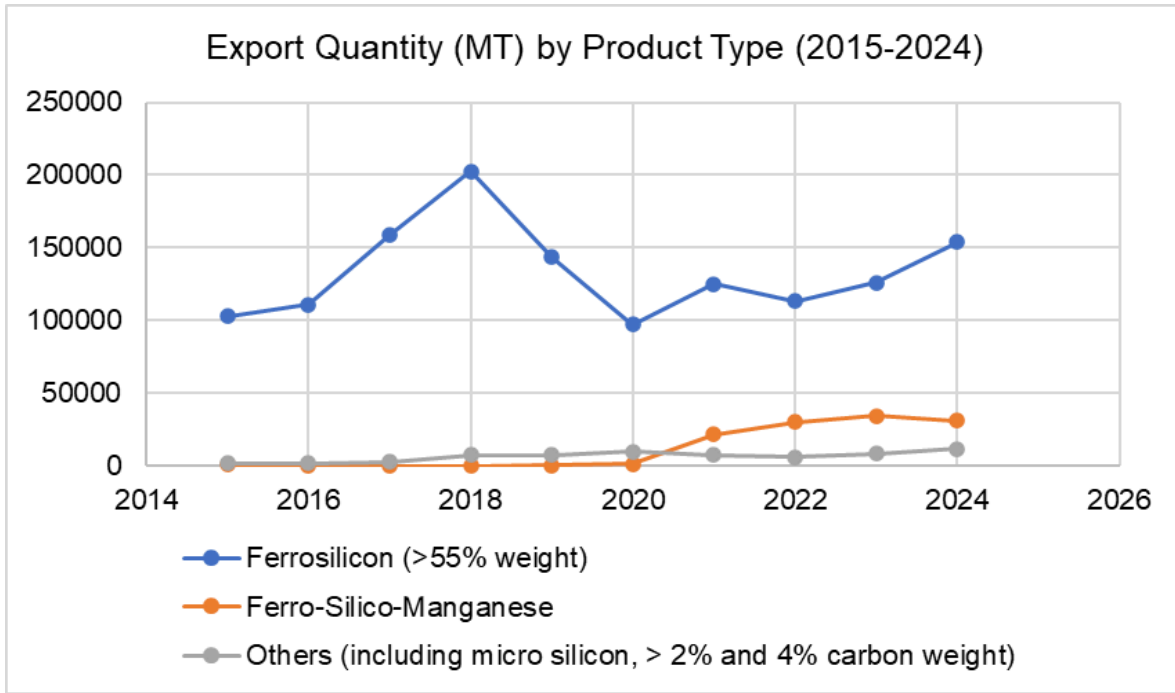


Overall, the chart highlights that Bhutan's ferroalloy exports are heavily concentrated in high-grade ferrosilicon, with minimal diversification into other ferroalloy types.

### 3.5.2. Breakdown of export product composition

Bhutan’s ferroalloy exports are primarily dominated by high-grade ferrosilicon, but there has been a clear increase in the export of ferro silico manganese and other ferroalloys since 2020, suggesting a gradual diversification and expansion of export offerings, as seen in the following figure.

Figure 18: Volume of export by product type



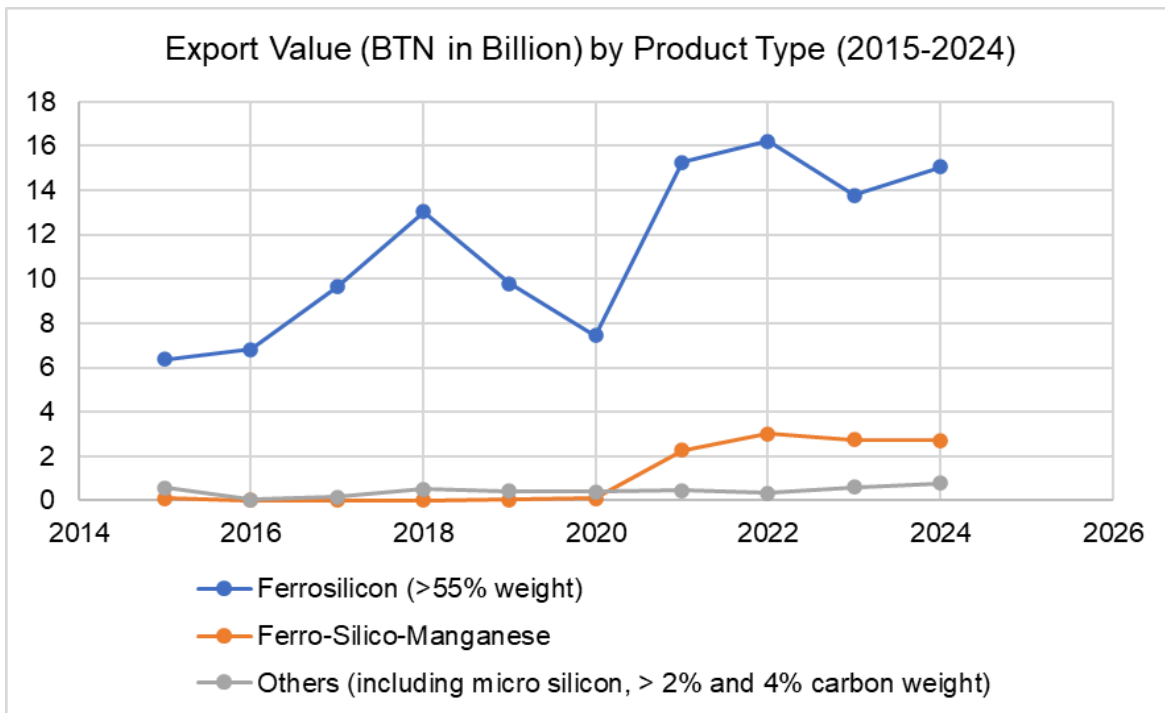
#### Key observations

The figures show the export trends of Bhutan’s ferroalloys by type from 2015 to 2024.

- Ferrosilicon (>55% weight) dominates exports throughout the period. Its export quantity rose from 102,724 MT in 2015 to 153,771 MT in 2024, showing significant growth overall. The exports peaked in 2018 (202,386 MT), then dipped in 2019–2020, before recovering steadily in subsequent years.
- Ferro silico manganese shows a much more variable trend. Exports were minimal in the early years, almost disappearing in 2018 (0 MT), but then surged dramatically from 1,237 MT in 2020 to 34,443 MT in 2023, stabilizing slightly at 31,275 MT in 2024.
- Other ferroalloys (including micro silicon and high-carbon alloys) also show fluctuations. Exports grew from 1,810 MT in 2015 to 11,439 MT in 2024, with notable peaks in 2018–2020, indicating increasing diversification of Bhutan’s ferroalloy export portfolio over time.

Likewise, the figure below shows the export value of Bhutan's ferroalloys by product from 2015 to 2024, measured in BTN billion.

Figure 19: Value of export by product type



### Key observations

- Ferrosilicon (>55% weight) consistently accounts for the largest share of export value. Its value increased from BTN 6.37 billion in 2015 to BTN 15.06 billion in 2024, with a peak in 2022 (BTN 16.22 billion). There were notable dips in 2019 (BTN 9.79 billion) and 2020 (BTN 7.45 billion), likely reflecting reduced export volumes in those years.
- Ferro silico manganese contributes a relatively small share initially but shows a sharp rise after 2020, growing from almost negligible values (BTN 0.01-0.11 billion) in 2015-2020 to over BTN 2.7-3.0 billion in 2021-2024. This indicates increasing market value and demand for this product.
- Other ferroalloys remain a minor portion of export value, fluctuating between BTN 0.03 billion and 0.8 billion over the period, showing slow but gradual growth.
- Therefore, the export value is heavily dominated by ferrosilicon, mirroring the export volume trend. However, since 2021, ferro silico manganese has grown significantly in value, suggesting both diversification in product mix and stronger pricing or demand for this alloy.

### **3.5.3. Overall composition of ferroalloy export product types**

Bhutan's ferroalloy exports are heavily dominated by ferrosilicon (>55% weight) throughout the period, both in terms of quantity and value. Export volumes increased from 102,724 MT in 2015 to 153,771 MT in 2024, peaking in 2018 (202,386 MT). Correspondingly, the export value rose from BTN 6.37 billion in 2015 to BTN 15.06 billion in 2024, with the highest value observed in 2022 (BTN 16.22 billion). Temporary dips in volume and value occurred in 2019-2020, reflecting fluctuations in production or market demand.

Ferro silico manganese, initially a minor component, showed minimal exports before 2020. However, both volume and value surged sharply after 2020, with exports increasing from 1,237 MT in 2020 to 31,275 MT in 2024, and value rising from BTN 0.11 billion to around BTN 2.7 billion over the same period. This indicates growing production, demand, and market significance.

Other ferroalloys, including micro silicon and high-carbon alloys, remain a smaller part of the export portfolio. Their volume grew from 1,810 MT in 2015 to 11,439 MT in 2024, and value increased gradually from BTN 0.58 billion to BTN 0.8 billion, suggesting slow but steady diversification.

Overall, Bhutan's ferroalloy exports are strongly centered on high-grade ferrosilicon, but there is a clear trend of diversification since 2020, with ferro silico manganese and other ferroalloys gaining a larger share in both volume and value. This shift points to expanding production capacity and a more varied export mix.

### **3.6. Pricing of the exported ferroalloys**

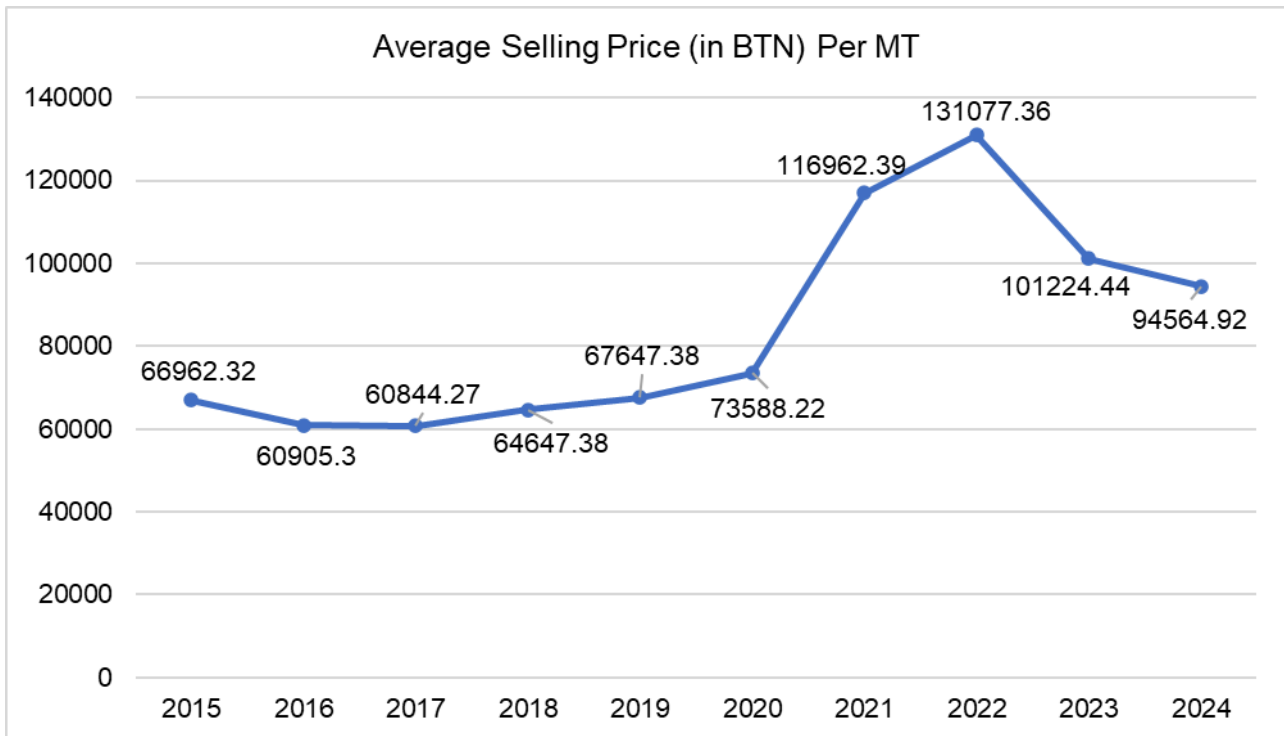
The pricing trend of the exported ferroalloys in the past decade shows initial stagnation between 2015 and 2017, a steady rise from 2018, a sharp peak in 2021-2022, followed by a slight decline in the most recent two years.

#### **3.6.1. Average selling price per ton of exported ferroalloys (2015-2025)**

The following graph presents the trend in the average selling price per ton of Bhutan's exported ferroalloys over the past decade, computed from the export value and volume.

It highlights the changes in market value of the exported ferroalloy over time, which follows the same pattern as the average market price of the ferroalloys provided by the firsthand industry accounts.

Figure 20: Average selling price (BTN) per MT for ferroalloy export



### Key observations

- From 2015 to 2017, the average price slightly declined from 66,962 BTN to around 60,844 BTN and remained almost flat at 60,844 BTN in 2017. This period shows a mild decline and relative stability, suggesting either stable global prices or consistent quality of exports.
- It then gradually increased from 2018, reaching 73,588 BTN in 2020. This period reflects a steady upward trend, indicating improving market conditions or higher-value products being exported.
- A sharp spike occurred in 2021, with the price jumping to 116,962 BTN, followed by a further rise to 131,077 BTN in 2022. This represents almost a doubling in price over two years, likely due to global supply-demand imbalances, increased international ferroalloy prices, or Bhutan exporting higher-grade alloys.
- After this peak, the average price declined over the next two years, dropping to 101,224 BTN in 2023 and 94,565 BTN in 2024.

In conclusion, the trend reflects moderate fluctuations in the early years, a dramatic surge during 2021–2022, and a slight correction in 2023–2024. This indicates a market correction or normalization after the spike, possibly due to reduced global prices or competition.

### 3.6.2. Examining the abnormal export value surge of 2021–2022

In 2021 and 2022, Bhutan's ferroalloy industry made significant revenue. The average selling price rose to 116,962 BTN per ton in 2021 and increased to 131,077 BTN per ton in 2022 despite the volume of exports being low. While that was the average selling price for the overall sector, the highest price recorded among the industries was BTN 265,000 in 2021 and BTN 235,600 in 2022.

However, it should also be noted that in the same period, the average export prices lowered to as much as BTN 58,125 in 2021 and BTN 80,000 in 2022. Similar price pattern is observed in the price data provided by the industries, as covered in earlier sections.

The following factors are considered for the abnormal export value surge:

#### 1. *Global supply chain disruptions*

COVID-19 caused lockdowns, labour shortages, and transport disruptions worldwide, particularly in major ferroalloy-producing countries like China, India, and Russia. This reduced global supply of ferroalloys, leading to higher international prices, which Bhutan could benefit from by exporting at higher rates.

#### 2. *Increased commodity prices*

During 2021-2022, metal and steel industries saw surging demand as countries tried to restart economies post-lockdowns. As ferroalloys are essential for steel production, it is likely that Bhutan benefited from rising steel prices, allowing its exports to command much higher BTN per ton.

#### 3. *Favourable timing for exports*

Bhutan's ferroalloy exports may have faced less domestic disruption compared to larger producers struggling with COVID measures. As a smaller, flexible supplier, Bhutan could meet demand while others struggled, capturing a premium price.

#### 4. *Temporary nature of the spike*

The spike was followed by a decline in 2023–024, suggesting that the high profits were opportunistic, tied to temporary market imbalances caused by COVID rather than long-term structural growth.

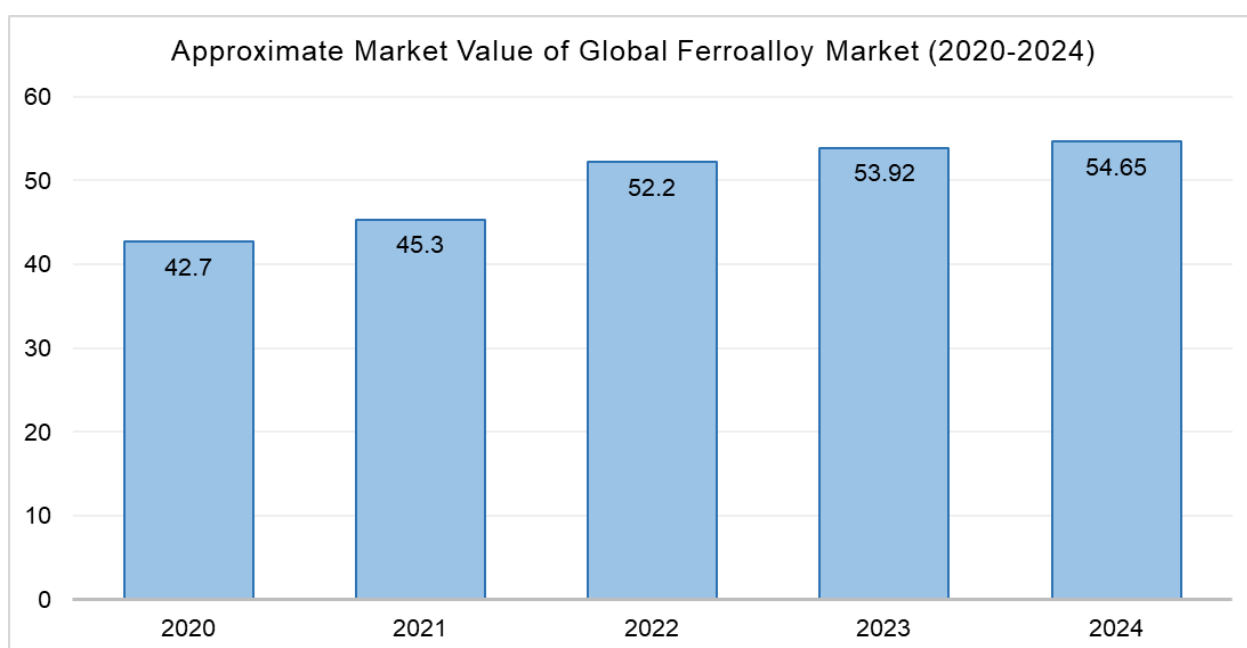
Hence, it can be presumed that the COVID-19 pandemic indirectly created a favourable market environment for Bhutan's ferroalloy industry by causing global supply shortages and price surges, leading to unusually high profits in 2021-2022.

## 4. Global ferroalloy market analysis

### 4.1. Growth of the global ferroalloy market

Over the past five years, the global market grew from USD 42.7 billion in 2020 to USD 56.23 billion in 2024 at an estimated CAGR of 6.36%<sup>9</sup>. The largest jump occurred between 2021 and 2022 when the value increased from USD 45.3 billion to USD 52.2 billion, following which the growth continued at a steady pace. Overall, there is a clear upward trend in market value over the five-year period.

Figure 21: Market value of global ferroalloy market (2020-2024)

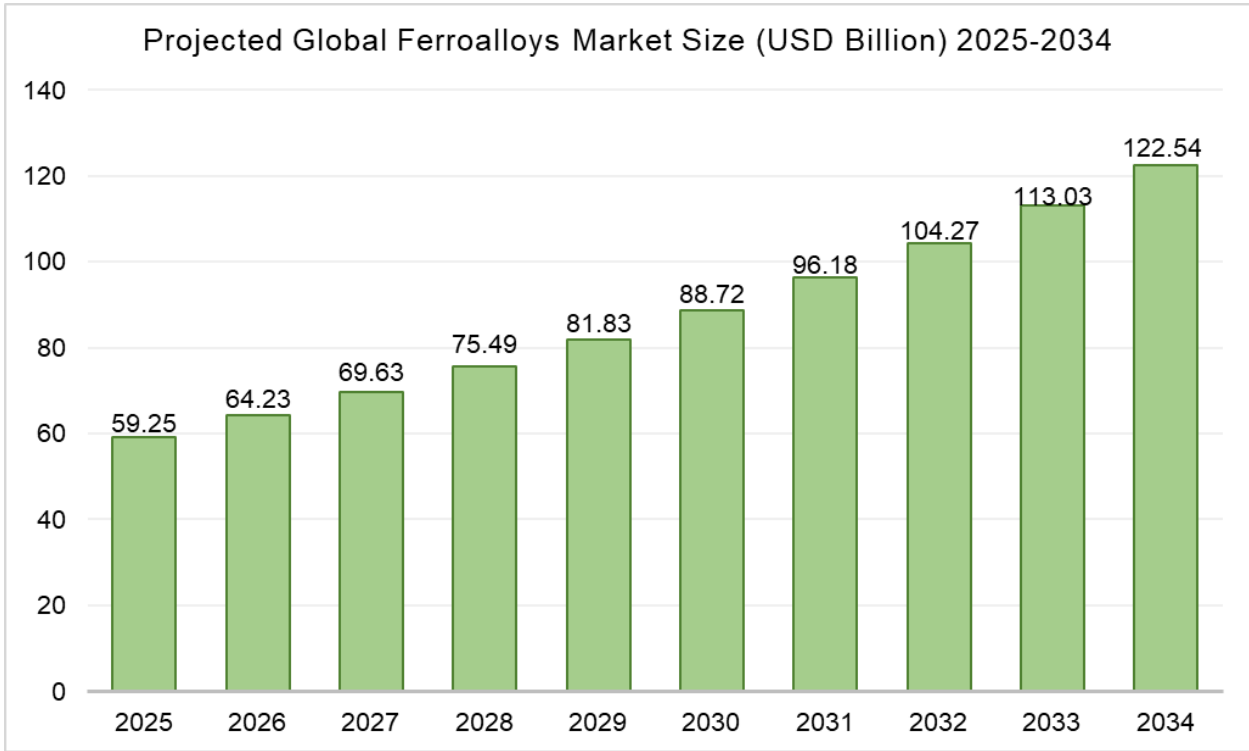


The global ferroalloy market size was valued at USD 54.65 billion in 2024 and is forecasted to further grow at a CAGR of 8.41% from 2025 to 2034, reaching around USD 122.54 billion by 2034<sup>10</sup>. The market growth is propelled by the growing construction industry and the high demand for steel in various end-use industries are driving the expansion of the steel industry.

<sup>9</sup> Research and Markets. (2025). *Ferroalloys Market - Global Forecast 2025-2030*.

<sup>10</sup>Precedence Research. (2025). *Ferroalloys Market Empower steel and aluminum sectors with high-yield, energy-efficient alloy solutions*.

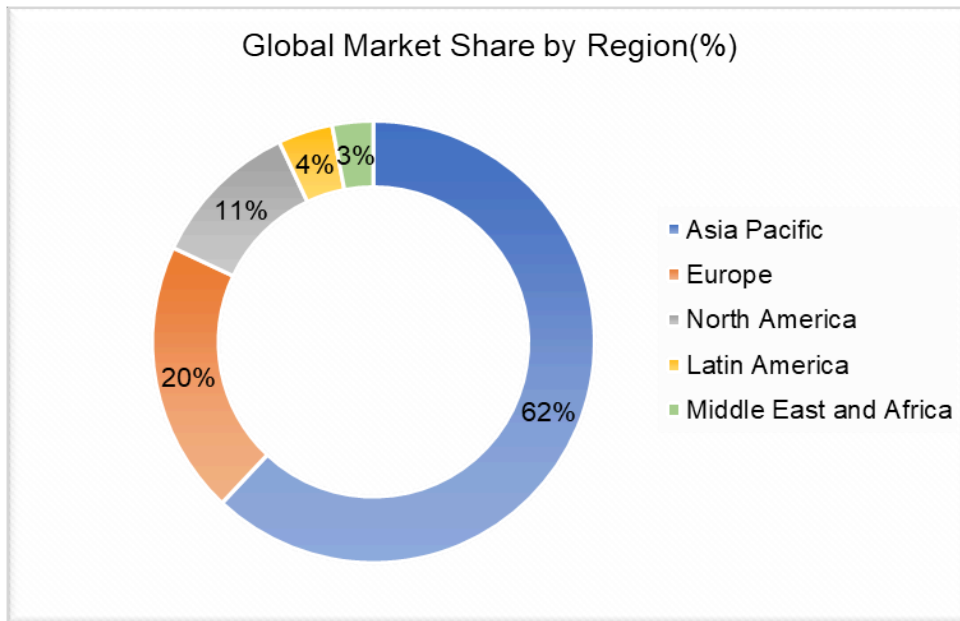
Figure 22: Projected global ferroalloy market growth (USD Billion) 2025-2034



#### 4.2. Regional distribution of the global ferroalloy market

As of 2024, the Asia Pacific region dominated the ferroalloys market, holding 62% of the market share, followed by Europe at 20% and North America at 11%<sup>11</sup>.

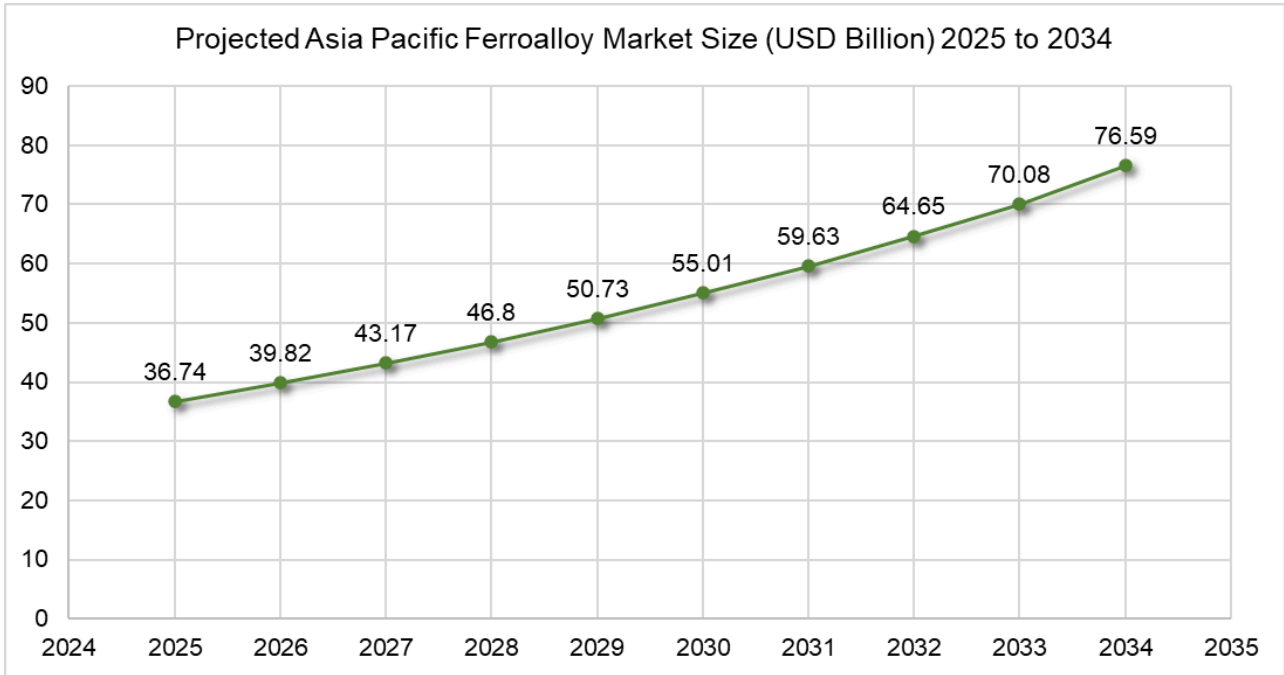
Figure 23: Global market share by region in 2024



<sup>11</sup> Precedence Research. (2025). *Ferroalloys Market Empower steel and aluminum sectors with high-yield, energy-efficient alloy solutions.*

In 2024, the Asia Pacific ferroalloy market size was calculated at USD 33.88 billion, projected to be worth more than USD 76.49 billion by 2034, rising at a CAGR of 8.5% in 10 years<sup>12</sup>. The market growth is attributed to rising industrialisation and the growing demand for steel material products from end-use industries such as construction, automotive manufacturing and defense. Moreover, China, India and Japan are major drivers of demand for ferroalloys. In 2023, China accounted for over 77% share of the ferroalloy market in the region.

Figure 24: Projected Asia Pacific ferroalloy market size (USD Billion) 2025 to 2034



The European ferroalloys market size was estimated at USD 26.51 billion in 2023 and expected to grow from USD 28.15 billion in 2024 to USD 43.28 billion by 2035. The market growth rate is estimated to be approximately 3.83% over the forecasted ten-year period (2025-2035)<sup>13</sup>.

On the other hand, the North American market for ferroalloys was valued at USD 6.3 billion in 2024, projected to reach USD 8.9 billion in 2028, growing at a CAGR of 7.3%<sup>14</sup>.

<sup>12</sup> Precedence Research. (2025). *Ferroalloys Market Empower steel and aluminum sectors with high-yield, energy-efficient alloy solutions.*

<sup>13</sup> Market Research Future. (2025). *Europe Ferro Alloys Market Overview.*

<sup>14</sup> Grand View Research. (2024). *North America Ferroalloys Market Size & Outlook.*

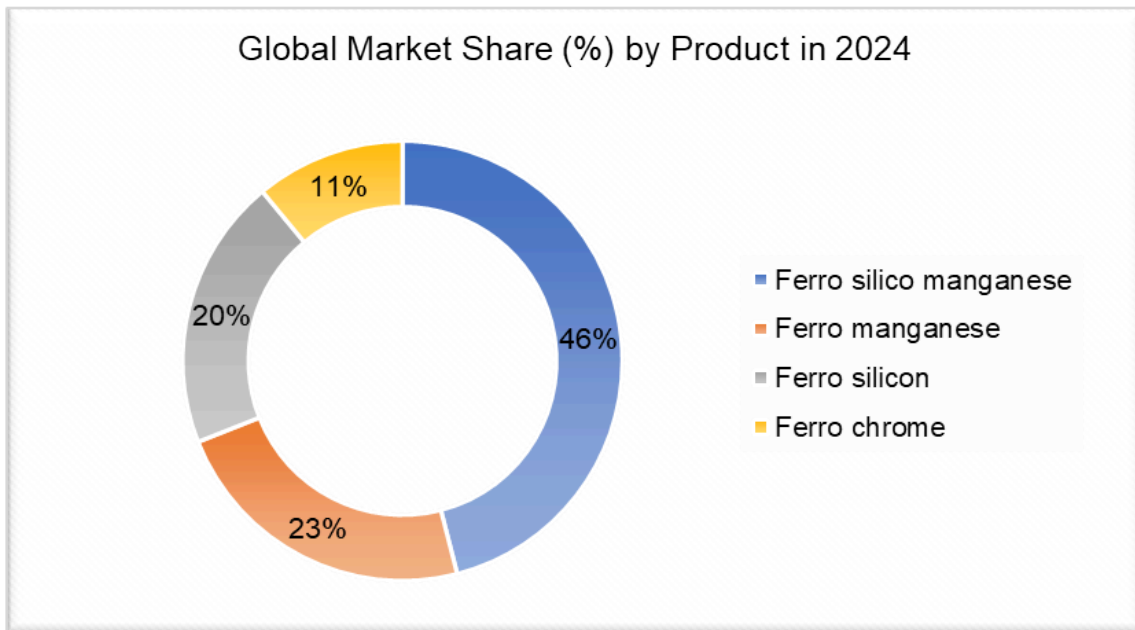
### 4.3. Composition of the global ferroalloy market by product and application

#### 4.3.1. Product composition

In 2024, ferro silico manganese accounted for the largest share of the market at 46%<sup>15</sup>. This kind of product contains high levels of manganese and low levels of silicon and is mainly used as an alloying and deoxidizing agent during the production of steel, stainless steel and manganese-rich steel. Moreover, the consumption of ferro silico manganese is expected to be driven by the steel demand from the electric vehicle (EV) and aerospace industries<sup>16</sup> as it imparts light weight, high strength and corrosion resistance properties that are desirable in such industries.

Ferro manganese was the second highest market share holding 23%, followed by ferro silicon and ferro chrome at 20% and 11% respectively. However, forecasts predict that the ferro silicon market is suggested to grow substantially at a CAGR rate of 6.8% in the next decade.

Figure 25: Global market share by product in 2024



#### 4.3.2. Usage/application

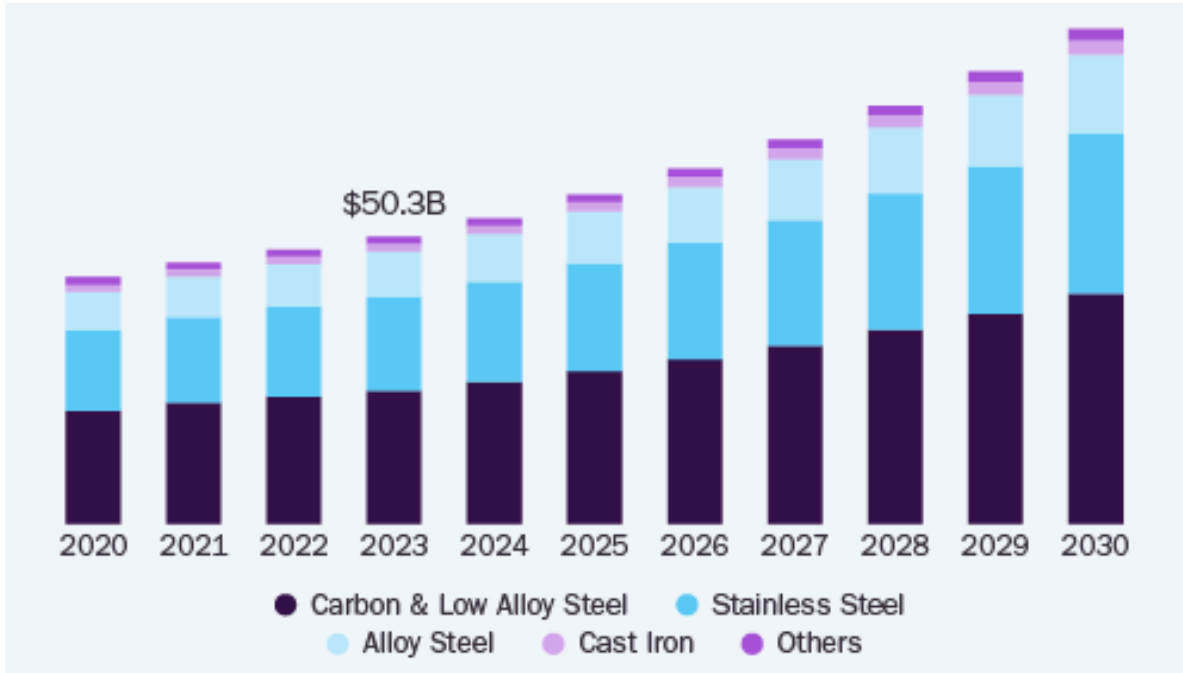
Ferroalloys are mainly used in manufacturing carbon and low alloy steel, stainless steel, alloy steel, and cast iron among others. In 2024, the carbon and low alloy steel segment accounted for the dominant share of the ferroalloys market, as it is highly demanded in

<sup>15</sup>Precedence Research. (2025). *Ferroalloys Market Empower steel and aluminum sectors with high-yield, energy-efficient alloy solutions.*

<sup>16</sup> Grand View Research. (2024). *Ferroalloys Market Size, Share & Trends Analysis Report By Product (Ferrochrome, Ferromanganese), By Application (Carbon & Low Alloy Steel, Stainless Steel), By Region, And Segment Forecasts, 2024 - 2030.*

end-use industries such as shipbuilding, engineering plants, construction, and automobiles. This was followed by stainless steel, alloy steel and cast iron manufacturing. However, the cast iron segment is projected to grow the fastest by 2030 as it has a growing demand in the consumer goods industry.

Figure 26: Ferroalloy market share by application (2020-2030)



Ferroalloys are mainly used as deoxidizers and alloying agents and inoculants in steel manufacturing. As a deoxidizer, it removes oxygen from molten steel, which prevents porosity and strengthens the structure of the steel. As an alloying agent, it introduces silicon into steel and other steel alloys to enhance the hardness, strength and corrosion resistance. As a foundry inoculant, it is added to molten cast iron to control solidification and prevent casting defects, which is expected to grow steadily. There is also the emerging use of ferroalloys in the manufacture of electric vehicles (EVs), which is one of the reasons for the increase of FeSi consumption over the forecast period.

Based on application, the inoculant segment is expected to grow at a steady CAGR, in terms of volume, over the forecast period. Inoculant is used widely in cast iron manufacturing and its growing demand in various industries, such as energy, railways, and pipes, is propelling the product consumption<sup>17</sup>. Deoxidizer accounts for the maximum application at 78.95%.

<sup>17</sup> Grand View Research (2023). *India Ferrosilicon Market Size Worth \$512.8 Million By 2030*.

#### 4.4. Bhutan's position in the global ferroalloy market

Bhutan occupies a modest but noteworthy position in the global ferroalloy market, primarily through its production and export of ferrosilicon. In 2023, Bhutan's total ferroalloy exports were valued at approximately USD 212 million, making it the 29th largest export among 126 global exporters<sup>18</sup>. Specifically, Bhutan ranked as the 22nd largest exporter of ferrosilicon worldwide, and the 19th largest exporter of ferro-silico-manganese.

In terms of production capacity, Bhutan was the 8th largest producer of ferro silicon globally in 2023 and 2024<sup>19</sup>. Export volumes are similarly significant at the regional level where in 2024, Bhutan exported 153,770 tons of ferrosilicon, a figure that exceeded India's domestic production of about 60,000 tons during the same year<sup>20</sup>.

Despite these figures, Bhutan remains a relatively small player when compared with leading global exporters. China dominates the international market, accounting for more than 60% of global ferrosilicon exports, followed by Russia, Norway, and Brazil, which together contribute a substantial share of the remainder. By contrast, Bhutan's exports represent less than 1% of the global total, emphasising its role as a niche supplier rather than a major market leader.

Nevertheless, Bhutan plays a strategic role in South Asia as a reliable supplier to India, its primary trading partner. Bhutan's competitive advantage lies in its reliance on hydropower, which provides relatively low-cost and sustainable electricity for the highly energy-intensive ferroalloy industry. This energy advantage enables Bhutanese producers to maintain cost efficiency despite the country's smaller production scale.

In summary, Bhutan's position in the global ferroalloy market can be characterized as that of a small but dependable exporter with regional significance. Its export performance demonstrates competitiveness in niche segments, though its heavy reliance on India highlights the need for market diversification and value-added production strategies to strengthen resilience and enhance long-term competitiveness.

#### 5. Indian ferroalloy market analysis

The Indian ferrosilicon market was valued at USD 347.7 million in 2022 and is projected to expand at a CAGR of 5% from 2023 to 2030, reaching an estimated 512.8 million by 2030<sup>21</sup>. Moreover, the market in South India is expected to grow at a 4.7% CAGR during

<sup>18</sup> OEC World. (2025). *Ferro silicon stats*.

<sup>19</sup> U.S. Department of the Interior & U.S. Geological Survey. (2025). *Mineral Commodity Summaries 2025*.

<sup>20</sup> The Bhutanese. (2025). *Is the Ferro Industry becoming too big to fail? Billions in investments and loans in 9 upcoming Ferro factories in Norbugang?*

<sup>21</sup> Grand View Research. (2024). *Ferroalloys Market Size, Share & Trends Analysis Report By Product (Ferrochrome, Ferromanganese), By Application (Carbon & Low Alloy Steel, Stainless Steel), By Region, And Segment Forecasts, 2024 - 2030*.

the forecast period as the demand for steel and cast-iron in that state will be driven by the state government's increasing investment in the construction and infrastructure sector.

## 5.1. India's ferroalloy industry

### 5.1.1. Market value of India's ferroalloy industry

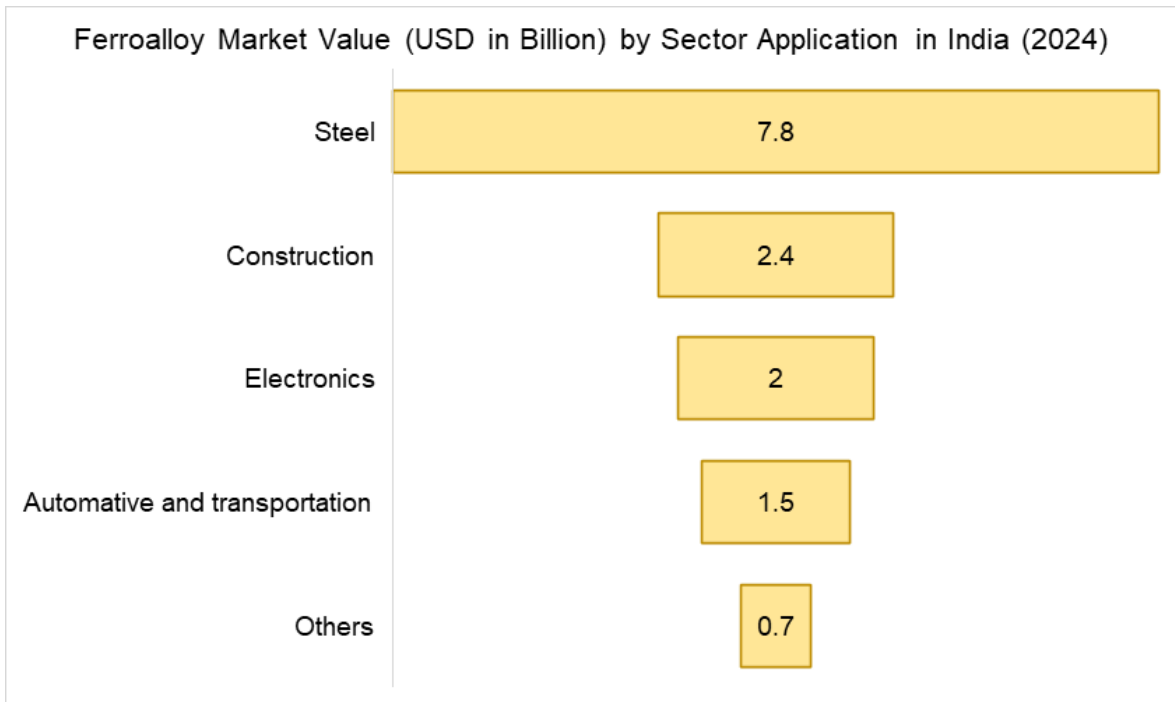
India's ferroalloys market size was valued at USD 14.48 billion in 2018, which rose to USD 15.38 billion in 2024, projected to increase to USD 23.81 billion by 2035, growing at a CAGR of 3.83% during the forecast decade<sup>22</sup>.

Most of the ferroalloy manufacturing industries in India are located in Andhra Pradesh, Chhattisgarh, Delhi, Gujarat, Haryana, Jharkhand, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Tamil Nadu, Telangana, Uttar Pradesh and West Bengal.

In addition, ferro alloy industries are emerging in Arunachal Pradesh as the upcoming mega hydro energy projects are positioned to generate 58000 MW electricity by 2035, supplying affordable and abundant power to the industries in the state<sup>23</sup>. In West Bengal, Bankura is a ferroalloy hub with multiple established industries.

The figure illustrates India's ferroalloy usage across various industries in 2024, highlighting the dominant role of the steel sector.

Figure 27: Ferroalloy usage by sectors/industries in 2024



<sup>22</sup> Market Research Future. (2025). *Indian Ferro Alloys Market Overview*.

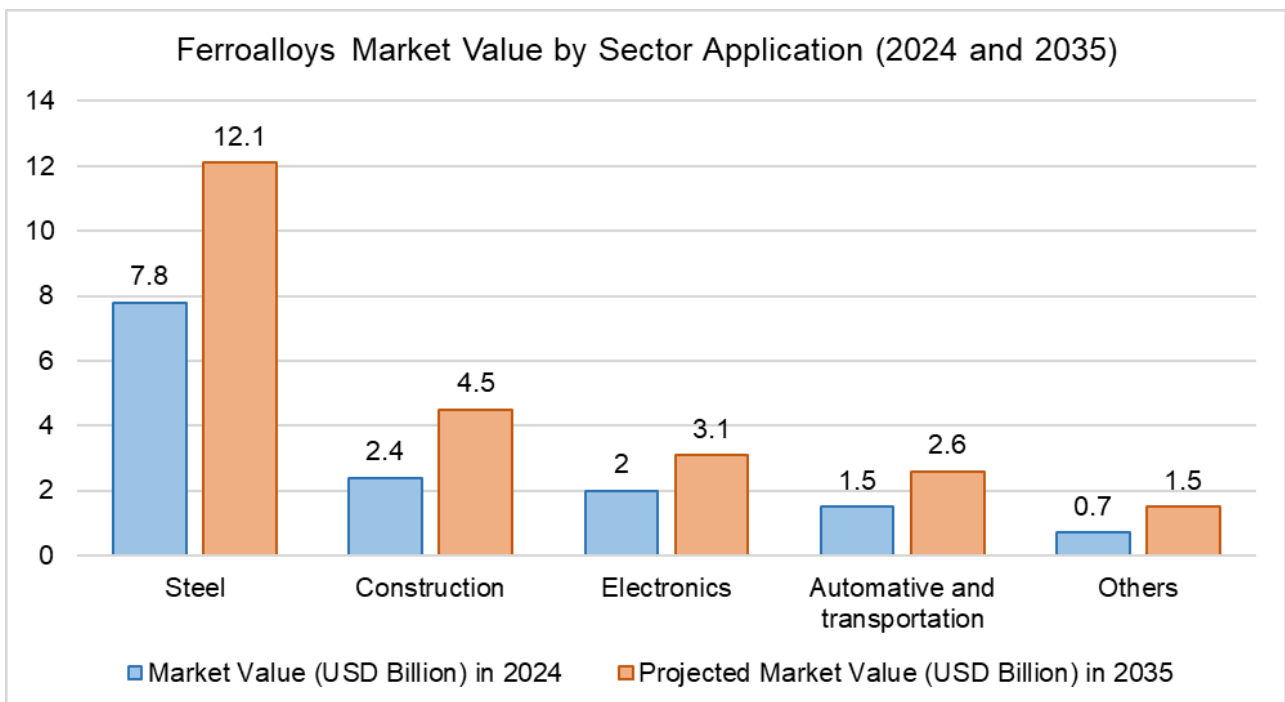
<sup>23</sup> The Hindu. (2025). *Arunachal announces decade-long focus on hydropower projects*.

## Key observations

- Steel is by far the largest consumer, accounting for 54.17% of the total market with an estimated value of USD 7.8 billion. This is expected, as ferroalloys are essential for producing steel with desired properties like strength, corrosion resistance, and durability.
- Construction is the second-largest sector, representing 16.67% of the market, valued at USD 2.4 billion. This is driven by the use of ferroalloy-enhanced steel in infrastructure and building projects.
- The automotive and transportation industry follows, making up 10.42% of the market with a value of USD 1.5 billion. Ferroalloys are crucial for manufacturing vehicle components that require high strength and wear resistance.
- Electronics has a smaller but significant share at 13.89%, valued at \$2 billion, indicating its reliance on specialized ferroalloys for certain applications.
- All other sectors combined, labeled as "Others," account for the remaining 4.86%, with a value of USD 0.7 billion.

The figure below projects significant growth for India's ferroalloy market between 2024 and 2035, with the total market value expected to increase from \$14.4 billion to \$23.8 billion. This growth is driven by rising demand across key industries, especially steel, which remains the primary consumer.

Figure 28: Ferroalloy usage projection by 2030 (baseline 2024)



## Key observations

The following highlights a strong growth trajectory for India's ferroalloy industry, with key sectors showing substantial increases in projected value.

- *Steel:* As the largest application, the steel industry's consumption of ferroalloys is forecast to grow from USD 7.8 billion to USD 12.1 billion. This is driven by government initiatives to boost domestic steel production and major infrastructure projects.
- *Construction:* The construction sector is projected to nearly double its consumption, from USD 2.4 billion to USD 4.5 billion. This aligns with India's rapid urbanization and a focus on large-scale infrastructure development, such as highways, railways, and smart cities, all of which require high-performance steel.
- *Electronics:* The electronics sector is expected to see its ferroalloy market value grow from USD 2 billion to \$3.1 billion. The "Make in India" initiative and a surging demand for consumer electronics are key drivers of this growth.
- *Automotive and transportation:* This sector's projected value is set to increase from USD 1.5 billion to USD 2.6 billion. The growth is fueled by the rising demand for both traditional vehicles and electric vehicles (EVs), which require high-strength, lightweight materials for efficiency and safety.
- *Others:* The "Others" category, which includes various other industrial applications, is also projected to grow from USD 0.7 billion to USD 1.5 billion, reflecting broad-based industrial expansion.

This projected growth signifies India's position as a major consumer and producer of ferroalloys, driven by a robust domestic economy and ambitious development plans.

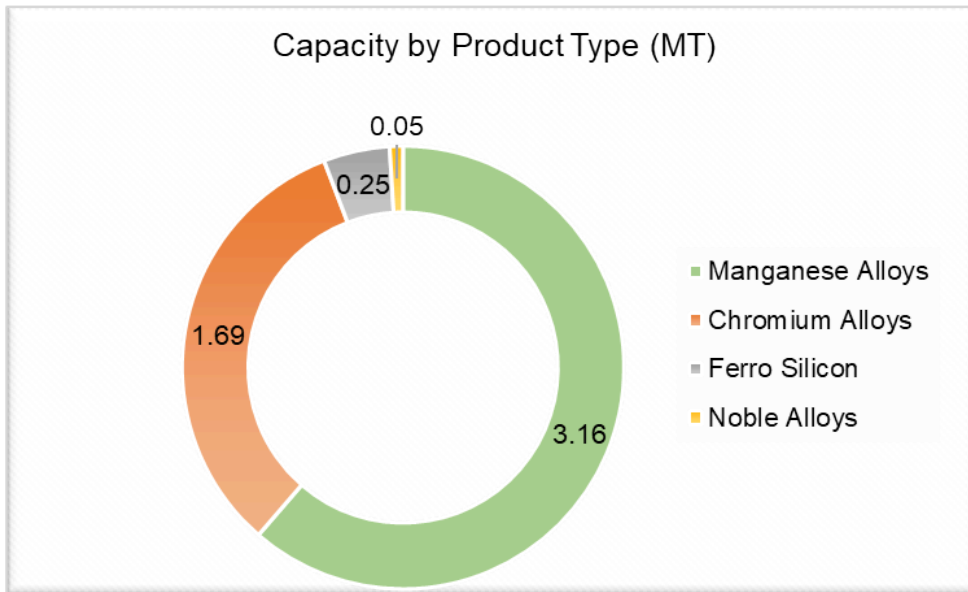
### 5.1.2. India's ferroalloy capacity

According to the Indian Ferroalloys Producers' Association (IFAPA), India's combined ferroalloy industry currently has an annual installed capacity of 2,900 MV with output measured at 5.15 million tons<sup>24</sup>. In the past 15 years, the production increased by 56% from 2.9 million tonnes in 2010 to 5.15 million tonnes. Among the production, manganese alloys accounted for 61.36% of the total capacity, followed by chromium alloys at 32.82%, and ferrosilicon at 4.85%. Noble alloys accounted for the least share, constituting 0.97%.

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<sup>24</sup>Indian Ferro Alloy Producers Association. (2005). *About Us*.

Figure 29: Breakdown of the total capacity (5.15 million tonnes) by product



In terms of absolute figures, India produced 3.16 million tonnes of manganese alloys and 1.69 million tonnes of chromium alloys, exhibiting significant output in this category. However, India only produced 250,000 tonnes of ferrosilicon and 50,000 tonnes of noble ferroalloys.

On one hand, India is an established exporter of silico manganese and high carbon ferrochrome to countries such as Bangladesh, Europe, Germany, Indonesia, Japan, Korea, Pakistan, Sri Lanka, UAE, USA, etc. It is, in fact, the largest exporter of manganese alloys and the third largest exporter of ferrochrome. On the other hand, India is a major importer of ferro silicon, which Bhutan's ferroalloy industries specialise in.

India has a competitive advantage compared to Bhutan in manufacturing ferroalloys in terms of having highly qualified manpower, latest equipment and technologies and recognition in the international market. At the same time, electricity costs account for over 40% to 70% of the total cost of production, electricity price is also high and raw materials availability has issues. India's ferroalloy industry growth and competitiveness is hampered by high power tariffs, restricted high-grade domestic ore supply and shortage of high-quality coke<sup>25</sup>.

Nevertheless, the existing ferroalloy industries in India are expanding their capacities in light of key market opportunities with the rising steel production, government infrastructure initiatives, and technological advancements.

<sup>25</sup> The Economic Times. (2024). *A Bright future ahead: India's ferro alloys sector embraces transformation.*

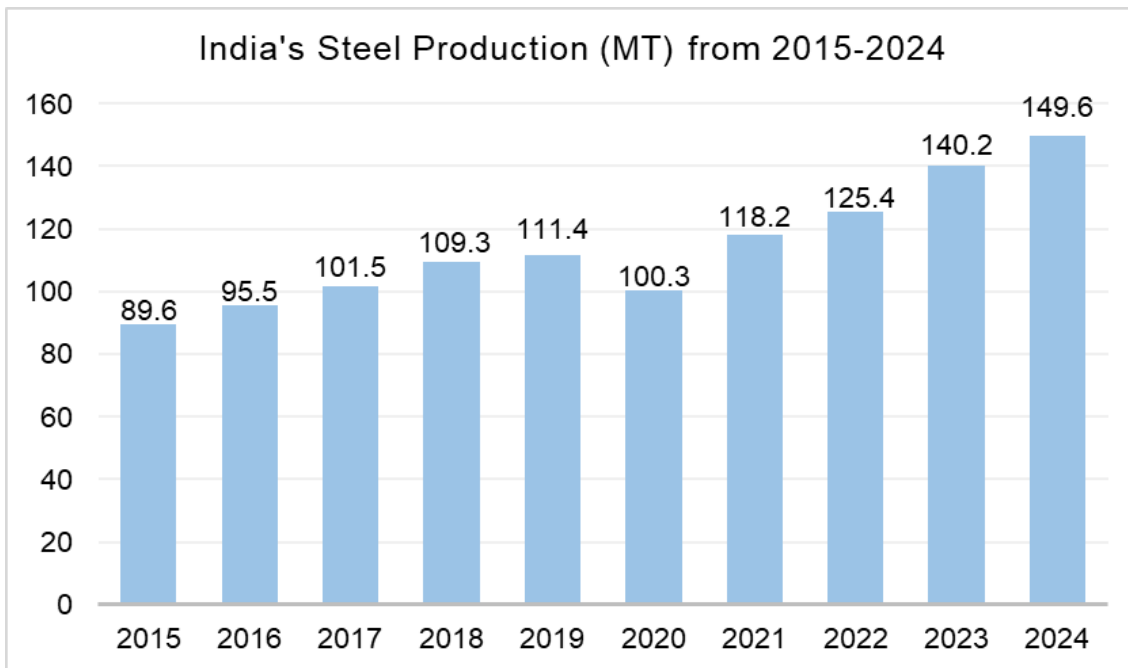
## 5.2. Growth of India's steel industry

India's steel industry has a central position in the country's economic structure, functioning both as a driver of industrial growth and a key indicator of economic development. Globally, India is the second-largest producer of crude steel after China. Recognized as one of the eight core industries within the Index of Industrial Production (IIP), the steel industry contributes approximately 2% to India's GDP. Furthermore, the sector also has a robust demand, increasing investments, strong policy support, and a competitive advantage<sup>26</sup>.

In 2024, India produced 149.4 million tonnes of crude steel, amounting to nearly 8% of the total steel production of the world. Moreover, India's per capita finished steel consumption was 97.7 kg in 2023-2024<sup>27</sup>. By 2025, India's crude steel production reached 151.1 million tonnes with a total steelmaking capacity of about 200 million tonnes<sup>28</sup>.

The figure below represents the production trend of India's crude steel production over a ten-year period from 2015 to 2024.

Figure 30: India's crude steel production 2015-2035<sup>29</sup>



<sup>26</sup> IBEF. (2025). *Iron & Steel Industry in India*.

<sup>27</sup> *An overview of steel sector*. (n.d).

<sup>28</sup> Reuters. (2025). *India confident of achieving steel production target by 2030, official says*.

<sup>29</sup> Ministry of Steel (2019). *Several initiatives taken by the Ministry of Steel to support a competitive, efficient, environment friendly steel industry, adhering to global safety and quality standards*.

## Key observations

- India's steel production has demonstrated a strong and consistent upward trend. From an output of 89.6 million tonnes in 2015, production rose by over 67% to reach a record 149.6 million tonnes in 2024. This significant expansion solidifies India's position as a major player in the global steel market.
- The only interruption to this growth was a temporary decline in 2020, where production fell to 100.3 million tonnes from 111.4 million tonnes in the previous year. This dip is directly attributable to the global economic slowdown and logistical challenges posed by the COVID-19 pandemic.
- Following the 2020 setback, the industry exhibited rapid recovery and sustained growth. Production recovered swiftly, increasing to 118.2 million tonnes in 2021 and continuing its steep upward curve in the subsequent years.

### 5.3. India's steel policies and their implications for Bhutan's ferroalloy market

#### 5.3.1. India's strategic steel policy framework

The Government of India has undertaken key initiatives and policy reforms to enhance India's steel sector. Most notably, their *National Steel Policy 2017* envisages the development of a technologically advanced and globally competitive, self-sufficient steel industry, aiming to expand India's crude steel production capacity to 300 million tonnes by 2030 and increase per capita steel consumption to 160 kg<sup>30</sup>.

Table 5: Projected steel capacity by 2030 as per National Steel Policy 2017

Sl. No	Parameter	Projection by 2030
1	Total crude steel capacity	300 MT
2	Total crude steel demand/production	255 MT
3	Total finished steel demand/production	230 MT
4	Per capita finished steel consumption	160 Kg

In addition to enhancing crude steel production, India is encouraging the manufacture of high-value specialty steel products through the introduction of a *Production-linked Incentive (PLI) Scheme for Specialty Steel* in 2021. The scheme, with a budgetary outlay of INR 63.2 billion, envisions providing fiscal incentives on incremental production and

<sup>30</sup>Ministry of Steel. (2017). *National Steel Policy(NSP), 2017*.

sales of high-value steel products (such as coated/plated steel products, high-strength/wear-resistant steel, specialty rails, alloy steel products and steel wires and electrical steel) until 2027<sup>31</sup>.

According to India's Ministry of Steel, the scheme is projected to boost domestic specialty steel production capacity to 42 million tonnes by 2027, which is a significant rise from around 18 million tonnes in 2021. As of 2025, the annual production of specialty steel increased by 1.95 million tonnes under the PLI scheme. This aim of substituting imports of value-added steel products in turn intensifies domestic demand for ferroalloys such as ferrosilicon, silico-manganese, and ferrochrome.

Furthermore, in 2025, India revised its *Domestically Manufactured Iron and Steel Products Policy* to boost the competitiveness of local manufacturers<sup>32</sup>. This revised policy prioritizes the use of locally manufactured iron and steel products in government procurement. The policy shall be in effect for the next five years and may be extended. Leveraging the government procurement process, this initiative applies to all government ministries, departments and agencies as well as projects funded by the government. The mandate is that all iron and steel procurement exceeding INR 500,000 shall give priority to domestic products. This move came after India recorded high import of steel from China, South Korea and Japan in 2024, as a result, the domestic manufacturers struggled with low prices to combat the cheaper import of steel<sup>33</sup>.

Similarly, India plans to put in place a green steel procurement mandate from 2027 that will require government projects to exclusively use green-rated steel for eight years<sup>34</sup>. The government has allocated INR 4.55 billion in piloting green steel projects<sup>35</sup>.

In Andhra Pradesh, the state government incentivises the ferroalloy industries with reduced power charges. In November 2023, electricity duty for ferro alloy industries were reduced to INR 6 per unit and the liability of demand charges were reduced by 90%, with industries being required to pay only 10% as nominal charges<sup>36</sup>. However, this relief is a short term one, which may be extended.

### **5.3.2. India's policy trends and their relevance to Bhutan's ferroalloy industry**

India's goal of increasing its steel capacity and achieving self-sufficiency in steel production, supported by its policies, will likely increase the demand for ferroalloys, especially ferrosilicon. Bhutan, which is already a key exporter of ferrosilicon to India, stands to benefit from this by securing long-term export opportunities. Moreover, India's

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<sup>31</sup> PM India. (2021). *Union Cabinet approves Production-linked Incentive (PLI) Scheme for Specialty Steel*.

<sup>32</sup> S&P Global. (2025). *India revises 2025 steel procurement policy to boost domestic production*.

<sup>33</sup> Reuters. (2025). *India tightens steel procurement in favour of domestic mills*

<sup>34</sup> The Economic Times. (2025). *Green steel mandate in works for government projects*.

<sup>35</sup> Hydrogen Insights. (2024). *'India's first' green steel pilot awarded government funds*.

<sup>36</sup> The New Indian Express. (2025). *Andhra government reduces power charges for ferro alloy units*.

shift towards prioritising high-value and green steel provides Bhutan an opportunity to upscale and diversify its ferroalloy production as high-value steel production requires more precise and consistent alloy inputs.

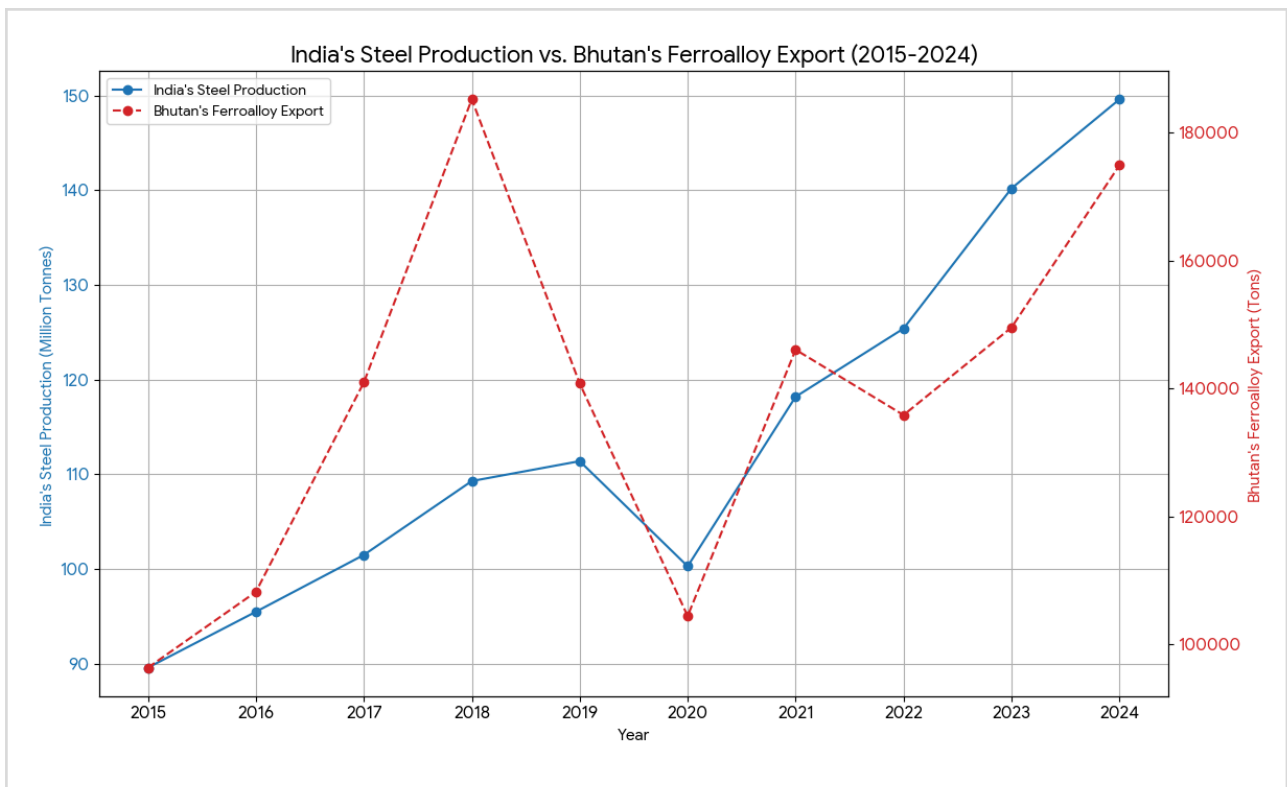
Bhutan’s ferroalloy industries may also need to invest in cleaner technologies, energy efficiency and certification practices, to help position it as a preferred trading partner in India’s especially steel supply chain which has high quality and sustainability standards.

On the other hand, India’s pursuit of self-reliance may lead to strengthening its domestic ferroalloy capacity and production, which could pose a threat to Bhutan’s ferroalloy industries. Bhutan must remain competitive by addressing its higher power costs, reliance on imported raw materials, and compliance with rigorous standards like BIS.

#### 5.4. Linkages between Bhutan’s ferroalloy export and India’s steel production

The growth of India’s steel industry drives the demand for ferroalloys. The past decade figures for India’s steel production and Bhutan’s ferroalloy export show a strong positive correlation between the two. However, the data reveal a difference in the rate of growth, indicating that Bhutan has not fully capitalized on the growth of the Indian ferrosilicon market, possibly due to India diversifying its import sources. This trend, nevertheless, highlights a considerable future opportunity for Bhutan to expand its market share in India.

Figure 31: Relationship between India's annual steel production and Bhutan's ferro silicon exports.



## Key observations

- India's crude steel production has shown a steep, consistent increase over the last decade, almost doubling from 89.6 million tons in 2015 to 149.6 million tons in 2024. This growth is driven by significant industrial expansion and government initiatives.
- Bhutan's ferroalloy exports, particularly ferrosilicon, while also increasing, have done so at a slower and more variable pace. The country's exports have grown from around 88,812 tons in 2010 to 145,675 tons in 2024. The comparative rate of growth indicates that while Bhutan is a key supplier, its export capacity has not been able to keep up with the accelerating demand from India's rapidly expanding steel industry.
- In conclusion, based on the graph and the provided data, the relationship between India's steel production and Bhutan's ferroalloy exports is a positive correlation, but with a significant difference in the rate of growth.

### 5.5. Bhutan's position in India's ferroalloy market

India is by far the most important external market for Bhutanese ferroalloys, both in terms of volume and structural demand potential. In 2023, Bhutan accounted for approximately 16.4% of India's ferroalloy imports by value, making it the second-largest source after Indonesia and ahead of larger economies such as Brazil and China<sup>37</sup>. This confirms that Indian steelmakers already rely on Bhutan as a stable supplier of alloy inputs.

As seen above, India's domestic ferroalloy requirements are underpinned by two major policy drivers, the *National Steel Policy 2017* and the *Production-Linked Incentive (PLI) Scheme for Specialty Steel*. Within this demand context, ferrosilicon, a product in which Bhutan specializes, remains structurally short in India. In 2023, India imported around 162,000 tonnes of ferrosilicon worth approximately USD 262 million, with demand projected to grow at a CAGR of 5% through 2030<sup>38</sup>. Bhutanese exports are well aligned with this demand profile, as more than 88% of Bhutan's ferroalloy export basket consists of ferrosilicon (>55% silicon content).

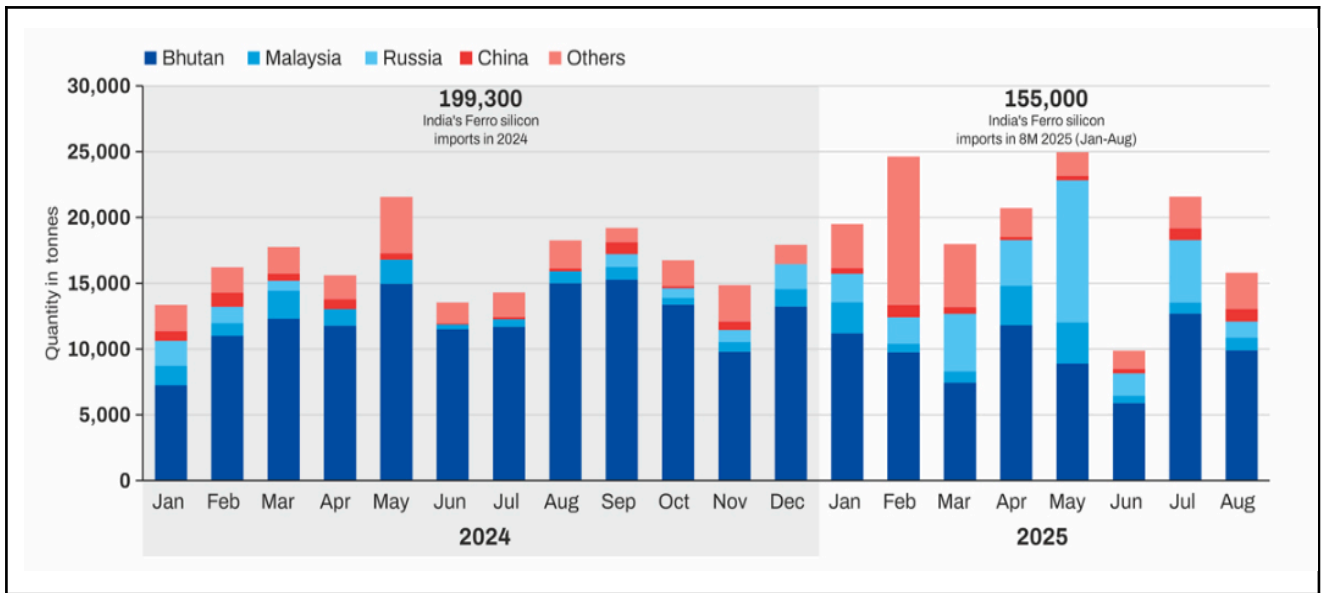
Furthermore, the figure below shows that Bhutan is a top supplier of ferrosilicon to India between 2024 and 2025, leading above countries such as China, Malaysia, Russia and others.

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<sup>37</sup> UN Comtrade. (2024). *International Trade Statistics: HS Code 7202 – Ferroalloys*. United Nations Statistics Division.

<sup>38</sup> Market Research Future. (2023). *India Ferrosilicon Market Research Report 2023–2030*.

Figure 32: India's ferrosilicon import (January 2024 - August 2025)<sup>39</sup>



Moreover, Bhutan enjoys distinct comparative advantages over other exporting nations in terms of preferential market access as under the bilateral Free Trade Agreement, Bhutanese exports to India are free from customs duties and benefit from duty-free transit arrangements, unlike those from other suppliers. Likewise, since Bhutanese industries are geographically closer to India's eastern and central steel clusters, the advantage of proximity ensures lower transport and logistics costs, leading to shorter delivery lead-times compared to seaborne competitors.

It is also noted that Bhutan's ferrosilicon quality specifications, particularly with silicon content ranging between 70-75%, directly match Indian mills' requirements for deoxidation and silicon control, minimizing qualification barriers for long-term supply agreements, with Bhutanese ferrosilicon industries additionally securing Bureau of Indian Standards (BIS) certification under IS 1110:202 to support their export compliance<sup>40</sup>.

Despite these advantages, several risks must be recognized. The domestic expansion of Indian ferroalloy capacity under the PLI scheme could reduce import dependency over time, particularly in manganese-based alloys. However, ferrosilicon is expected to remain structurally import-dependent due to India's limited domestic production capacity. In addition, sustainability standards and carbon disclosure requirements are becoming increasingly relevant in global and regional steel supply chains. While this presents a risk, it also creates a strategic opportunity for Bhutan to differentiate its exports by leveraging its hydropower-based electricity (green energy) to position ferrosilicon as a low-carbon alloy input<sup>41</sup>.

<sup>39</sup> Big Mint. (2025). *How will ferro silicon price trajectory evolve in Q4CY'25? BigMint analysis*

<sup>40</sup> ERCS. (2024). *BIS Audit of Ferrosilicon IS 1110 under FMCS in Bhutan Completed.*

<sup>41</sup> Financial Express. (2025, February 21). *India's green steel ambitions could reshape raw material demand.*

For Bhutanese ferroalloy industries, India represents both a secure demand base and a competitive niche. The country’s existing market share, coupled with tariff-free access and product specialization, provides a strong foundation for long-term feasibility.

## 6. Overall feasibility assessment and recommendations

### 6.1. SWOT analysis

Bhutan’s ferroalloy industry enjoys strong comparative advantages through cheap renewable energy, geographic proximity to India, and a solid production base. However, its heavy reliance on India, infrastructure bottlenecks, and global price volatility are significant weaknesses.

Future market feasibility rests on leveraging opportunities in Indian steel growth, diversifying export destinations, and investing in higher-value, low-carbon ferroalloys.

Table 6: SWOT analysis of Bhutan’s ferroalloy industry

Strengths	Weakness
<ul style="list-style-type: none"> <li>→ <i>Affordable abundant hydroelectric power:</i> Bhutan’s low-cost, renewable electricity provides a major competitive advantage in energy-intensive ferroalloy production.</li> <li>→ <i>Geographic proximity to India:</i> Close access to India, one of the world’s largest steel producers and ferroalloy consumers, ensures a stable export market.</li> <li>→ <i>Established production base:</i> The industry has decades of experience in ferro silicon production, forming a strong foundation for growth and diversification.</li> <li>→ <i>Infrastructure development:</i> The Norbugang Industrial Park is developing key infrastructure,</li> </ul>	<ul style="list-style-type: none"> <li>→ <i>Heavy reliance on India:</i> Over 90% of exports are directed to India, creating vulnerability to Indian steel market fluctuations and policy changes.</li> <li>→ <i>Infrastructure constraints:</i> Limited road and transport capacity within Bhutan increases logistics costs and weakens supply chain efficiency.</li> <li>→ <i>Limited domestic demand:</i> Almost no internal steel industry means the sector is fully dependent on external markets for growth.</li> <li>→ <i>Volatile production trends:</i> Capacity fluctuations (e.g., in 2019–2020) suggest sensitivity to operational or market disruptions.</li> <li>→ <i>Narrow product mix:</i> Despite diversification, the industry</li> </ul>

<p>including roads, power supply, and water systems, with several ferro-silicon factories nearing completion</p> <ul style="list-style-type: none"> <li>→ <i>Government support:</i> Significant investments in infrastructure, such as Nu 3.6 billion for the industrial estate, bolster industry prospect</li> <li>→ <i>Growing diversification:</i> Expansion into ferro silico manganese and inoculants reduces overreliance on ferro silicon and broadens market opportunities.</li> <li>→ <i>Supportive trade relations:</i> Bhutan benefits from preferential trade arrangements with India, reducing barriers to export.</li> </ul>	<p>still heavily depends on ferro silicon, making it susceptible to global price swings.</p> <ul style="list-style-type: none"> <li>→ <i>Overcapacity Risks:</i> The rapid expansion in Norbugang may lead to oversupply, potentially depressing prices.</li> <li>→ <i>High production costs:</i> Imported raw materials and potential increases in electricity tariffs could elevate production costs.</li> <li>→ <i>Import dependent for raw materials:</i> Major raw materials such as coke and charcoal are imported from India.</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>→ <i>Rising Indian steel production:</i> India's National Steel Policy 2017 and Production-Linked Incentive (PLI) scheme aim for 300 million MT steel capacity by 2030, ensuring long-term demand for ferroalloys.</li> <li>→ <i>Export diversification:</i> Growing markets in Europe and South East/East Asia present avenues to reduce dependence on India.</li> <li>→ <i>High-value product focus:</i> Inoculants and specialized alloys have higher margins and growing global demand in niche steel applications.</li> </ul>	<ul style="list-style-type: none"> <li>→ <i>Global price volatility:</i> Ferroalloy prices fluctuate with global steel demand, creating revenue instability.</li> <li>→ <i>Competition from larger producers:</i> Major exporters like China, Malaysia, and Norway enjoy economies of scale and could undercut Bhutan's prices in third markets.</li> <li>→ <i>Policy risks in India:</i> Changes in Indian trade policy, tariffs, or domestic ferroalloy production incentives could reduce Bhutan's market share.</li> <li>→ <i>Environmental concerns:</i></li> </ul>

<p>→ <i>Green branding potential:</i> Bhutan's hydropower-based production could position it as a supplier of "low-carbon ferroalloys," attractive to environmentally conscious buyers.</p> <p>→ <i>Joint ventures with Indian firms:</i> Collaborations could strengthen capital investment, technology transfer, and market access.</p>	<p>Despite hydropower reliance, ferroalloy smelting produces emissions; stricter regulations could raise costs. Increased production may lead to environmental challenges, necessitating sustainable practices.</p> <p>→ <i>Silicon metal impact:</i> Silicon metal is an alternative to ferro silicon and India's import of it has been on the rise.</p> <p>→ <i>Energy concerns:</i> Increase in electricity tariff may lead to loss of competitive edge ferro silicon production</p>
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## 6.2. Conclusion and Recommendations

Based on the market feasibility assessment, Bhutan's ferroalloy industry has demonstrated remarkable resilience and growth, firmly establishing itself as a key economic pillar. The analysis confirms that the industry is highly competitive, driven by its access to low-cost hydropower, a key advantage in energy-intensive production. Also, the significant expansion of India's steel industry presents a sustained opportunity for demand.

However, its long-term sustainability is contingent on navigating critical risks, primarily the over-reliance on the Indian market and vulnerability to imported raw material costs. Therefore, the industry must proactively implement strategies for diversification and leverage its strengths to mitigate risks and fully capitalize on the market availability. Moving forward, the industry's success will be defined not just by production volume, but by its capacity to adapt to evolving global market demands, particularly by positioning its products as high-value and environmentally sustainable.

In conclusion, Bhutan's ferroalloy industry holds strong market prospect supported by an established industry base, comparative advantage in affordable hydropower energy, and proximity to India's growing steel industry. However, there are also significant potential risks for the industry arising from over-reliance on the Indian market, raw material import dependency, and exposure to global price volatility. All things considered, the market feasibility assessment suggests that further investments in ferroalloy industries are

advisable, provided they are coupled with risk-mitigation strategies and a focus on sustainable, value-added production that aligns with evolving global steel industry demands.

To ensure long-term viability, the following strategies are recommended to mitigate the risks associated with market concentration and capitalize on new opportunities

### **6.2.1. Strategic market diversification**

Although India remains a crucial market, a targeted expansion strategy into other regions is essential to reduce over-reliance on a single market and mitigate risks associated with Indian policy shifts and market fluctuations. The European market shows potential to absorb Bhutan's ferroalloys as recent export data indicates promising growth for emerging markets like Italy, the Netherlands, and the UK who already have a robust industrial base. Particularly Italy, which has a strong and growing steel manufacturing sector, is the primary driver of ferroalloy demand in Europe and is also the second country after India for whom most of the export is drained to. Moreover, there are growing markets in North America, United Arab Emirates and East Asia where Bhutan's export has seen an upward trend.

### **6.2.2. Product and technology diversification**

While ferro silicon has a strong grip on the Indian market, expanding the product portfolio will help the industry capture new market segments and improve resilience against price volatility. For instance, industries can strategically invest in higher-value products such as ferrosilico manganese and inoculants, which the study identifies as having higher growth rates.

At the same time, adopting new production technologies that are energy-efficient will help in managing the power costs and enhance product quality, further reinforcing Bhutan's brand as a producer of high-quality, sustainable ferroalloys.

### **6.2.3. Leverage Green Branding**

Bhutan's production, powered by hydropower, offers a significant strategic advantage. The industry should actively market its ferroalloys as "low-carbon" products. This will help differentiate Bhutanese exports and attract environmentally conscious buyers in global steel supply chains, creating a unique competitive edge.

Bhutan's carbon-negative status and its use of hydropower for energy-intensive ferrosilicon production provide a significant competitive advantage in an increasingly sustainability-focused European market. This allows Bhutan to leverage its green credentials and strategically position its ferroalloy exports as a premium, low-carbon

alloy, aligning with the growing demand for sustainable inputs in global steel supply chains.

#### **6.2.4. Address Raw Material Dependency**

Efforts should be made to improve supply chain resilience by exploring domestic sources for key raw materials like quartz and charcoal, or by diversifying import sources beyond India to reduce vulnerability to supply disruptions and cost volatility.

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