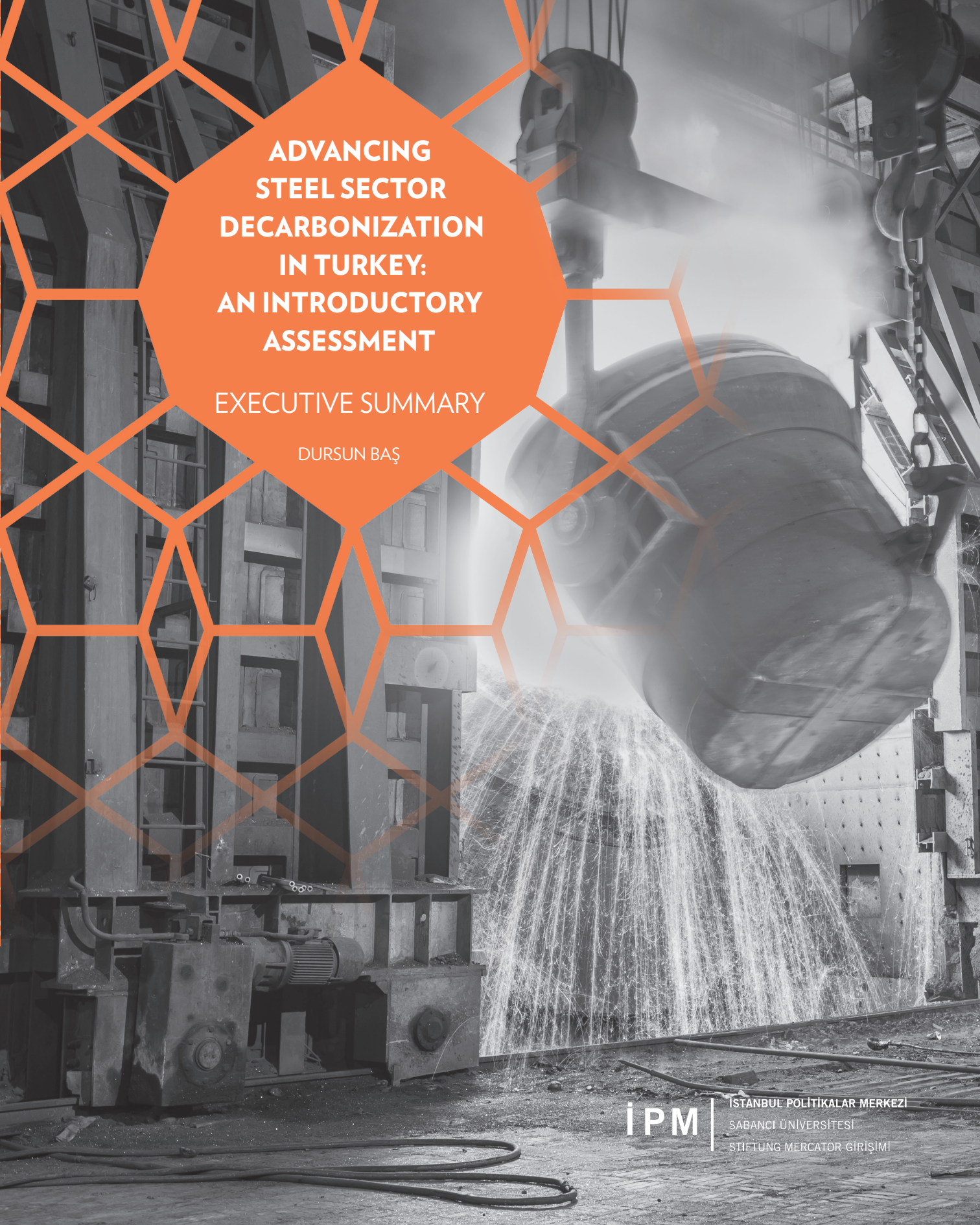

ADVANCING STEEL SECTOR DECARBONIZATION IN TURKEY: AN INTRODUCTORY ASSESSMENT

EXECUTIVE SUMMARY

DURSUN BAŞ

İPM
İSTANBUL POLİTİKALAR MERKEZİ
SABANCI ÜNİVERSİTESİ
STIFTUNG MERCATOR GİRİŞİMİ

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December 2023

Istanbul Policy Center (IPC)

Istanbul Policy Center (IPC) is a global policy research institution that specializes in key social and political issues ranging from democratization to climate change, transatlantic relations to conflict resolution and mediation. IPC organizes and conducts its research under six main clusters:

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Editor:

Dr. Ümit Şahin

Researcher and Author:

Dursun Baş

ABBREVIATIONS (SELECTED)

BF	Blast furnace
BFG	Blast furnace gas
BOF	Basic oxygen furnace
CBAM	Carbon border adjustment mechanism
CO_2	Carbon dioxide
COG	Coke oven gas
COP	Conference of the Parties
ÇİB	Turkish Steel Exporters' Association
DRI	Direct reduced iron
EAF	Electric arc furnace
EC	European Commission
ETS	EU Emissions Trading System
EU	European Union
GHG	Greenhouse gas
GDP	Gross domestic product
HBI	Hot-briquetted iron
IEA	International Energy Agency
IED	Industrial Energy Directive
IF	Induction furnace
INDC	Intended Nationally Determined Contribution
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial processes and product use
ISP	Integrated steel plant
LULUCF	Land use, land-use change and forestry
MoENR	Ministry of Energy and Natural Resources
MoEUCC	Ministry of Environment, Urbanization and Climate Change
MRV	Monitoring, reporting and verification
MS	Member states
NDC	Nationally Determined Contribution
NIR	National inventory report
RFCS	Research Fund for Coal and Steel
TÇÜD	Turkish Steel Producers' Association
TurkStat	Turkish Statistical Institute
UNFCCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

Turkey, which has recently announced its 2053 Net Zero target, also needs to define its binding targets for emission-intensive industrial sectors and develop the industrial decarbonization framework as soon as possible to create a conducive environment for financial, energy infrastructure, and regulatory conditions that will facilitate the achievement of these targets.

Turkey's Nationally Determined Contribution (NDC), initially declared in 2015 with revised targets revealed at the 27th Conference of the Parties (COP27) to the United Nations Framework Convention on Climate Change in November 2022, provides an overview of generic, albeit non-specific, measures for the industrial sector. The absence of a long-term legal framework defining obligatory reduction targets for high-emission industrial sectors remains unaddressed and has not been implemented to date.

THE IMPERATIVE OF FORMULATING A STRATEGIC PLAN FOR INDUSTRIAL DECARBONIZATION

Achieving a successful and just "Net Zero" transition in Turkey necessitates not only the decarbonization of the electricity sector but also the production of heavy industrial goods in accordance the principles of a circular economy, coupled with a reduction in the consumption of raw materials and energy in the manufacturing process. As a significant global exporter and consumer of heavy industrial products, Turkey is obligated to align with the mandates of the United Nations Framework Convention on Climate Change - Paris Agreement (UNFCCC/PA) and the European Union (EU) membership criteria. Concurrently, with the ascendancy of low-carbon steel production as the prevailing norm, maintaining competitiveness within its industrial sector necessitates the establishment of a comprehensive roadmap for the process of industrial decarbonization.

The IPC project "Decarbonization of the Turkish Steel Sector", is designed to assess the requirements and potential avenues for decarbonizing the 'iron and steel' industry. The primary objective is to furnish essential information and key indicators to pertinent stakeholders.

This report, developed under the project's purview, unveils the present state of the steel industry, delving into the sector's alignment with decarbonization endeavours through the presentation of analytical data and evaluative discussions.

OBJECTIVE OF THE REPORT:

Aligned with Turkey's long-term climate policies aimed at achieving a net-zero target, there is a crucial mandate to substantially reduce greenhouse gas emissions (GHG) not only in the energy sector but also in key industrial domains such as cement, iron-steel, petrochemicals, glass-ceramic, and refineries.

Focusing particularly on the iron and steel sector, recognized as the leading energy consumer and carbon emitter within the industrial landscape, understanding the sector's specific conditions, both past and present, is crucial to identifying the challenges and opportunities associated with its transformation toward decarbonization.

This report, titled *Advancing Steel Sector Decarbonization in Turkey: An Introductory Assessment,* is crafted to comprehensively elucidate the sector's status. Employing a steel production-consumption value chain approach, tracing from raw material extraction to the trade of final steel products, this comprehensive analysis aims to provide valuable insights for further studies focused on decarbonizing industrial production.

TURKISH IRON AND STEEL INDUSTRY

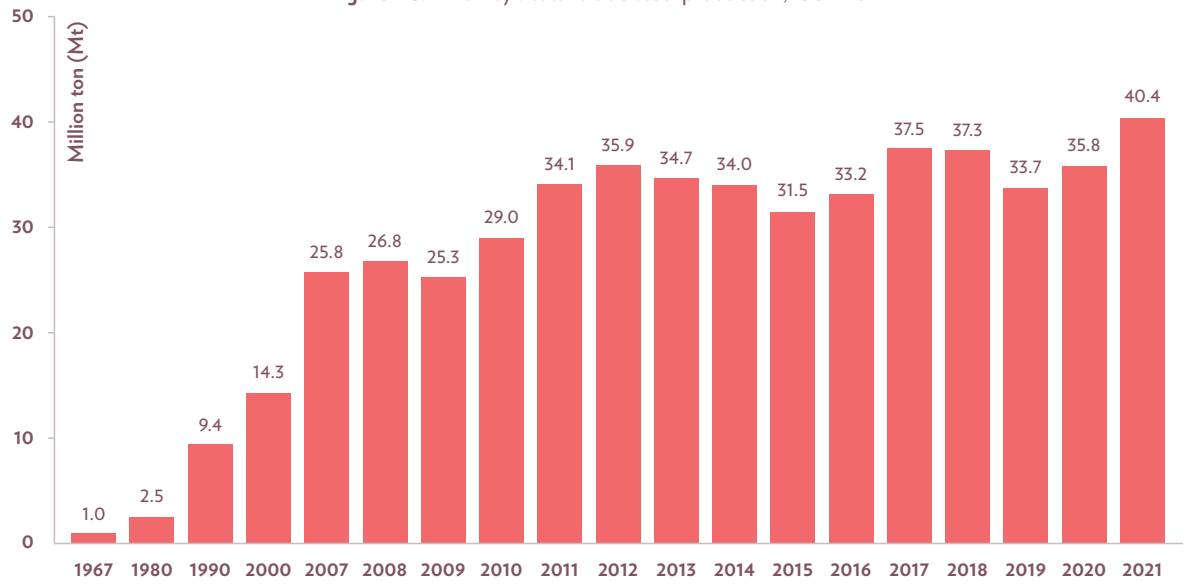
Since 1980, Turkey's iron and steel industry has witnessed remarkable growth, positioning itself among the fastest-growing sectors globally. As of 2021, the steel industry stands as Turkey's third-largest export sector, trailing only the automotive and chemical sectors, boasting an export value of USD 25 billion. Directly employing 55,000 individuals and indirectly supporting the livelihoods of 300,000 people, the sector plays a significant role in the country's economic landscape.[1]

Over the past two decades, there has been a twofold increase in steel production, imports, and exports. This surge is attributed to the simultaneous growth in both domestic consumption, driven by sectors such as construction and automotive, and the expansion of export volumes, collectively contributing to the industry's robust expansion.

In the span of two decades, Turkey has undergone a significant ascent in the global steel production landscape. From being the 17th largest steel producer in 2000, it has advanced to claim the 7th position by 2021. According to 2021 data from the World Steel Association (wordsteel), Turkey holds a prominent position as the world's 6th largest exporter and 5th largest importer of steel. Additionally, the country ranks as the leading global importer of scrap and the third-largest consumer of scrap.

The steel industry's robust growth is evident in the escalation of its total crude steel production, surging from 2.5 million tons (Mt) in 1980 to an impressive **40.4 Mt** in 2021. This substantial output now constitutes 2.1% of the world's total steel production, as illustrated in **Figure ES.1** and **Figure ES.2.**

Figure ES.1– Turkey's total crude steel production, 1967–2021



1 While presenting information on the production, consumption, foreign trade, raw material use, energy consumption, and CO_2 emissions of the iron and steel industry in the report, the year 2021, when the most reliable data was accessible, was taken as the base year.

Figure ES.2 – Major crude steel producers (Mt), 2021

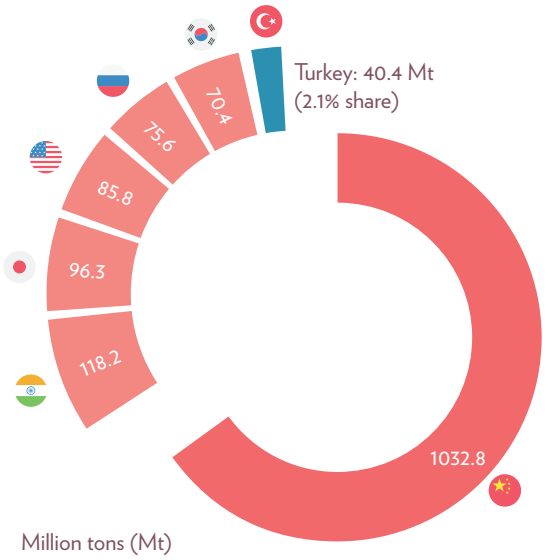
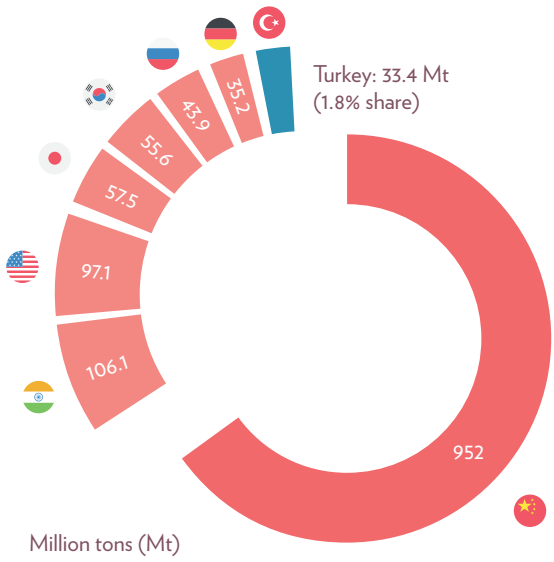


Figure ES.3 – Major apparent steel users (Mt), 2021



According to 2021 data, Turkey is the 8th largest consumer (1.8% share) of apparent steel in the world, using **33.4 Mt.** Turkey has witnessed a threefold increase in its consumption of steel products since the year 2000. Peak consumption, reaching 36 Mt, was recorded in 2017. Primary consumers of steel include manufacturing industries such as automotive, machinery, white goods, and shipbuilding, as well as the infrastructure and construction sectors (**Figure ES.3**).

IRON STEEL INDUSTRY FOREIGN TRADE BALANCE

Despite a trade surplus in final steel products, the Turkish steel industry faces a trade deficit when considering all inputs and raw materials used in production. The Turkish steel industry is a net importer of iron ore, scrap, and coal as well as refractory materials and electrodes. The industry relies heavily on imports, with over 70% of scrap, over 90% of coke, and over 60% of iron ore being imported. Therefore, securing affordable and reliable supplies of these materials is a critical challenge for Turkish steel producers (**Table ES.1**).

The sector's heavy dependence on imported raw materials and inputs is underscored by their substantial share in total imports. Turkish Statistical Institute (TURKSTAT) data indicates that raw material imports of the sector in 2021 amounted to approximately USD 16.1 billion, representing 6% of the country's total imports. Scrap and iron ore imports, in particular, play a critical role, accounting for 70% of the sector's import value (**Table 43**).

Table ES.1 – Iron and steel sector foreign trade balance, 2021

Products and raw materials	Export		Import	
	Quantity (thousand tons)	Value (Million USD)	Quantity (thousand tons)	Value (Million USD)
Steel Products				
Semi-products (billet, slab)	1,067	737	4,596	3,095
Flat products	6,703	7,280	9,430	9,765
Long products	12,089	8,526	1,339	1,510
Sub-total of steel products	**19,889**	**16,543**	**15,365**	**14,370**
Pipes	1,946	2,089	451	855
Other steel products	2,877	6,449	381	1,743
All steel products	**24,682**	**25,081**	**16,197**	**16,968**
Raw Materials				
Pig iron	4	3	1,200	681
Ferro alloys	184	333	544	926
Sponge iron	0	0	276	128
Scrap	194	308	25,072	11,155
Iron ore	3,812	432	11,188	2,042
Coking coal	0	0	5,521	932
Graphite electrode	1	2	48	226
Total raw materials	**4,195**	**1,078**	**43,849**	**16,090**

(Source: Ministry of Industry and Technology)

CRUDE STEEL PRODUCTION PLANTS AND THEIR SHARE IN PRODUCTION

As of 2022, Turkey has a total of 41 crude steel production facilities, including 27 electric arc furnace (EAF) plants, 11 induction furnace (IF) plants,[2] and three integrated steel plants[3] (blast furnace – BF; basic oxygen furnace – BOF) (**Figure ES.4**)

Notably, in 2021, İsdemir and Erdemir integrated steel plants produced over half of Turkey's finished flat steel products. Additionally, EAF plants accounted for approximately 90% of finished long steel production in 2021 (**Table 34**).

In the year 2021, EAF and IF plants accounted for 72% of total crude steel production. İsdemir and Erdemir integrated plants were responsible for producing over half of the final flat steel products. Notably, EAF facilities contributed to approximately 90% of the final long steel products, as detailed in **Table ES.2**.

2 The report incorporated the production figures of IF plants into the overall production figures of EAF plants.

3 Turkey's integrated steel industry is anchored by three key players: Erdemir, İsdemir, and Kardemir, where 'demir' signifies 'iron' in Turkish.

Figure ES.4 – Map of Turkey's crude steel production plants, 2021

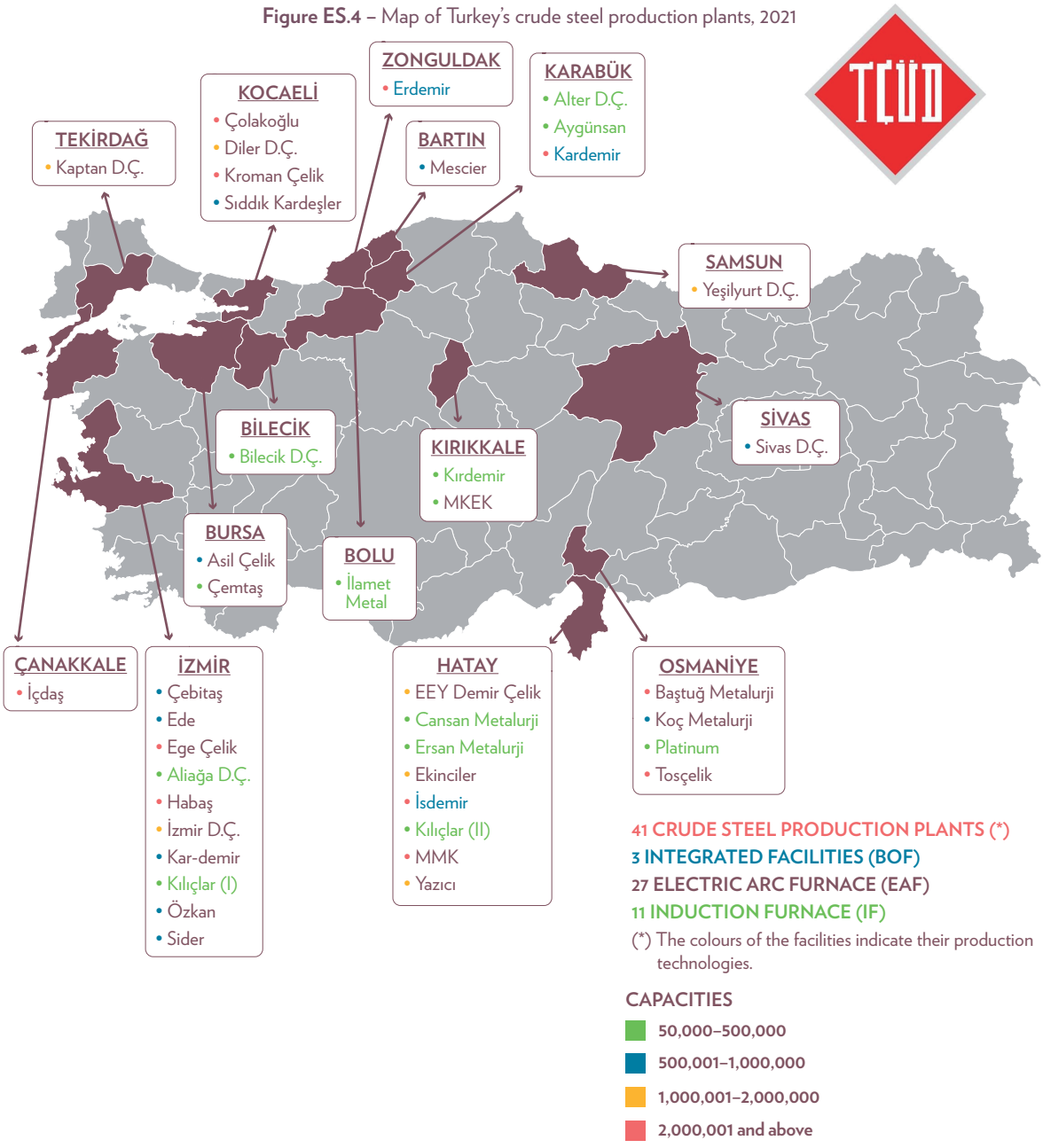


Table ES.2 – Data on crude steel production from integrated plants and EAF plants, 2021.

Plant Type	Producers	Crude Steel Production (Mt - %)	Slab (Mt - %)	Billet (Mt - %)	Total Final Product (Mt)	Final product Flat (Mt)	Final product Long (Mt)
BF/BOF Integrated plants	Kardemir	2.3 (6%)	-	2.3 (9%)	2.3 (6%)	-	2.4 (9%)
	İsdemir	5.7 (14%)	4.8 (34%)	0.9 (3%)	4.0 (10%)	3.2 (21%)	0.9 (3%)
	Erdemir	3.3 (8%)	3.3 (24%)	-	4.4 (11%)	4.4 (30%)	-
	Integrated plants total	11.5 (28%)	8.2 (57%)	3.3 (13%)	10.7 (26%)	7.5 (51%)	3,204 (12%)
Facilities with EAF/IF[4]	EAF and IF total facilities	28.9 (72%)	6.0 (43%)	22.8 (87%)	30.7 (74%)	7.1 (49%)	23.6 (88%)
Total	**All facilities**	**40.4 (100%)**	**14.2 (100%)**	**26.1 (100%)**	**41.4* (100%)**	**14.6* (100%)**	**26.8* (100%)**

*It also includes small steel production facilities that do not have steel mills but manufacture final products from purchased semi-finished products.

The Turkish steel industrial players are located primarily in the coastal regions of the Marmara Sea, the Black Sea, the Aegean Sea (Izmir), and the Mediterranean Sea (Osmaniye and Hatay). The accompanying map provides details on crude steel producers in Turkey, categorizing them based on production route and capacity (**Figure ES.4**).

STEEL INDUSTRY'S ENERGY FOOTPRINT IN TURKEY

As per the 2021 National Energy Balance Table released by the Ministry of Energy and Natural Resources (MoENR), *the Basic Metals Industry* sector contributes around 10% to final energy consumption. Among the components of this sector, crude steel producers account for the most significant portion of energy consumption. The Basic Metals Industry sector has witnessed a doubling of energy consumption due to the substantial growth in crude steel production capacity since 2000.

The sub-sector *"Iron and Steel Products Manufacturing,"* which falls under the Basics Metal Industry sector, contributes to 7% of the overall final energy consumption and 22% of the total industrial energy consumption (**Table ES.3**).

The *"Iron and Steel Products Manufacturing"* sub-sector accounts for approximately

- 7% of total final consumption
- 22% of industrial energy consumption

From the 1980s until the 2020s, the "Iron and Steel Products Manufacturing" sub-sector has consistently held a substantial portion of the overall sectoral consumption. The majority of the consumption of this sub-sector belongs to crude steel production plants.

4 Although EAF and IF basically have the same process steps; they differ in terms of the working principle of the furnace and the scrap sizes fed into the furnace. In EAFs, the arc created with a graphite electrode is used to melt the scrap, while in IOs, heat generated by induced currents due to the electromagnetic field created by a coil placed inside the furnace and surrounding the furnace is utilized.

Table ES.3 – Final energy consumption data for the "Iron and Steel Products Manufacturing" sub-sector, 1980–2021 (Data source: MoENR)

Energy consumption	1980	1990	2000	2010	2020	2021
Final energy consumption of *Iron and Steel Products Manufacturing* sub-sector (million toe)	1.0	3.6	4.5	6.2	8.5	9.1
Share of the subsector in final energy consumption (%)	5.0	9.0	7.0	8.0	7.6	7.4
The subsector's share in industrial final energy consumption (%)	21	27	20	24	23.6	21.9
Final energy consumption of industry (million toe)	4.8	13.6	22.9	26.1	36.2	42.0
Final energy consumption (million toe)	19.6	42.2	61	79.2	113.1	124.0

The primary energy sources employed in the "*Iron and Steel Products Manufacturing*" sub-sector include coke, electricity, natural gas, and hard coal. The sector accounts for 96% of coke consumption, 14% of hard coal consumption, 10% of electricity consumption, and 5% of natural gas consumption.

ENERGY SOURCE BREAKDOWN IN INTEGRATED IRON-STEEL PLANTS AND EAF PLANTS

Around 90% of the energy consumed in integrated plants in Turkey is derived from coal. For EAF plants, the energy composition, dependent on the facility's final product type and various parameters, is predominantly electrical, constituting approximately 60%. These facilities also exhibit significant consumption of natural gas.

Based on the 2019 iron and steel industry benchmarking studies[5] conducted by MoENR, the distribution of energy resources in integrated facilities and EAF facilities is as follows:

- In **integrated steel plants[6]:** Coal: 89.8%; Natural gas: 6.7%; Electricity: 3.5%
- In **EAF plants:** Electricity: 55.1%; Natural gas: 32.2%; Coal: 12.6%; Other sources: 0.1%

The majority of energy consumption in integrated facilities occurs in the BF unit, while in EAF facilities, it is primarily utilized in the steel mill at EAF unit.

Energy use of integrated iron and steel plants

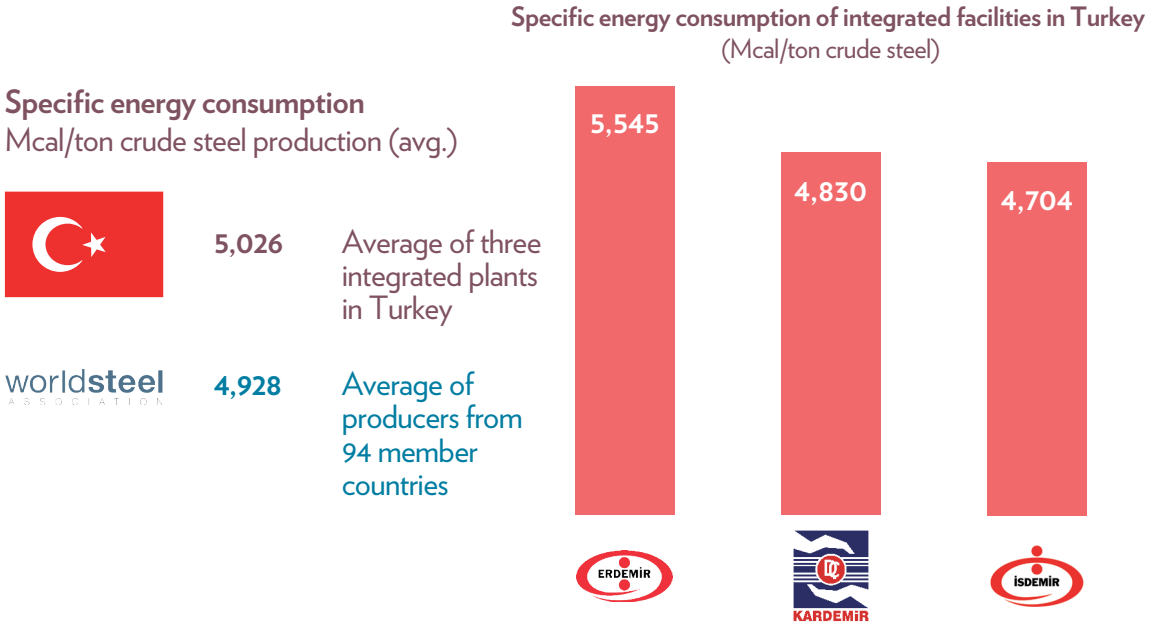
As per worldsteel, the average energy consumption for producing one ton of crude steel in 94 member countries is 4,928 Mcal. Turkish integrated steel plants, based on data from private companies' annual reports, have an average energy consumption of around 5,000 Mcal per ton of crude steel (**Figure ES.5**).

Based on the Turkish Steel Producers Association (TÇÜD) data from 2000, integrated steel plants have achieved a reduction of about 26.5% in total energy consumption per ton of crude steel production by 2021. The figure, which stood at 6,842 Mcal in 2000, decreased to 5,026 Mcal in 2021.

5 The 'Iron and Steel Sector Benchmarking Studies' conducted by MoENR (DG Energy Efficiency and Environment, Planning and Inspection Department, Measurement and Assessment Group) offers a broad evaluation of the sector's energy consumption. It's important to note that the study, while informative, does not encompass all crude steel producers.

6 The specified coal consumption value aligns with the quantity utilized in integrated steel plants for electricity and coke production. The electrical energy consumption value encompasses purchased electricity (electrical energy produced within facilities excluded from this metric).

Figure ES.5 – Specific energy consumption data for integrated iron and steel facilities in Turkey and worldsteel member countries, 2021



Energy use of EAF plants

As per the 2019 iron and steel sector benchmarking studies by MoENR, the overall energy consumption in EAF plants varies. The weighted average of the facilities covered in the study is approximately 600 MCal per ton of liquid steel for the steel mill stage and 1,000 MCal per ton of steel product for the rolled product.

GHG EMISSIONS OF INTEGRATED STEEL PLANTS, 2021 (estimated)

In Turkish integrated steel production facilities, much like those in other parts of the world, the production process involves sinter production units, coke plants, blast furnaces for pig iron production, and basic oxygen furnaces for liquid steel. Out of these processes, blast furnaces are the primary emitters of GHGs.

GHG emissions of Kardemir integrated iron and steel plant, 2021

Kardemir integrated steel plant produced around 2.5 Mt of crude steel in 2021. According to the company's 2021 sustainability report, a total of **6.1 MtCO_2e** were emitted as part of Kardemir's operations. The GHG emissions for each ton of steel produced amount to 2.32 tCO_2e (**Figures ES.6** and **ES.7**).

Figure ES.6 – GHG intensity of the crude steel production (ton CO_2e/ton crude steel) at Kardemir Iron and Steel Plant.

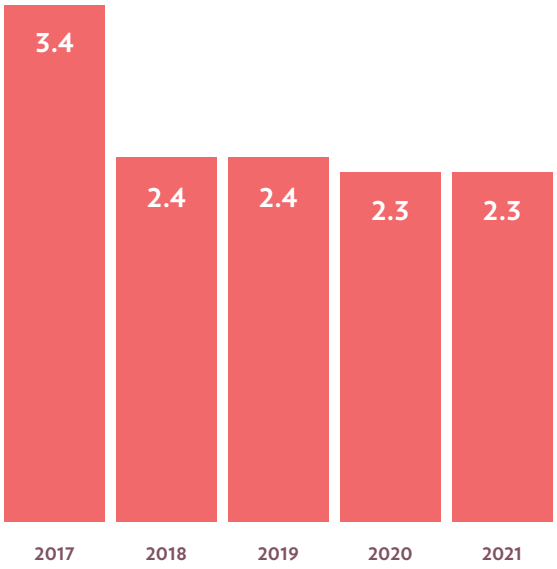
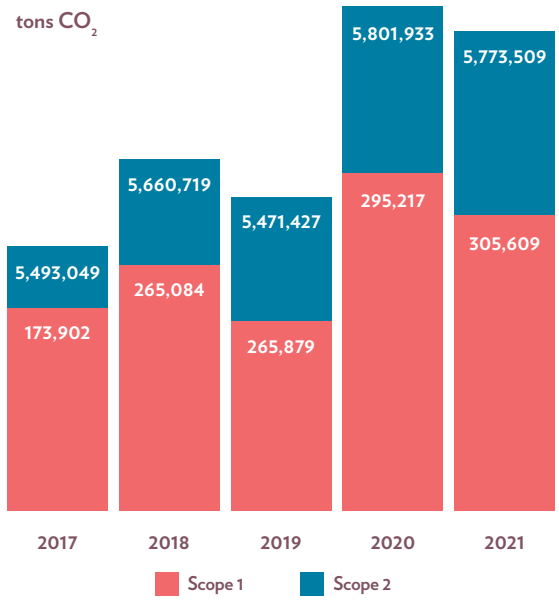


Figure ES.7 – Scope 1 and Scope 2 CO_2e emissions (tCO_2e) of Kardemir Iron and Steel Plant.



GHG emissions of Erdemir and İsdemir integrated iron and steel plants (estimated), 2021

The GHG emissions from Erdemir and İsdemir integrated plants have not been publicly disclosed. In estimating the GHG emissions for these facilities, a value of 2.1 tons of CO_2e per ton of crude steel produced was assumed. The combined crude steel production of these two facilities reached about 9 Mt in 2021 (Erdemir – 3.3 Mt and İsdemir – 5.7 Mt). Consequently, the total emissions from both plants (Scope 1 and 2) are projected to be approximately **19 $MtCO_2e$** (İsdemir: 12.0 $MtCO_2e$, Erdemir: 6.9 $MtCO_2e$).

Total estimated GHG emissions for integrated facilities, 2021

Based on available data and the crude steel production figures for 2021, the total GHG emissions from integrated steel plants in Turkey are estimated to be around **25 $MtCO_2e$** (**Table ES.4**).

Table ES.4 – GHG estimations for integrated steel plants, 2021

Integrated Steel Plant	Mt CO_2e
Kardemir	6.1
Erdemir (estimated)	6.9
İsdemir (estimated)	12.0
Total	**25.0**

GHG Emissions from EAF Plants, 2021 (estimated)

The CO_2 intensity of EAF facilities is contingent on factors such as the iron type used in production (pig iron or scrap), the sources of electricity, and operational efficiency. The primary sources of emissions in the EAF production route include electricity generation, the use of natural gas as fuel, carbon reacting with oxygen in the steel bath, flammable materials from scrap, and the utilization of graphite electrodes and refractories.

For this study, an average of 0.51 tons of CO_2 equivalent per ton of crude steel (tCO_2e/ton-crude steel) was assumed for both Scope 1 and Scope 2 emissions from EAF plants in Turkey. Considering this estimate, the combined Scope 1 and 2 emissions from EAF plants, which produced 28.9 Mt of crude steel in 2021, are projected to be approximately **15 $MtCO_2e$**.

ESTIMATED CO_2 EMISSIONS PER TON OF ROLLED PRODUCT FROM EAF PLANTS

As per assessments by industry experts, the average combined Scope 1 and 2 emissions from EAF steel producers amount to approximately 0.5–0.7 tons of CO_2 for each ton of rolled product. This figure falls within the range of about 0.7–0.9 tons of CO_2 per ton of rolled steel when considering Scope 1, 2, and 3 emissions (**Table ES.5**).

Notably, around 27% of the overall emissions stem from Scope 1 emissions linked to production, while nearly half (46%) are Scope 2 emissions, representing indirect emissions. The remaining 27% comprises Scope 3 emissions.

Table ES.5 - CO_2 emissions of EAF plants per ton of rolled product production

kg CO_2 per ton of rolled product	Scope
188 – 243	Scope 1
320 – 414	Scope 2
188 – 243	Scope 3
508 – 657	Scope 1 and 2
696 – 900	Scope 1, 2 and 3

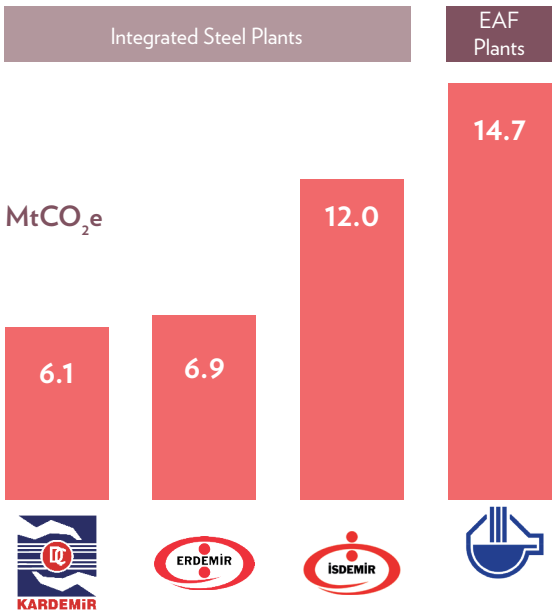
Source: Expert evaluation, Muammer Bilgiç, Bilecik Demir Steel Inc.

Total GHG Emissions Of Turkish Crude Steel Producers (2021 – estimated)

Based on gathered data and estimates, crude steel producers, responsible for producing 40 Mt of crude steel in 2021, contributed to approximately 40 $MtCO_2e$ (Scope 1 and 2) (see **Figure ES.8**). This value accounts for 7% of Turkey's total emissions in 2021:

- Integrated iron and steel plants constituted 63% (**25.0 Mt CO_2e**) of the GHG emissions from the crude steel producers,
- The majority of emissions from EAF plants (**15 Mt CO_2e**) result from indirect emissions during electricity production sourced from the grid and the combustion of natural gas/coal within the facility.

Figure ES.8 – GHG emissions of Turkish crude steel producers, 2021 (estimated)



PRODUCTION ROUTE-BASED CO_2 EMISSION INTENSITY DATA FOR TURKEY AND SELECTED COUNTRIES

As per emission intensity data for crude steel production released by the EU Joint Research Center (JRC), Turkey exhibits a weighted average of approximately 1 ton of CO_2 per ton of steel, which is the second-lowest value globally, following the United States, owing to its significant EAF capacity (**Figure ES.9** and **Figure ES.10**).

Figure ES.9 – Emission intensities and weighted averages of BF-BOF and EAF production routes (Scope 1 and 2)

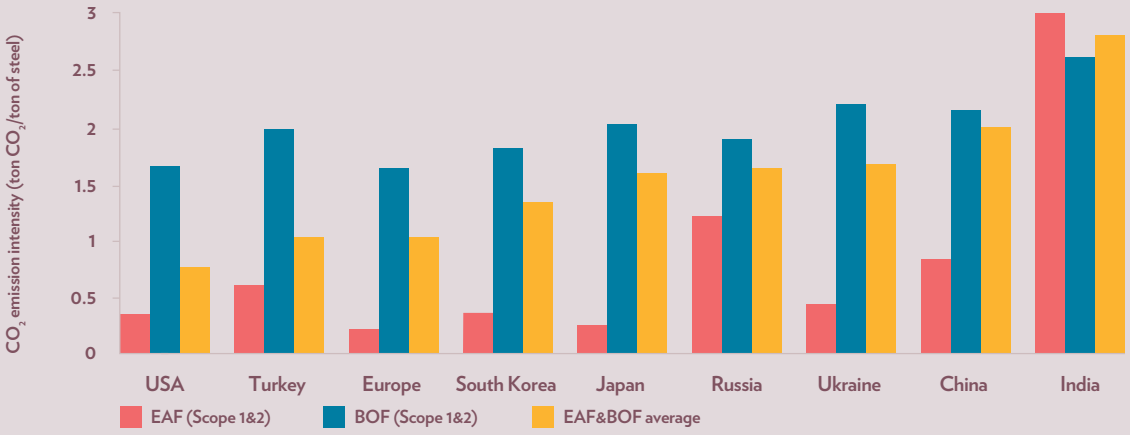
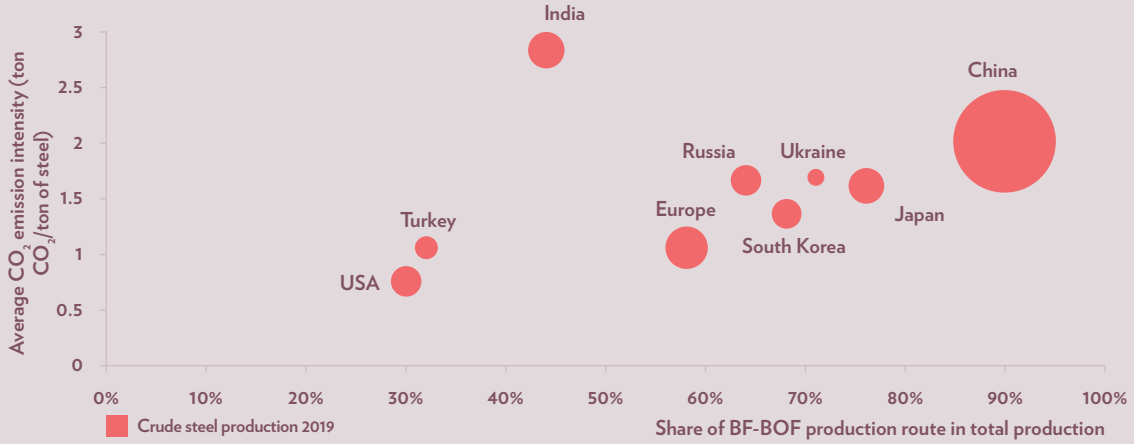


Figure ES.10 – Average CO_2 emission intensity (combining all production methods by country), BF-BOF share, and total steel production in 2019



Source: KOOLEN, Derck, and Danko VIDOVIC. "Greenhouse Gas Intensities of the EU Steel Industry and Its Trading Partners." JRC Publications Repository, 2022. https://publications.jrc.ec.europa.eu/repository/handle/JRC129297.

In contrast, Turkey ranks as the fourth-highest globally in CO_2 intensity for the EAF production route, with 0.6 tons of CO_2 emitted per ton of steel, following India, Russia, and China.

While Turkey's CO_2 intensity for the BF-BOF steel production route falls below the global average at 2 tons of CO_2 per ton of steel, it exceeds the values achieved by Europe, the USA, and South Korea (**Figure ES.9**).

In terms of Scope 1 emissions, Turkish crude steel producers exhibit a relatively lower average CO_2 intensity when compared to their global counterparts. However, when Scope 1, 2, and 3 emissions are collectively considered, the CO_2 emission value per unit production increases due to the high CO_2 intensity of electricity production (Scope 2) and the emissions associated with raw material extraction/logistics (Scope 3).

Table ES.5 – Key figures of the sector

Production	Consumption	Export	Import
Crude steel production 40.4 Mt (2021)	**Steel consumption** 33.4 Mt (2021)	**Steel exports** 24.7 Mt of steel products (2021)	**Steel imports** 16.2 Mt of steel products (2021)
Billet production 26.1 Mt (2021)	**Scrap consumption** 35 Mt (2021)	**Long product exports** 12,1 Mt (2021)	**Share of imports in steel consumption** Turkey's steel imports constitute more than half of the total domestic steel consumption (2021)
Slab production 14.2 Mt (2021)	**Final energy consumption** 7% of total final energy use (2021)	**Flat product exports** 6.7 Mt (2021)	**Scrap imports** 25.1 Mt (2021)
Iron ore production 8.3 Mt (2020) 16 Mt run-of-mine iron ore production (2021)	**Industrial energy consumption** 22% of the final energy used by the industrial sector (2021)		**Coke imports** 5.5 Mt of coking coal coke imports (2021)
Amount of slag More than 6 Mt of slag were formed (2021)	**Hard coal use** 28% of hard coal used by the industrial sector (2021)	**Iron ore exports** 3.8 Mt (2021)	**Iron ore imports** 11.2 Mt (2021)

OVERALL ASSESSMENTS FROM THE REPORT

Formulating Policies to Achieve Net-Zero Emissions in the Sector and Identifying Financial Mechanisms to Support These Policies

The Turkish steel industry and steel-consuming sectors (including automotive, machinery, construction, and others) are anticipated to encounter diverse challenges in aligning with the targets of the Paris Agreement and the EU Green Deal, contingent on the investment decisions and business paths they choose.

Hence, the Turkish Government must establish realistic and legally binding long-term goals for the heavy industry sectors, including steel, while providing clear rules and procedures for these objectives. Ultimately, a reassessment of policies related to financing and budget infrastructure is imperative to align with the Paris Agreement and comply with the climate targets set by the EU.

A successful decarbonization transition in the steel industry will be possible with a more comprehensive economic and societal approach, beyond pilot projects focusing on the goal of producing low-carbon steel, to which large financial resources will be transferred.

To maximize resource and energy efficiency, Turkey should leverage its limited financial and human resources by adopting the best available techniques in steel production processes, utilizing new input materials, increasing the electrification rate and reliance on renewable energy sources, and promoting the development of demand-side methods.

Reliance on Imported Raw Materials and Challenges in Securing a Stable Supply

Despite the relatively advantageous position of the Turkish crude steel production sector in terms of average CO_2 intensity (thanks to the high prevalence of EAF facilities), it may encounter competitiveness challenges due to escalating raw material and energy costs, along with potential shortages in the supply of scrap metal.

Turkey could face difficulties in accessing quality and affordable scrap metal in the near future, especially as the number of EAF plant investments focusing on low-carbon steel production increases in major steel-producing regions and countries.

Additionally, the expectation of rising export taxes and legislative measures restricting scrap exports adds to the challenges. It is advisable for sector representatives and relevant public administrations to collaborate on a roadmap to enhance national scrap management in key scrap-producing sectors (such as automotive, construction, machinery, and agricultural machinery) to boost the availability of high-quality scrap.

Improving Performance in Occupational Safety and Concerns Related to Environmental Health

Persistent shortcomings in compliance with environmental, public, and occupational health regulations across the steel production value chain in Turkey, spanning from ore extraction to scrap recycling, as well as indoor and outdoor air pollution exposures, are anticipated to be rectified.

It is imperative for public administrations and plant owners to make necessary investments to meet the legal requirements outlined in pollution prevention and control legislation. This pertains to the indoor air quality management of crude steel production facilities, control of hazardous substances in flue gases, and management of slag.

A similar imperative exists for the management of hazardous waste (including asbestos, heavy metals, and PCBs) in ship dismantling facilities, where significant quantities of scrap are recycled and disposed of. The prevalent method in ship dismantling yards poses an ongoing pollution challenge for marine and coastal ecosystems in areas where dismantling operations occur.

There is a need to amplify initiatives and programs ensuring that industrial pollution prevention and control measures align with the goal of low-carbon production.

Establishing the Legal Framework for State Aid

Turkish producers view the constraints established by the Turkey-ECSC Free Trade Agreement regarding state aid as hindrances to the industry's advancement towards sectoral decarbonisation.

Additionally, steel producers advocate for the implementation of "incentives" similar to those in the EU for investments in low-carbon steel production. However, the legal framework governing the Turkish steel industry's access to state aid under the Turkey-ECSC Free Trade Agreement is currently unclear.

Given the pressing need for technological advancements in low-carbon steel production, it is imperative that the ongoing negotiations between Turkey and the European Commission be expeditiously concluded, leading to the establishment of a clear legal framework that will facilitate the implementation of state-backed technological investments while adhering to competition regulations within the steel sector.

The Capability of Turkey to Take the Lead in Low-Carbon Steel Manufacturing

In the impending landscape, where potential trade restrictions on scrap metal and forthcoming US and EU regulations (such as carbon border tax legislation) pose a risk, there is a potential loss of global competitiveness unless the Turkish steel sector proactively adapts to evolving market conditions.

By the end of 2022, Turkish crude steel producers have outlined plans to increase production capacities, particularly in EAF facilities. However, the level of investment in low-carbon steel production, encompassing new technological advancements in manufacturing processes, metallurgical efficiency, and scrap management, remains insufficient to enhance energy consumption and emission reduction performance.

Consequently, these planned investments must be strategically designed to bolster the sector's competitiveness, considering the challenges faced in raw material supply (iron ore and scrap) and access to financing for low-carbon steel production technologies and investments.

Enhancing decarbonization performance throughout the steel production and consumption value chain will strengthen the capacity to meet market demands for low-carbon steel products. Approaching decarbonization initiatives and emerging regulations as opportunities that enhance competitiveness, rather than mere challenges, will facilitate the management of the transition process.

It should be emphasized that ongoing efforts to comply with EU climate and trade regulations not only fulfill mandated legal requirements for CO_2 emissions but also extend beyond these requirements, generating broader social and economic co-benefits as steel producers enhance occupational safety, environmental health, and energy/resource efficiency performance.

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İstanbul Politikalar Merkezi
Bankalar Caddesi No: 2 Minerva Han 34420
Karaköy, İstanbul Türkiye
+90 212 292 49 39
+90 212 292 49 57
@ ipc@sabanciuniv.edu
w ipc.sabanciuniv.edu