Global Energy Monitor

BRIEFING: FEBRUARY 2024

Russia doubles down on coal-based steelmaking, even as opportunity grows for greener technology

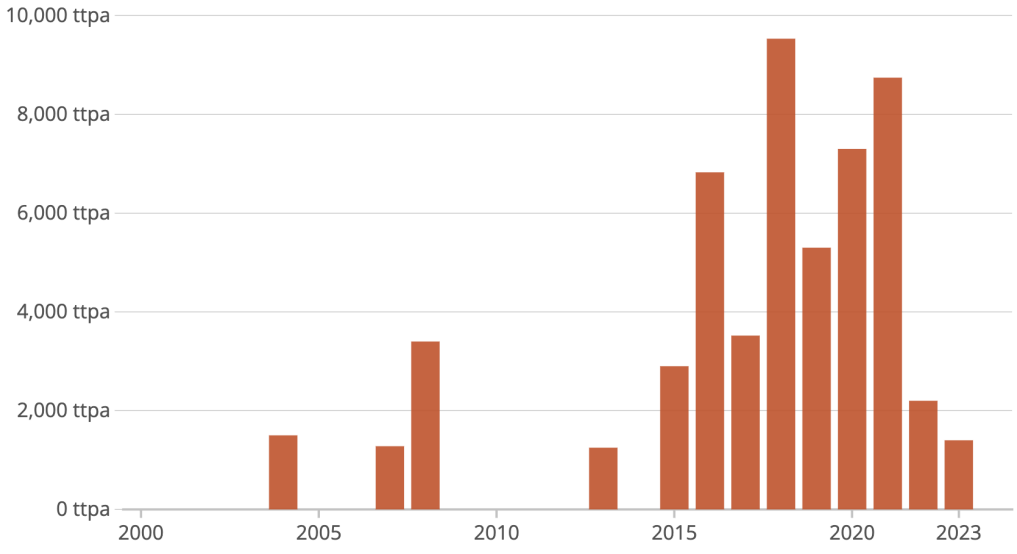
Introduction

Russia's large steel industry is dominated by emissions-intensive, coal-based blast furnace-basic oxygen furnace (BF-BOF) steelmaking technology. However, the opportunity to switch to low-emissions electric arc furnace (EAF) steel production is growing in response to pressure from international decarbonization initiatives, including carbon tariffs and corporate climate disclosures.

Despite this opportunity, Russia continues to cling to dirty steelmaking technologies by refurbishing blast furnaces through relinings, rather than investing in new, low-emissions direct reduced iron (DRI) production (Figure 1).

Recent relinings prolong the life of Russia's coal-based steel capacity

Relinings or new capacity added at Russian steel plants, in thousand tonnes per year (ttpa)



Source: Global Blast Furnace Tracker, Global Energy Monitor

Figure 1

In 2022, Russia was the fifth-largest producer of steel, with a total annual production of 71.5 million tonnes. Nearly two-thirds of Russia's steel industry uses the coal-based BF-BOF steelmaking route (Table 1). The country also has smaller amounts of less carbon-intensive steelmaking processes, including scrap-based EAF and DRI-fed EAFs.

The most promising technology for decarbonizing the steel industry is hydrogen-based DRI-EAF production, which can fully replace BF-BOF steelmaking. Currently, Russia's DRI units operate using fossil fuels, but they could be modified or replaced with hydrogen-based units.

Table 1. Russian steelmaking capacity by technology

Technology	Total operating capacity (ttpa)	Share of capacity (%)
BF-BOF	53,79	60.9%
DRI-EAF	7,900	8.9%
EAF	26,701	30.2%
Total	88,400	100.0%

Table 2. Russian iron and steelmaking units

Technology	Operating units (N)	Total operating capacity (ttpa)*
Ironmaking		
BF	34	59,167
DRI	7	7,900
Steelmaking		
BOF	19	53,799
EAF	40	34,601

**Operating capacity represents total nominal capacity. It's unclear if the units are operating to the fullest capacity.*

Pressure to decarbonize

While Russia's national plan for decarbonization has been deemed critically insufficient, international pressures from carbon tariffs and corporate climate disclosures mean that the country's export-heavy iron and steel industry will need to act.

One such pressure, the EU Carbon Border Adjustment Mechanism (CBAM), entered into force in October 2023 and will be in full effect starting in 2026. Unless Russian industry cleans up its production routes, Russian exports to the EU are expected to become more difficult and expensive due to carbon pricing.

Although Russian steel companies were impacted by EU sanctions applied in response to Russia's invasion of Ukraine, extended grace periods have enabled Russia to maintain the EU as a main customer of iron and steel product exports.

For example, the latest EU sanctions package extended the grace period for Russian steel slab imports through 2028, rather than the original plan to stop imports in 2024. While the EU market has gradually decreased Russian iron and steel imports, the lack of consistency in restrictions leaves steel trade experts predicting that Russia will continue trade with the EU, thus becoming subject to CBAM.

In addition, corporate sustainability reporting is now mandatory in the EU under the Corporate Sustainability Reporting Directive and is set to become mandatory in the United States next year under the Securities and Exchange Commission's Climate Rule. While these rules mainly target the EU and U.S.-based companies, respectively, they will also affect tens of thousands of companies globally, including exporters from Russia.

Hanging on to coal-based blast furnaces

Despite the mounting pressures of international decarbonization efforts, numerous reconstruction and modernization works keep Russian coal-based blast furnaces online. While Russia has operated many blast furnaces for decades, regular reconstruction works have renewed the lifecycle of units, positioning the Russian blast furnace fleet to continue operating for many years to come unless there is a change in current operations (Figure 2).

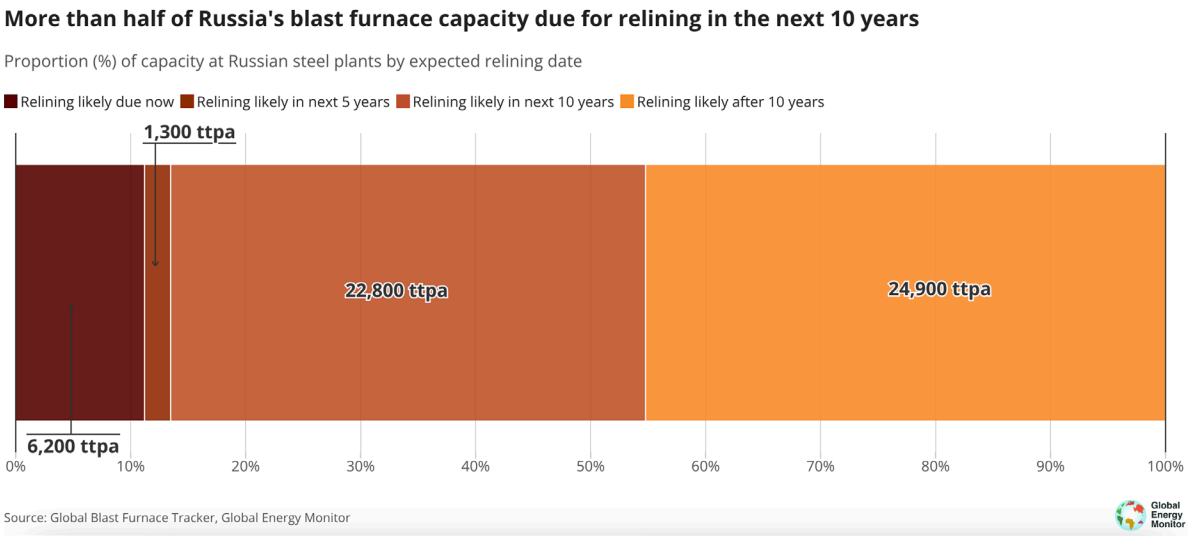


Figure 2

Russian steel companies have investment plans to build new and refurbish old blast furnaces and associated infrastructure, including new units equipped with carbon capture and storage projects (Table 3).

Carbon capture and storage (CCS) has not yet been proven at scale in the iron and steel industry, and even if top capture rates are achieved, CCS is limited in its ability to decarbonize the BF-BOF process. Instead, these investments could be redirected to a transition away from BF-BOF processes and towards hydrogen-based DRI-EAF steelmaking, creating domestic demand for hydrogen, which the country currently lacks.

Table 3. Prospective iron and steelmaking units in Russia

Plant name	Owner company	Parent company	Technology	Unit capacity (ttpa)	Status	Expected start date
Amurstal steel plant	Amurstal LLC	Armada JSC	DRI	Unknown	Announced (2019)	Unknown
Donelektrostal Shakhty steel plant	Donelektrostal LLC	Donelektrostal LLC	DRI	Unknown	Construction	Unknown
Lebedinsky GOK DRI Plant	Lebedinskiy GOK JSC	Metalloinvest LLC	DRI	2080	Announced (2020)	2025
Metalloinvest Mikhailovsky HBI plant	Mikhailovsky HBI LLC	Metalloinvest LLC	DRI	2080	Announced	2025
Ecolant steel plant	Ecolant LLC	Ecolant LLC	DRI	2500	Construction	2025
Amurstal steel plant	Amurstal LLC	Armada JSC	EAF	850	Announced	Unknown
Metalloinvest OEMK steel plant	Oskol'skiy Elektrometallurgicheskiy Kombinat Imeni Alekseya Alekseyevicha Ugarova JSC	Metalloinvest LLC	EAF	1200	Announced	Unknown
Ecolant steel plant	Ecolant LLC	Ecolant LLC	EAF	1800	Construction	Unknown
Balakovo Steel Plant	MZ Balakovo JSC	Abinsk Electrometallurgical Plant LLC	EAF	1500	Construction	Unknown
Donelektrostal Shakhty steel plant	Donelektrostal LLC	Donelektrostal LLC	EAF	Unknown	Construction	Unknown
Magnitogorsk Iron & Steel Works	Magnitogorskiy Metallurgicheskiy Kombinat PJSC	Magnitogorskiy Metallurgicheskiy Kombinat PJSC	BF	3700	Announced	Unknown

Russia's hydrogen production strategy

Russia has a plan to produce 550 thousand tonnes of hydrogen per annum (ttpa), but it currently faces major challenges with limited options for export and few incentives to encourage domestic consumption. Russia's hydrogen strategy initially focused on exports to the EU, but, in the face of energy export sanctions, has pivoted to hydrogen production intended for domestic consumption. Russia's main hydrogen goal is to become a prominent producer globally.

In the absence of ready customers abroad, Russia now needs to foster domestic demand and has identified the transportation sector as a possible target. But its steel industry also presents a promising opportunity to absorb some of the hydrogen supply.

If Russia reallocated future investments from building new blast furnace units and relining old units to building out more hydrogen-based DRI units, Russia could stimulate its domestic hydrogen demand, while also aligning itself with an increasingly decarbonized global market.

The average emissions intensity for hydrogen-based DRI-EAF steelmaking is less than a third that of coal-based BF-BOF steelmaking (at 0.7 tonnes CO_2 per tonne of crude steel, compared to 2.2 tonnes CO_2 per tonne for BF-BOF steelmaking) and approximately half that of fossil gas-based DRI-EAF (1.4 tonnes CO_2 per tonne of crude steel).

Russia faces challenges in building its planned DRI-EAF units — a few of them have been postponed (Table 3) due to the exit of Midrex, Danieli, and Primetals from the Russian market, three of the world's top iron and steel furnace suppliers.

Additionally, Russia's hydrogen strategy is vague about which type of hydrogen production the country will pursue, meaning it's unclear exactly how big the emissions savings will be by switching to hydrogen-based DRI.

Grey hydrogen is produced using fossil gas without capturing the greenhouse gas emissions, while blue hydrogen is produced in a similar manner but includes the use of carbon capture and storage technologies (CCS). Green hydrogen is produced via electrolysis with renewable energy sources providing electricity for this process, producing hydrogen with near zero emissions.

Regardless of hydrogen type, the hydrogen-based DRI process still produces steel at a lower emissions intensity than BF-BOF or gas-based DRI-EAF steelmaking.

Russian steel giants need to awaken to decarbonization

A few Russian steel giants like Metalloinvest and NLMK experience particularly strong outside pressure to switch to low-carbon production to accommodate the EU CBAM and increasingly more stringent corporate sustainability reporting requirements.

NLMK accounted for 80% of Russian slab imports by the EU in 2022. NLMK's process is dominated by coal-based BF-BOF steelmaking. With the grace period for the import of slabs extended from 2024 to 2028, NLMK's products will be subject to EU CBAM pricing starting in 2026, significantly raising the costs for NLMK if the company does not transition away from BF-BOF production.

Metalloinvest operates both BF-BOF and gas-based DRI-EAF steelmaking plants. In 2021, Metalloinvest accounted for 60% of all EU imports of DRI and, in 2022, DRI imports increased to 1.65 million tonnes. But with the new sanctions package, Metalloinvest can now export only 1.14 million tonnes and 651,906 tonnes of DRI in 2024 and 2025, respectively.

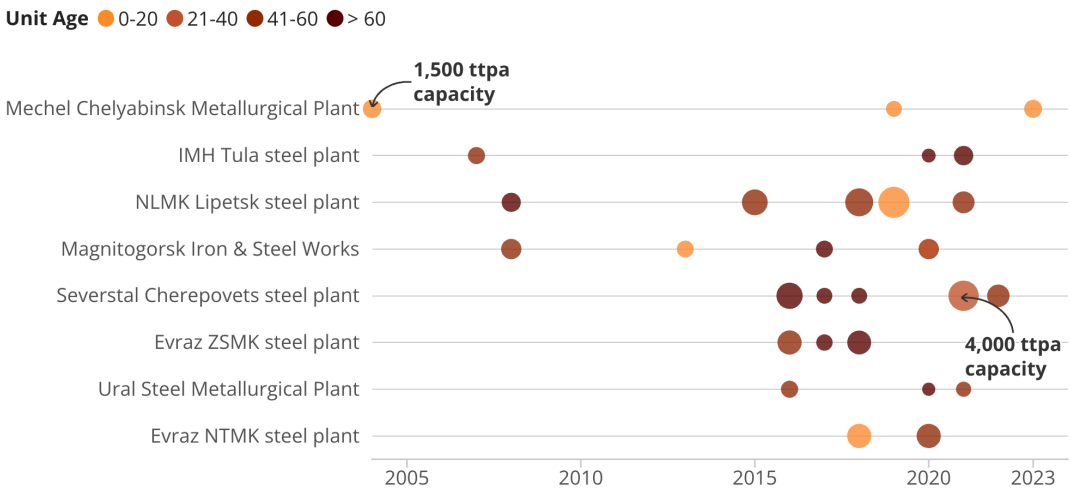
With diminishing markets, Metalloinvest has an added incentive to transition from fossil gas-based DRI to the cleaner hydrogen-based DRI sooner, since it would face additional profit loss from carbon pricing in the future. The company plans to switch its BF ironmaking to DRI production between 2026 and 2036, while also beginning to implement green hydrogen, though Metalloinvest remains vague about how it will use green hydrogen in its production processes. The company currently uses fossil gas as a reductant to produce DRI, but it can switch to 30% hydrogen in existing units today. In the short term, the company plans to focus on CCS instead, which is risky given the unproven success of CCS in the steel industry thus far.

Other Russian steel companies impacted by the sanctions, such as Magnitogorsk Iron & Steel Works

and Severstal, seem to focus on domestic demand, exports to the Commonwealth of Independent States (CIS) countries, as well as new markets in Asia and North Africa. Nonetheless, the growing global need for decarbonization of steel made its way to their agenda, visible in their decarbonization and GHG reduction initiatives (Evraz, Severstal, OMK).

Multiple relinings at Russian steel plants since 2015

Relinings or new capacity added in Russian steel plants; circles sized by current capacity in thousand tonnes per year (ttpa)



Source: Global Blast Furnace Tracker, Global Energy Monitor

Figure 3

Russia's nascent hydrogen economy could play a key role in decarbonizing its steel industry

The growing need to decarbonize steel, coupled with domestic hydrogen production goals, creates an opportunity for Russia to transition away from emissions-intensive steelmaking toward cleaner production technologies. Switching from blast furnace steelmaking to low-carbon hydrogen-based DRI would create domestic demand for hydrogen, with the added benefit of decarbonizing the country's steel industry, thus aligning Russian steel producers with the requirements of CBAM and other international emissions standards.

To realize these goals, further development of DRI technology in Russia is necessary. The Russian government intends to develop its own domestic technology and equipment in hydrogen production, storage, and transportation. As for the proposed new EAF and DRI units, the dissolution of partnerships with Western suppliers and lack of domestic technology to produce the necessary equipment has halted projects. Russian steel companies are searching for new partners, yet the progress is unknown.

While the cost of hydrogen and switching to hydrogen-based DRI production may represent a significant challenge for Russian steelmakers, reallocations of the millions of dollars of investments planned for blast furnace relinings and government support and financing of the projects could narrow this gap. Given Russia's efforts to keep up with the growth of the global hydrogen market, strategic government support could help to transition the ailing steel industry and build the nascent hydrogen market.

Background on Global Energy Monitor

Global Energy Monitor (GEM) develops and shares information in support of the worldwide movement for clean energy. By studying the evolving international energy landscape, creating databases, reports, and interactive tools that enhance understanding, GEM seeks to build an open guide to the world's energy system. Follow us at www.globalenergymonitor.org and on Twitter/X @GlobalEnergyMon.

Background on the Global Blast Furnace Tracker

The Global Blast Furnace Tracker (GBFT) is a worldwide dataset of blast furnace units. It tracks each of the furnaces at iron and steel plants in the Global Steel Plant Tracker, which includes plants with a crude iron or steel capacity of 500 thousand tonnes per annum (ttpa) or more, as well as those that have been proposed or under construction since 2017 and retired or mothballed since 2020.

AUTHORS

Caitlin Swalec
Program Director, Heavy Industry
Global Energy Monitor
caitlin.swalec@globalenergymonitor.org

Hanna Fralikhina
Researcher
Global Energy Monitor

Zhanaiym Kozybay
Researcher
Global Energy Monitor