2023 WORLD DIRECT REDUCTION STATISTICS

CONTENTS

Audited by WSD WORLD STEEL DYNAMICS®

World DRI production reaches 135.7 Mt in 2023

Sets yet another new annual production record

Annual global direct reduced iron (DRI) production in 2023 was 135.7 million tons (Mt). DRI output was up by 8.3Mt or 6.5% from the previous record of 127.4 Mt set in 2022. This increase was primarily due to the increase in DRI produced in India via rotary-kilns (4.6Mt / 12.9%) and natural-gas based shaft furnaces (3.7Mt / 4.1%). Once again, the combination of India and Iran produced well over half of the global DRI. In the last five years, worldwide DRI output has grown by almost 27.6 Mt, or approximately 25.6%. During this period, DRI production in India (mainly coal-based DRI) increased by 46.2%, and natural gas-based DRI production in Iran grew by 17.3%. New natural gas-based plants were started in Algeria, USA, and Iran. In the last 10 years, DRI production has grown by 61Mt, or approximately 82%. In this last decade, shaft furnace production increased by 33Mt (56%) and rotary-kiln by 25Mt (161%).

The production of hot DRI (HDRI), which is fed directly to a nearby melt shop for energy savings and productivity gains, was 15.0 Mt, an 8% increase compared to 2022, and made up 11.0% of the total in 2023. The production of hot briquetted iron (HBI) – a compacted form of DRI ideally suited for

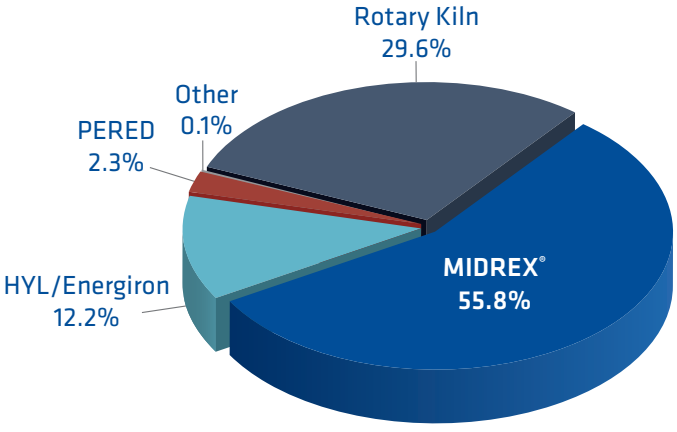
(Continued on page 3)

2023 Top 5 DRI Producing Nations

COUNTRY	PRODUCTION (Million Tons)
India	49.3
Iran	33.4
Russia	7.8
Saudi Arabia	6.7
Egypt	6.4

Source: World Steel Association, SIMA, and Midrex Technologies, Inc.

2023 World DRI Production by Process



Note: Percentages are rounded to the nearest decimal.

Total World Production: 135.7 Mt

	2021	2022	2023
MIDREX®	59.5%	57.8%	55.8%
HYL/Energiron	12.7%	12.1%	12.2%
PERED	2.2%	2.2%	2.3%
Other	0.1%	0.1%	0.1%
Rotary Kiln	25.4%	27.9%	29.6%

Source: Midrex Technologies, Inc.

shipping and for use in the blast furnace – is estimated to have been 12.0 Mt, a 9% increase over 2022.

MIDREX® Plants produced 75.7 Mt of DRI in 2023, which is 3.0% more than the 73.6 Mt produced in 2022, both annual records. The production total for 2023 was calculated from the 38.7 Mt confirmed by plants located outside of Iran and Russia and the estimated 37.0 Mt by plants in Iran and Russia derived from data reported by the World Steel Association (WSA). The MIDREX Process continued to account for approximately 80% of world-wide production of DRI by shaft furnaces in 2023: 95.4Mt. Almost 11 Mt of HDRI (73% share) and 10.8Mt of HBI (90% share) were produced by MIDREX Plants in this period.

Natural gas is generally the main source of reducing gas in shaft furnace-based processes, and DRI produced using natural gas has significantly lower CO_2 emissions than DRI produced using coal (directly or indirectly). In 2023, approximately 68.5% of the DRI produced was natural gas-based (i.e., low CO_2 DRI), whereas the balance, 31.5%, was coal-based (i.e., high CO_2 DRI). The proportion of low CO_2 DRI has steadily decreased due to the faster growth in DRI produced in India via Rotary-Kilns.

Since 1970, the cumulative production of DRI is 2,263 Mt, of which shaft-furnaces have produced 1,820 Mt. The cumulative production of HBI is 239.7 Mt (since 1977) and of HDRI is 164.3 Mt (since 1998). Through the end of 2023, MIDREX Plants have produced a cumulative total of over 1,400 Mt of all forms of DRI (CDRI, HDRI, and HBI).

BEHIND THE NUMBERS

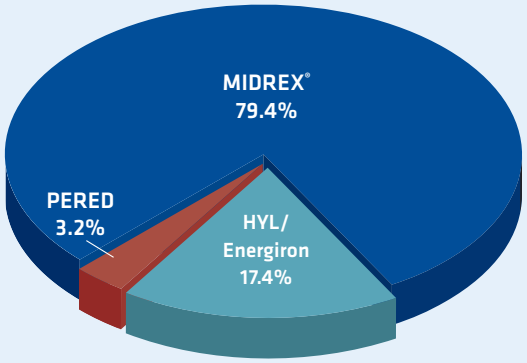
Crude Steel Production

World crude steel production for the 64 countries reporting to the World Steel Association (worldsteel) was 1,892 Mt in 2023, approximately a 0.1% increase compared to 1,890 Mt in 2022.

THE TOP 5 STEEL PRODUCING NATIONS IN 2022

CHINA	1,019 Mt
INDIA	140.7 Mt
JAPAN	87.0 Mt
USA	81.4 Mt
RUSSIA	76.0 Mt

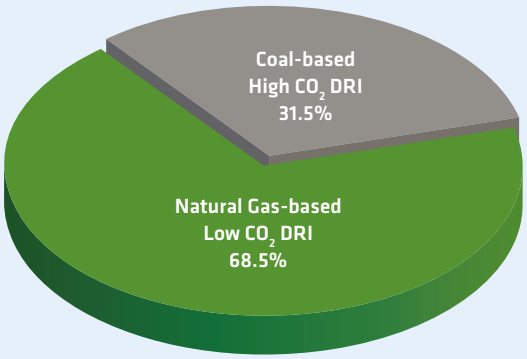
2023 World Shaft Furnace Production by Process



	2021	2022	2023
MIDREX®	79.7%	80.2%	79.4%
HYL / Energiron	16.4%	16.8%	17.4%
PERED	3.9%	3.0%	3.2%

Source: Midrex Technologies, Inc.

2023 World DRI Production by CO_2 Emissions



	2021	2022	2023
High CO_2 DRI	27.5%	29.9%	31.5%
Low CO_2 DRI	72.5%	70.1%	68.5%

Source: Midrex Technologies, Inc.

The top 5 producing regions were:

- **Asia** produced **1,395 Mt**, up 1% over 2022 production. Worldsteel includes China, India, Japan, South Korea, and Vietnam as the top 5 producing countries in Asia.
- **EU** (European Union) (27) produced **126.3 Mt** in 2023, a decrease of 7.4% compared to 2022. Germany, Italy, Spain, and France are each producing over 10 Mt.
- **North America** produced **110.2 Mt** in 2023, a 1.3% decrease compared to 2022. Worldsteel includes Canada, Cuba, El Salvador, Guatemala, Mexico, and United States in North America.
- **Russia & Other CIS + Ukraine** production in 2022 was **90.3 Mt**, a 4.9% increase over 2023. Worldsteel includes Belarus, Kazakhstan, Moldova, and Uzbekistan in CIS.
- **Middle East** produced **54.5 Mt** in 2023, an increase of 0.6% over 2022. Worldsteel includes Iran, Saudi Arabia, United Arab Emirates, Oman, and Qatar in Middle East.

Iron ore supply and steel demand

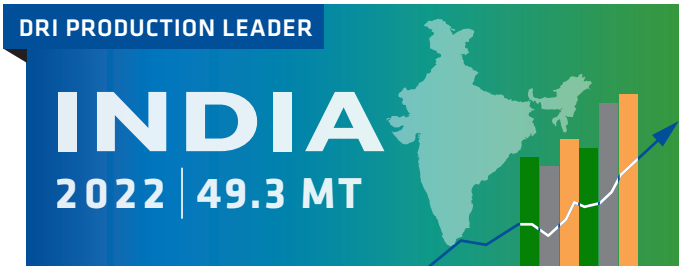
The profitability of direct reduction plants is strongly impacted by iron ore pricing and availability- and steel demand. Energy (mostly natural gas) price and demand also influence the operating cost of a direct reduction plant; since they vary greatly by region, they may only affect specific DRI producers.

Overall, iron ore supply was relatively stable in 2023. Iron ore pricing saw less volatility compared to previous years. Prices increased early in the first quarter, dropped in the second quarter, and progressively increased through the rest of the year. For the 62% Fe iron ore, the lowest price was in early January and the highest price in late December, its highest value since June 2022. On the other hand, the DR premium peaked in August at over $65/ton, dropped in Q3 to under $50, and increased in the last two months of the year.

Aside from regional situations, the demand for steel that typically consumes DRI / HBI was strong, resulting in adequate margin for the mills. Similarly to iron ore, 2023 was less volatile for steel pricing than the previous years. Steel pricing trended upwards until April, dropped until the end of the summer, then resumed a steady increase in Q4.

Direct reduced iron production

As in previous years, **India** continued to be the largest DRI producer worldwide, producing a record **49.3 Mt** of DRI – 39.9 Mt in rotary kilns (an increase from 35.4 Mt in 2022) and 9.4 Mt by gas-based processes (an increase from 8.2 Mt in 2022) – an 13.1% increase overall, according to the Sponge Iron Manufacturers Association (SIMA) of India. Rotary kiln DRI production saw a 12.8% increase in 2023, after an 18% increase in 2022, and an 18.8% increase in 2021.



Production of DRI in **Iran** was **33.4 Mt**, a 1.5% increase from 32.9 Mt in 2022. All Iranian DRI production is from natural gas-based processes. The MIDREX Process accounts for ~90% of DRI production in Iran. PERED® plants produced an estimated 2.8 Mt.

Russia maintained its 3rd place as a DRI-producing nation with **7.8 Mt** in 2023, a slight increase over its production of 7.7 Mt in 2022. All Russian DRI is produced from natural gas-based processes.

Saudi Arabia retained its 4th place with **6.7 Mt**, increasing output from 6.5 Mt in 2022.

Egypt surpassed Mexico for 5th place, with **6.4 Mt** in 2022. Mexico's annual production was 5.9 Mt.

The DRI production in the **U.S.** reached its highest production at **5.5 Mt** in 2023, versus 5.2 Mt in 2022.

Algeria increased it output, with Tosyali Algerie and Algerian Qatari Steel (AQS) combining to produce almost **4.2 Mt** of DRI in 2023.

In **South America and the Caribbean**, production of DRI slightly decreased in Argentina and Trinidad and Tobago. Venezuela continued to produce well below rated capacity, around **1 Mt**.

NEW CAPACITY STARTED OR ANNOUNCED IN 2023

MIDREX

In March 2023, thyssenkrupp Steel awarded Midrex and SMS the contract for a DRI plant paired with two innovative melters. The 2.5 million tons per year MIDREX Flex® Plant will be located in Duisburg, North Rhine-Westphalia, Germany. This project will reduce CO_2 emissions by 3.5 Mt per year. It is scheduled for completion by the end of 2026.

HYL / ENERGIRON®

In June 2023, Hebei Iron & Steel Group (HBIS) announced the start of production at the new ENERGIRON ZR direct reduction plant, which will use hydrogen-enriched gas. The plant has a rated capacity of 0.6 Mt per year.

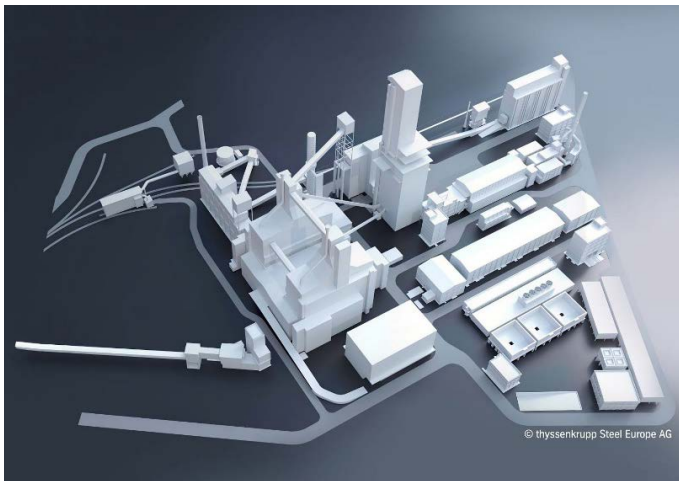
Salzgitter contracted the construction of a direct reduction plant on the site of Salzgitter Flachstahl GmbH with a consortium of Danieli, Tenova, and DSD Steel Group. The announcement, made in May 2023, is the first large-scale stage of the SALCOS® program. The HDRI / CDRI plant's capacity was listed as 2.1 Mt per year. Startup of the plant and a 100-MW electrolyzer are expected in mid-2026 according to later press releases. Tenova was selected by Ternium in October 2023 for the construction of a new steel mill in Pesquería, Nuevo León, Mexico. The new plant includes a 2.1 Mt per year DRI plant.

In December 2023, Vulcan Green Steel (part of the Jindal Steel Group) announced a 2.5 Mt per year ENERGIRON-ZR plant in Duqm, Al Wusta Governorate, Sultanate of Oman. The module will produce HDRI for an adjacent electric steelmaking complex and will also be able to produce HBI. The completion is scheduled for 2026.

PERED

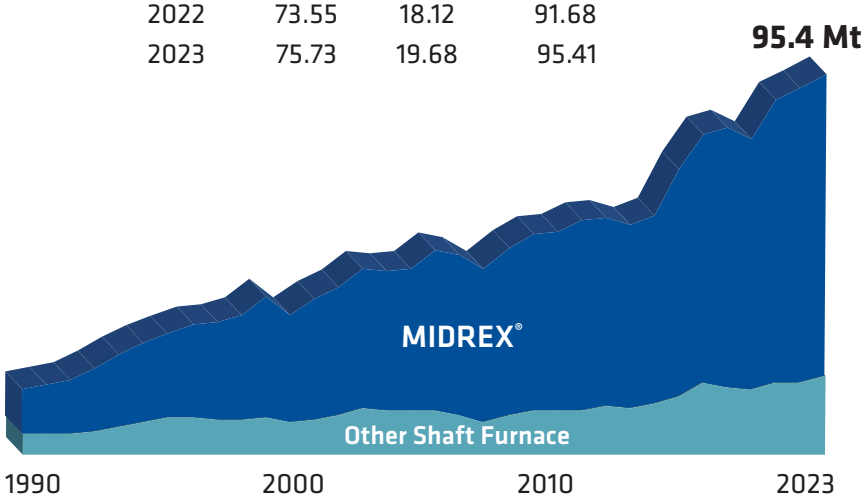
After nearly 10 years, Shanxi Taihang Mining commissioned a 0.3 Mtpy DRI plant using coke oven gas and hydrogen in 2023, according to one media article. The complex is located in Jinzhong City, Shanxi Province, China.

thyssenkrupp

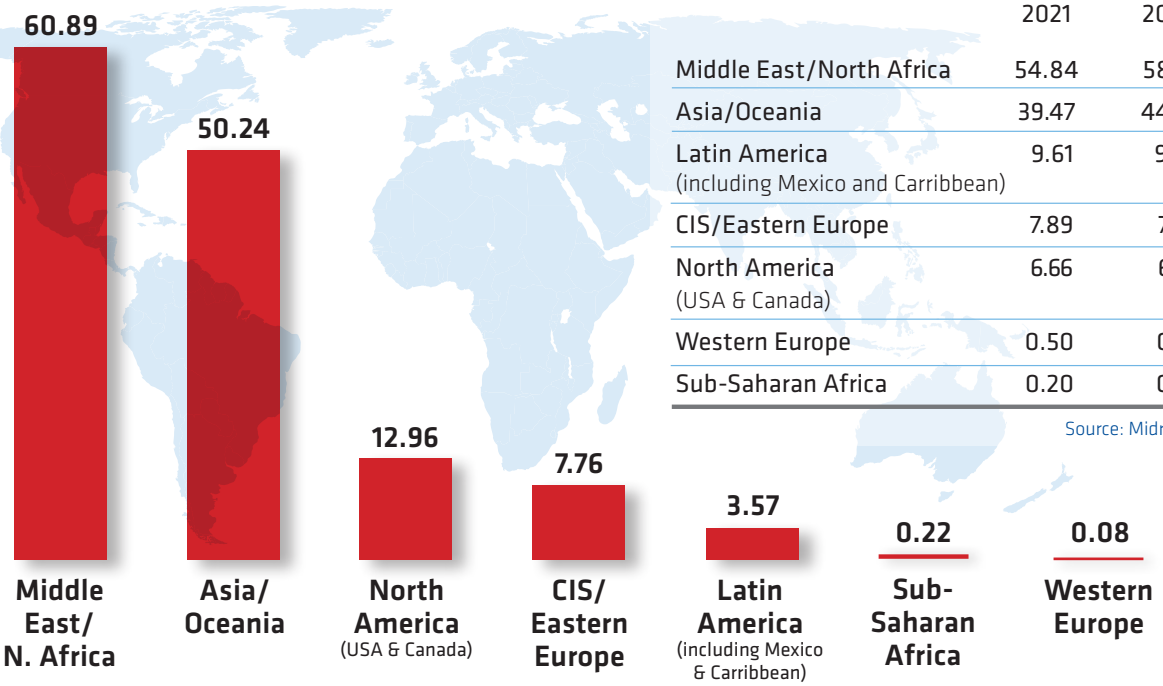


Shaft Furnace DRI Production by Process and by Year

Year	MIDREX®	Other Shaft Furnace	Total
1990	10.73	5.25	15.98
1991	11.96	5.40	17.36
1992	13.26	5.29	18.55
1993	15.91	5.73	21.64
1994	17.83	7.01	24.84
1995	19.86	8.15	28.01
1996	21.03	9.12	30.15
1997	23.08	9.55	32.63
1998	24.82	8.52	33.34
1999	26.12	8.81	34.93
2000	30.12	9.39	39.51
2001	26.99	8.04	35.03
2002	30.11	8.88	38.99
2003	32.06	9.72	41.78
2004	35.01	11.34	46.35
2005	34.96	11.00	45.96
2006	35.71	10.91	46.62
2007	39.72	11.20	50.92
2008	39.85	9.84	49.69
2009	38.62	7.88	46.50
2010	42.01	9.81	51.82
2011	44.38	11.03	55.41
2012	44.76	10.79	55.55
2013	47.56	11.29	58.85
2014	47.12	12.04	59.16
2015	45.77	11.62	57.39
2016	47.14	12.66	59.80
2017	56.65	14.68	71.33
2018	62.10	18.11	80.21
2019	65.37	16.57	81.94
2020	63.07	16.03	79.10
2021	70.85	17.84	88.69
2022	73.55	18.12	91.68
2023	75.73	19.68	95.41



2023 World DRI Production by Region (Mt)



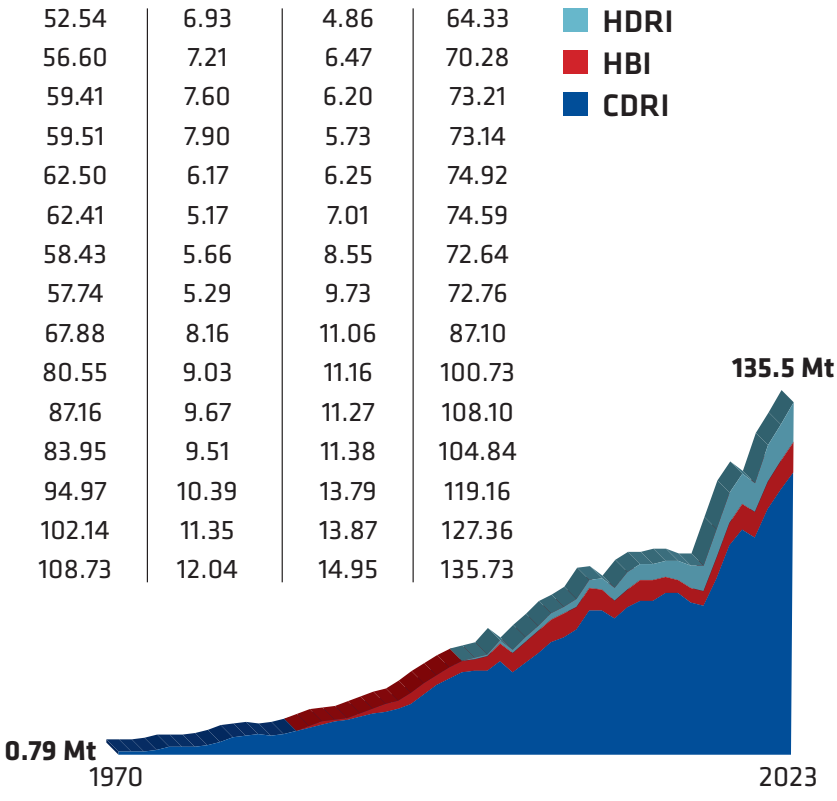
	2021	2022	2023
Middle East/North Africa	54.84	58.48	60.89
Asia/Oceania	39.47	44.33	50.24
Latin America (including Mexico and Carribbean)	9.61	9.79	3.57
CIS/Eastern Europe	7.89	7.66	7.76
North America (USA & Canada)	6.66	6.76	12.96
Western Europe	0.50	0.15	0.08
Sub-Saharan Africa	0.20	0.19	0.22

Source: Midrex Technologies, Inc.

World DRI Production by Year (Mt)

Source: Midrex Technologies, Inc.

Year	Total	Year	Total	Year	CDRI	HBI	HDRI	Total
'71	0.95	'90	17.68	'09	52.54	6.93	4.86	64.33
'72	1.39	'91	19.32	'10	56.60	7.21	6.47	70.28
'73	1.90	'92	20.51	'11	59.41	7.60	6.20	73.21
'74	2.72	'93	23.65	'12	59.51	7.90	5.73	73.14
'75	2.81	'94	27.37	'13	62.50	6.17	6.25	74.92
'76	3.02	'95	30.67	'14	62.41	5.17	7.01	74.59
'77	3.52	'96	33.30	'15	58.43	5.66	8.55	72.64
'78	5.00	'97	36.19	'16	57.74	5.29	9.73	72.76
'79	6.64	'98	36.96	'17	67.88	8.16	11.06	87.10
'80	7.14	'99	38.60	'18	80.55	9.03	11.16	100.73
'81	7.92	'00	43.78	'19	87.16	9.67	11.27	108.10
'82	7.28	'01	40.32	'20	83.95	9.51	11.38	104.84
'83	7.90	'02	45.08	'21	94.97	10.39	13.79	119.16
'84	9.34	'03	49.45	'22	102.14	11.35	13.87	127.36
'85	11.17	'04	54.60	'23	108.73	12.04	14.95	135.73
'86	12.53	'05	56.87					
'87	13.52	'06	59.70					
'88	14.09	'07	67.12					
'89	15.63	'08	67.95					



1970-2012 World DRI Production by Region (Mt)

Source: Midrex Technologies, Inc.

NAME	'70-'02	'03	'04	'05	'06	'07	'08	'09	'10	'11	'12
Latin America											
ARGENTINA	27.44	1.74	1.74	1.83	1.95	1.81	1.86	0.81	1.57	1.68	1.61
BRAZIL	8.29	0.41	0.44	0.43	0.38	0.36	0.30	0.01	–	–	–
MEXICO	80.63	5.62	6.54	5.98	6.17	6.26	6.01	4.15	5.37	5.85	5.59
PERU	1.09	0.08	0.08	0.09	0.14	0.09	0.07	0.10	0.10	0.09	0.10
TRINIDAD AND TOBAGO	19.06	2.28	2.36	2.25	2.08	3.47	2.78	1.99	3.08	3.03	3.25
VENEZUELA	89.84	6.90	7.83	8.95	8.61	7.71	6.87	5.61	3.79	4.47	4.61
Middle East/N. Africa											
ALGERIA	–	–	–	–	–	–	–	–	–	–	–
BAHRAIN	–	–	–	–	–	–	–	–	–	–	–
EGYPT	19.04	2.87	3.02	2.90	3.10	2.79	2.64	2.91	2.86	2.97	2.84
IRAN	40.65	5.62	6.41	6.85	6.85	7.44	7.46	8.20	9.35	10.37	11.58
LIBYA	12.90	1.34	1.58	1.65	1.63	1.64	1.57	1.11	1.27	0.30	0.51
OMAN	–	–	–	–	–	–	–	–	–	1.11	1.46
QATAR	13.33	0.78	0.83	0.82	0.88	1.30	1.68	2.10	2.16	2.23	2.42
SAUDI ARABIA	35.14	3.29	3.41	3.63	3.58	4.34	4.97	5.03	5.51	5.81	5.66
UAE	–	–	–	–	–	–	–	–	1.18	2.25	2.72
Asia/Oceania											
AUSTRALIA	3.27	1.95	0.69	–	–	–	–	–	–	–	–
CHINA	0.49	0.31	0.43	0.41	0.41	0.60	0.18	0.08	–	–	–
INDIA	52.10	7.67	9.37	12.04	14.74	19.06	21.20	22.03	23.42	21.97	17.77
INDONESIA	29.36	1.23	1.47	1.27	1.20	1.32	1.21	1.12	1.27	1.23	0.52
MALAYSIA	15.98	1.60	1.68	1.38	1.54	1.84	1.94	2.30	2.39	2.16	2.01
MYANMAR	0.51	0.04	0.04	–	–	–	–	–	–	–	–
PAKISTAN	–	–	–	–	–	–	–	–		–	–
North America											
CANADA	20.92	0.50	1.09	0.59	0.45	0.91	0.69	0.34	0.60	0.70	0.84
USA	16.10	0.21	0.18	0.22	0.24	0.25	0.26	–	–	–	–
CIS/Eastern Europe											
RUSSIA	30.02	2.91	3.14	3.34	3.28	3.41	4.56	4.67	4.79	5.20	5.24
Sub-Saharan Africa											
NIGERIA	1.53	–	–	–	–	–	0.20	–	–	–	–
SOUTH AFRICA	19.12	1.54	1.63	1.78	1.75	1.74	1.18	1.39	1.12	1.41	1.57
Western Europe											
GERMANY	9.74	0.59	0.61	0.44	0.58	0.59	0.52	0.38	0.45	0.38	0.56
Other Nations	0.47	–	–	–	–	–	–	–	–	–	–
WORLD TOTAL	547.03	49.48	54.60	56.87	59.70	67.12	67.95	64.33	70.28	73.21	73.14

1970-2012 World DRI Production by Process (Mt)

NAME	'70-'02	'03	'04	'05	'06	'07	'08	'9	'10	'11	'12
MIDREX®	343.33	32.11	35.01	34.96	35.71	39.72	39.85	38.62	42.01	44.38	44.76
HYL/Energiron	147.83	9.72	11.34	11.00	10.91	11.20	9.84	7.88	9.81	11.03	10.79
PERED	–	–	–	–	–	–	-	–	–	–	–
Rotary Kiln	42.05	5.04	6.41	9.17	11.53	14.90	16.92	17.33	18.12	17.32	17.06
Other *	13.82	2.61	1.66	1.70	1.53	1.29	1.33	0.76	0.34	0.48	0.53
WORLD TOTAL	547.03	49.48	54.60	56.87	59.70	67.12	67.95	64.33	70.28	73.21	73.14

* Other: A variety of processes using retorts, shaft furnaces, fluidized bed furnaces and hearths.
e - estimated

2013-2023 World DRI Production by Region (Mt)

Source: Midrex Technologies, Inc.

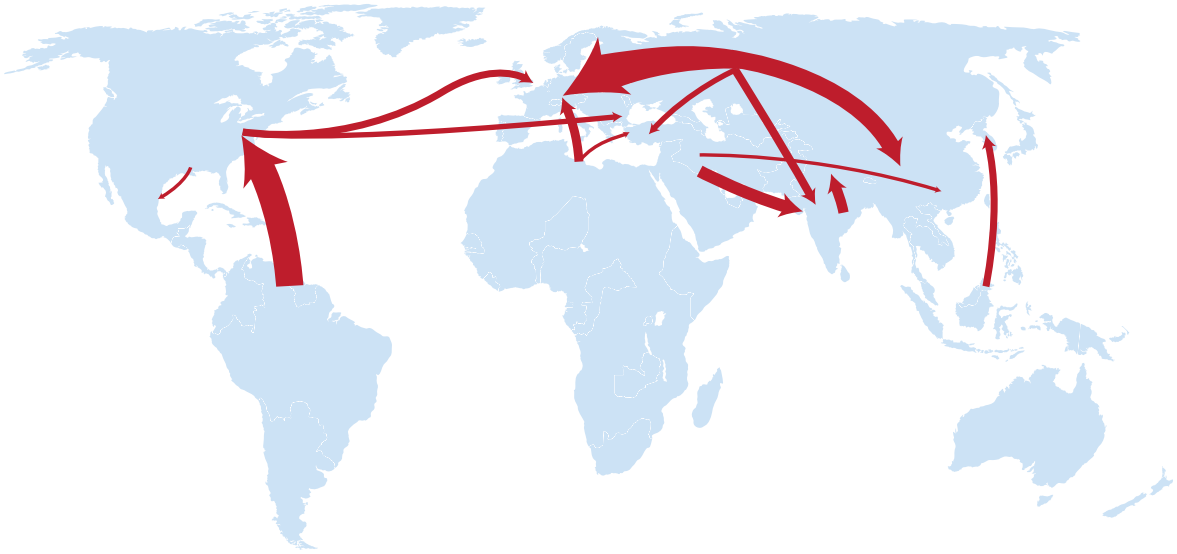
NAME	'13	'14	'15	'16	'17	'18	'19	'20	'21	'22	'23
Latin America											
ARGENTINA	1.54	1.67	1.26	0.78	1.23	1.61	1.09	0.53	1.41	1.51	1.49
BRAZIL	–	–	–	–	–	–	–	–	–	–	–
MEXICO	6.13	5.98	5.50	5.31	6.01	5.97e	5.97	5.17	5.83	5.84	5.92
PERU	0.10	0.09	0.07	0.01	–	–	–	–	–	–	–
TRINIDAD AND TOBAGO	3.29	3.24	2.52	1.50	1.59	1.54	1.70	1.34	1.62	1.43	1.39
VENEZUELA	2.77	1.68	2.75	1.59	1.68	0.99	1.01	0.89	0.76	1.01	0.69
Middle East/N. Africa											
ALGERIA	–	–	–	–	–	0.11	1.54	2.23	3.08	3.88	4.17
BAHRAIN	0.78	1.44	1.23	1.26	1.26	1.60	1.45	1.38	1.51	1.42	1.62
EGYPT	3.43	2.88	2.73	2.82	4.67	5.22e	4.05	4.71	5.23	5.82	6.42
IRAN	14.46	14.55	14.55	16.01	20.55	25.75	28.52	30.21	31.85	32.90	33.45
LIBYA	0.95	1.00	0.45	0.69	0.56	0.61	0.87	0.83	0.88	1.10	1.65
OMAN	1.47	1.45	1.48	1.46	1.51	1.50	1.75	1.73	1.70	1.82	1.60
QATAR	2.39	2.64	2.71	2.58	2.63	2.63	2.49	0.78	0.79	1.62	1.71
SAUDI ARABIA	6.07	6.46	5.80	5.89	5.74	6.00	5.79	5.19	6.13	6.48	6.68
UAE	3.07	2.41	3.19	3.48	3.61	3.78	3.67	2.96	3.66	3.45	3.59
Asia/Oceania											
AUSTRALIA	–	–	–	–	–	–	–	–	–	–	–
CHINA	–	–	–	–	–	–	–	–	–	–	–
INDIA	17.77	17.31	17.68	18.47	22.34	28.11	33.74	32.98	39.11	43.55	49.33
INDONESIA	0.76	0.16	0.05	–	–	0.24	-e	-e	-e	-e	-e
MALAYSIA	1.40	1.33	0.96	0.66	0.57	0.75	0.59	0.73	0.36	0.78	0.71
MYANMAR	–	–	–	–	–	–	–	–	–	–	–
PAKISTAN	0.06	–	–	–	–	–	–	–	–	–	–
North America											
CANADA	1.25	1.55	1.50	1.40	1.61	1.67	1.44	1.17	1.65	1.52	1.55
USA	–	1.30	1.10	1.81	2.99	3.35	3.24	3.35	5.01	5.24	5.48
CIS/Eastern Europe											
RUSSIA	5.33	5.35	5.44	5.70	6.99	7.90e	8.03	7.93	7.89	7.66	7.76
Sub-Saharan Africa											
NIGERIA	–	–	–	–	–	–	–	–	–	–	–
SOUTH AFRICA	1.41	1.55	1.12	0.70	0.93	0.83	0.66	0.18	0.20	0.19	0.22
Western Europe											
GERMANY	0.50	0.57	0.55	0.60	0.63	0.56	0.47	0.53	0.50	0.15	0.08
Other Nations	–	–	–	–	–	–	–	–	–	–	–
WORLD TOTAL	74.92	74.59	72.64	72.71	87.10	100.73	108.10	104.84	119.16	127.36	135.73

2013-2023 World DRI Production by Process (Mt)

NAME	'13	'14	'15	'16	'17	'18	'19	'20	'21	'22	'23
MIDREX®	47.56	47.12	45.77	47.14	56.65	61.96	65.37	63.07	70.85	73.55	75.73
HYL/Energiron	11.29	12.08	11.62	12.66	14.68	15.85	14.26	12.98	15.16	15.36	16.61
PERED	–	–	–	–	**	2.40	2.31	3.05e	2.67e	2.76	3.08
Rotary Kiln	15.93	15.39	14.74	12.67	15.34	20.31	25.98	25.50	30.30	35.57	40.16
Other *	0.14	–	0.51	0.24	0.44	0.22	0.18	0.24	0.16	0.11	0.15
WORLD TOTAL	74.92	74.59	72.64	72.71	87.10	100.73	108.10	104.84	119.16	127.36	135.73

* Other: A variety of processes using retorts, shaft furnaces, fluidized bed furnaces and hearths.
** Included in Other
e - estimated

Major Trade Routes for International Trade of DRI



The map shows the major routes of international transport of DRI in 2023. The width of the lines indicates the amount of DRI products that traveled over the individual routes. **NOTE: Domestic and smaller trade routes are not shown.**

MAJOR TRADE ROUTES FOR INTERNATIONAL TRADE OF DRI:

Total shipments of DRI decreased to 21.4 Mt in 2023, 13% less than the previous record of 25.7 Mt in 2022, including both domestic and international shipments. Land shipments made up the majority of the total in 2023, amounting to 14.8 Mt, a 6.1% decrease over the record 15.7 Mt in 2022. Water shipments showed a 33.7% decrease compared to 2022, totaling 6.6 Mt. The decreases in reported international trade of HBI and water shipments are likely due to un-reported data from sanctioned countries. It is more likely that both values were similar or above 2022 data.

	Importing Region							
Exporting Region	**MENA**	**Asia/ Oceania**	**Latin America**	**CIS/ E. Europe**	**North America**	**Sub-Saharan Africa**	**Western Europe**	**Total Mt**
MENA	0.9	1.6	-	-	-	-	0.4	2.9
Asia/Oceania	-	1.9	-	-	-	-	-	1.9
Latin America	-	0.0	-	-	1.3	-	0.1	1.5
CIS/Eastern Europe	0.6	1.2	-	0.3	-	-	1.2	3.2
North America	0.3	0.1	-	-	0.4	-	0.8	1.5
Sub-Saharan Africa	-	-	-	-	-	-	-	-
Western Europe	-	-	-	-	-	-	-	-
Total Mt	1.8	4.7	-	0.3	1.7	-	2.6	
						Grand Total	11.1	

International trade routes were estimated at 11.1 Mt.

Major Trade Routes for International Trade of DRI

SUPPLIERS

Russia is the leading exporter with approximately 3.0 Mt of DRI products, shipping predominantly HBI to Asia and Western Europe. However, there is a discrepancy between reported production and trade of Russian HBI. The USA became the second leading exporter with 1.5 Mt, shipping predominantly to Western Europe and Mexico. Iran, India, and Trinidad and Tobago complete the top five exporting nations, with 1.5, 1.3, and 1.3 Mt of DRI, respectively.

DESTINATIONS

According to data from ISSB, 29 countries imported significant quantities of DRI/HBI. The top three importers were India (1.6 Mt), USA (1.3 Mt), and Italy (1.0 Mt). The data indicates that India imported DRI from Iran and Russia. China imported significantly less DRI than in 2022 (0.3 Mt, from Iran and Russia).

OUTLOOK

The trade of DRI products in 2024 is not expected to change much compared to 2023. Trade regulations and sanctions are again likely to impact global trade.

Data Source

Data for the map was taken from three sources: International Steel Statistics Bureau (ISSB), International Iron Metallics Association (IIMA), and reports from individual operating DR plants. Data from the ISSB originates with national export and import records; for instance, from the US Customs Bureau. IIMA information derives from a variety of sources. It should be stressed that a significant portion of the export data does not match the import data. Also, reports from individual plants show large tonnages for which the destination is unknown.

The arrows do not originate and terminate at specific countries. Rather, sums for dispatch and arrival were totaled by region and the arrows flow from region to region. For instance, the wide arrow originating from the north coast of South America shows DRI and HBI coming from the Caribbean (Venezuela plus Trinidad and Tobago) and being transported to North America, Asia and Europe.

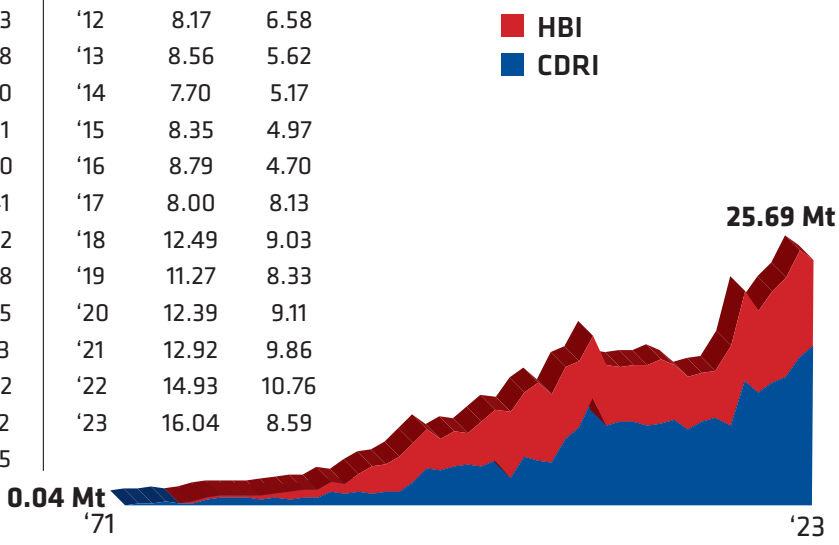
Notes:

- All references to tons are metric unless otherwise stated
- A MIDREX Plant can include one or more modules
- The Russian production and trade numbers were inferred from several sources. The production figures have a high degree of certainty. However, the amount of traded HBI is significantly lower than production.
- The list of rotary-kilns was removed from the 2023 publication due to lack of recent, accurate information matching the increased coal-based DRI production.

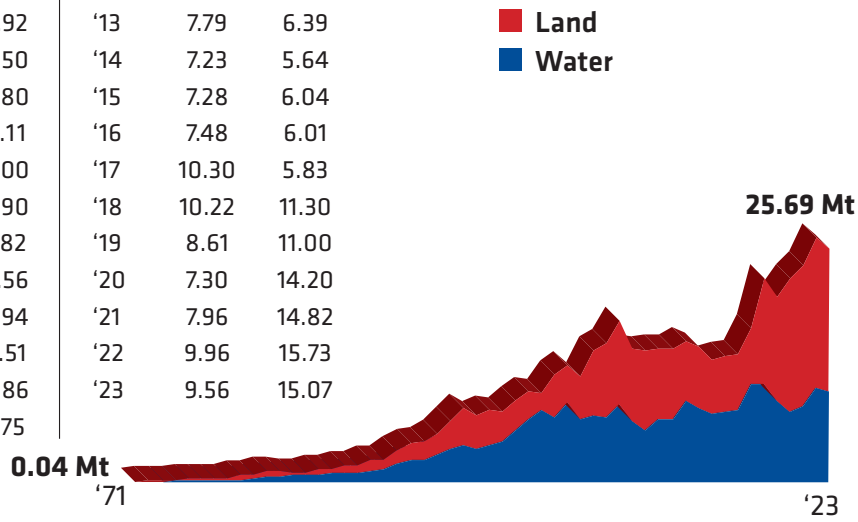
World DRI Shipments (Mt)

Source: Midrex Technologies, Inc.

Year	CDRI	HBI	Year	CDRI	HBI	Year	CDRI	HBI
'71	0.04	–	'89	1.27	0.94	'07	10.82	6.24
'72	0.08	–	'90	1.46	1.71	'08	8.01	5.99
'73	0.13	–	'91	1.29	2.67	'09	8.50	5.38
'74	0.26	–	'92	1.45	2.71	'10	8.42	5.60
'75	0.34	–	'93	1.45	3.56	'11	7.97	6.06
'76	0.37	–	'94	2.44	3.93	'12	8.17	6.58
'77	0.32	–	'95	3.69	3.98	'13	8.56	5.62
'78	0.28	0.11	'96	3.58	3.20	'14	7.70	5.17
'79	0.66	0.12	'97	3.99	3.51	'15	8.35	4.97
'80	0.81	0.25	'98	4.24	3.00	'16	8.79	4.70
'81	0.83	0.25	'99	4.01	4.41	'17	8.00	8.13
'82	0.80	0.18	'00	4.54	5.02	'18	12.49	9.03
'83	0.59	0.36	'01	2.83	6.58	'19	11.27	8.33
'84	0.83	0.39	'02	4.85	6.45	'20	12.39	9.11
'85	0.71	0.61	'03	4.63	7.63	'21	12.92	9.86
'86	0.89	0.73	'04	4.26	6.82	'22	14.93	10.76
'87	0.85	0.77	'05	6.76	7.12	'23	16.04	8.59
'88	1.48	0.83	'06	7.81	6.75			



Year	Water	Land	Year	Water	Land	Year	Water	Land
'71	–	0.04	'89	1.34	0.87	'07	8.19	8.87
'72	0.01	0.07	'90	1.79	1.38	'08	6.41	7.59
'73	0.02	0.12	'91	2.25	1.71	'09	5.39	8.48
'74	0.03	0.23	'92	2.24	1.93	'10	6.61	7.42
'75	0.06	0.28	'93	2.90	2.11	'11	6.49	7.55
'76	0.10	0.26	'94	3.46	2.91	'12	8.48	6.27
'77	0.04	0.27	'95	3.76	3.92	'13	7.79	6.39
'78	0.12	0.57	'96	3.40	3.50	'14	7.23	5.64
'79	0.33	0.45	'97	3.81	3.80	'15	7.28	6.04
'80	0.54	0.52	'98	4.22	3.11	'16	7.48	6.01
'81	0.53	0.55	'99	5.45	3.00	'17	10.30	5.83
'82	0.65	0.33	'00	6.66	2.90	'18	10.22	11.30
'83	0.67	0.28	'01	7.59	1.82	'19	8.61	11.00
'84	0.69	0.53	'02	6.74	4.56	'20	7.30	14.20
'85	0.81	0.51	'03	8.31	3.94	'21	7.96	14.82
'86	0.99	0.63	'04	6.57	4.51	'22	9.96	15.73
'87	0.95	0.67	'05	7.02	6.86	'23	9.56	15.07
'88	1.08	1.23	'06	6.80	7.75			



Note regarding land shipments: It is estimated that about 25% of the DRI produced in India is transported domestically to nearby melting furnaces. This tonnage is included in the figures given above.

World Direct Reduction Plants (as of 12/31/23)

Source: Midrex Technologies, Inc.

Plant	Location	Capacity (Mt/y)	Modules	Product	Start-up	Status*
MIDREX®						
ArcelorMittal Hamburg	Hamburg, Germany	0.40	1	CDRI	'71	O
ArcelorMittal Canada 1	Contrecoeur, Quebec, Canada	0.40	1	CDRI	'73	O
Tenaris Siderca	Campana, Argentina	0.40	1	CDRI	'76	O
ArcelorMittal Canada 2	Contrecoeur, Quebec, Canada	0.60	1	CDRI	'77	O
SIDOR I	Matanzas, Venezuela	0.35	1	CDRI	'77	I
Acindar	Villa Constitucion, Argentina	0.60	1	CDRI	'78	O
Qatar Steel 1	Mesaieed, Qatar	0.40	1	CDRI	'78	O
SIDOR IIA, IIB, IIC	Matanzas, Venezuela	1.29	3	CDRI	'79	O
ArcelorMittal Point Lisas I & II	Point Lisas, Trinidad & Tobago	0.84	2	CDRI	'80/'82	I
Delta Steel I & II	Warri, Nigeria	1.02	2	CDRI	'82	I
Hadeed A & B	Al-Jubail, Saudi Arabia	0.80	2	CDRI	'82/'83	O
OEMK I - IV	Stary Oskol, Russia	1.67	4	CDRI	'83/'85/'85/'87	O
Antara Steel Mills	Labuan Island, Malaysia	0.65	1	HBI	'84	O
EZDK I	El Dikheila, Egypt	0.72	1	CDRI	'86	O
Khouzestan Steel Co. I - III	Ahvaz, Iran	2.05	3	CDRI	'89/'90/'92	O
LISCO 1 & 2	Misurata, Libya	1.10	2	CDRI	'89/'90	O
AM/NS India I & II	Hazira, India	0.88	2	CDRI/HDRI	'90	O
FMO	Puerto Ordaz, Venezuela	1.00	1	HBI	'90	O
VENPRECAR	Matanzas, Venezuela	0.82	1	HBI	'90	O
AM/NS India III	Hazira, India	0.44	1	HBI/HDRI	'92	O
Hadeed C	Al-Jubail, Saudi Arabia	0.65	1	CDRI	'92	O
Mobarakeh Steel A - E	Mobarakeh, Iran	4.00	5	CDRI	'92/'93/'94	O
JSW Steel Ltd.	Dolvi, Maharashtra, India	1.00	1	CDRI	'94	O
EZDK II	El Dikheila, Egypt	0.80	1	CDRI	'97	O
LISCO 3	Misurata, Libya	0.65	1	HBI	'97	O
ArcelorMittal Lázaro Cárdenas	Lázaro Cárdenas, Mexico	1.20	1	CDRI	'97	O
COMSIGUA	Matanzas, Venezuela	1.00	1	HBI	'98	O
ArcelorMittal Point Lisas III	Point Lisas, Trinidad & Tobago	1.36	1	CDRI	'99	I
ArcelorMittal South Africa	Saldanha Bay, South Africa	0.80	1	CDRI	'99	I
EZDK III	El Dikheila, Egypt	0.80	1	CDRI	'00	O
Khouzestan Steel IV	Ahvaz, Iran	0.85	1	CDRI	'01	O
AM/NS India IV	Hazira, India	1.00	1	HBI/HDRI	'04	O
Nu-Iron	Point Lisas, Trinidad & Tobago	1.60	1	CDRI	'06	O
AM/NS India V	Hazira, India	1.50	1	HBI/HDRI	'06	O
Mobarakeh Steel F	Mobarakeh, Iran	0.85	1	CDRI	'06	O
DRIC I & II	Dammam, Saudi Arabia	1.00	2	CDRI	'07	O
Hadeed E	Al-Jubail, Saudi Arabia	1.76	1	HDRI/CDRI	'07	O
LGOK HBI-2	Gubkin, Russia	1.40	1	HBI	'07	O
Qatar Steel 2	Mesaieed, Qatar	1.50	1	CDRI/HBI	'07	O
Khouzestan Steel V	Ahvaz, Iran	0.92	1	CDRI	'08	O
Lion DRI	Banting, Malaysia	1.54	1	HDRI/HBI	'08	I
Hormozgan A & B	Bandar Abbas, Iran	1.66	2	CDRI	'09/'10	O
AM/NS India VI	Hazira, India	1.50	1	CDRI	'10	O
Khorasan Steel I	Neyshabur, Khorasan Razavi, Iran	0.80	1	CDRI	'10	O
JindalShadeed	Sohar, Oman	1.50	1	HDRI/HBI	'10	O

*** Status Codes: O – Operating I – Idle C– Under Contract or Construction**

World Direct Reduction Plants (as of 12/31/23)

Source: Midrex Technologies, Inc.

Plant	Location	Capacity (Mt/y)	Modules	Product	Start-up	Status*
MIDREX® *(Continued)*						
Ghadir Iron and Steel Company	Ardakan (Yazd), Iran	0.80	1	CDRI	'11	O
Khorasan Steel II	Neyshabur, Khorasan Razavi, Iran	0.80	1	CDRI	'11	O
South Kaveh Steel A & B	Bandar Abbas, Iran	1.86	2	CDRI	'12	O
Mobarakeh Steel (Kharazi A & B)	Mobarakeh, Iran	2.76	2	CDRI	'12/'14	O
Tuwairqi Steel Mills	Karachi, Pakistan	1.28	1	HDRI/CDRI	'13	I
SULB	Hidd, Bahrain	1.50	1	HDRI/CDRI	'13	O
Arfa Steel Company	Ardakan (Yazd), Iran	0.80	1	CDRI	'13	O
Mobarakeh Steel (Saba)	Chamgordan, Isfahan, Iran	1.38	1	CDRI	'13	O
JSW Steel Ltd.	Toranagallu, Karnataka, India	1.20	1	HDRI/CDRI	'14	O
Sirjan Iranian Co.	Bardsir, Kerman, Iran	0.80	1	CDRI	'14	O
Jindal Steel & Power	Angul, Odisha, India	1.80	1	HDRI/CDRI	'14	O
ESISCO	Sadat City, Egypt	1.76	1	HDRI/CDRI	'15	I
Sirjan Jahan Co. 1	Sirjan, Kerman, Iran	0.96	1	CDRI	'15	O
Golgohar Iron & Steel Development 1	Sirjan, Kerman, Iran	1.70	1	CDRI	'15	O
ArcelorMittal Texas HBI	Corpus Christi, Texas, USA	2.00	1	HBI	'16	O
Sefid Dasht Steel	Sefiddasht, Iran	0.80	1	CDRI	'16	O
LGOK HBI-3	Gubkin, Russia	1.80	1	HBI	'17	O
Persian Gulf Saba Steel	Bandar Abbas, Iran	1.50	1	HBI	'17	O
Sabzevar Steel Company	Khorasan Razavi, Iran	0.80	1	CDRI	'18	O
Golgohar Iron & Steel Development 2	Sirjan, Kerman, Iran	1.70	1	CDRI	'18	O
Tosyali Algérie 1	Oran, Algeria	2.50	1	HDRI/CDRI	'18	O
Chadormalu M & I Co.	Ardakan (Yazd), Iran	1.55	1	HDRI/CDRI	'18	O
Pasargad Steel	Shiraz, Fars, Iran	1.50	1	HDRI/CDRI	'19	O
Ardakan Steel	Ardakan (Yazd), Iran	0.96	1	CDRI	'20	O
Cleveland-Cliffs HBI Plant	Toledo, Ohio, USA	1.60	1	HBI	'20	O
Algerian Qatari Steel (AQS)	Bellara, Algeria	2.50	1	HDRI/CDRI	'21	O
Ghaenat	Nimbolook, South Khorasan, Iran	0.80	1	CDRI	'22	O
Khouzestan Steel VI	Ahvaz, Khuzestan, Iran	1.76	1	CDRI	'24	C
Tosyali Algerie 2	Oran, Algeria	2.50	1	HDRI/CDRI	'24	C
Makran	Chabahar, Sistan Baluchestan, Iran	1.60	1	HBI		C
Sirjan Jahan Co. 2	Sirjan, Kerman, Iran	0.90	1	CDRI		C
Torbat	Shirabad, Razavi Khorasan, Iran	1.85	1	CDRI		C
Saqqez	Saqqez, Kurdestan, Iran	1.00	1	HBI		C
H2 Green Steel	Boden, Sweden	2.10	1	HDRI/CDRI	'25	C
		99.19	99			
HYL/ENERGIRON						
Ternium 3M5	Monterrey, Mexico	0.50	1	CDRI	'83	O
ArcelorMittal Lázaro Cárdenas I	Lázaro Cárdenas, Mexico	1.00	2	CDRI	'88	O
ArcelorMittal Lázaro Cárdenas II	Lázaro Cárdenas, Mexico	1.00	2	CDRI	'91	O
JSW Salav**	Raigad, India	0.90	1	HBI/CDRI	'93	O
PT Krakatau Steel	Cilegon, Indonesia	1.35	2	CDRI	'93	I
Perwaja Steel	Kemaman, Malaysia	1.20	2	CDRI	'93	I
Usiba	Salvador Bahia, Brazil	0.31	1	CDRI	'94	I
Ternium 2P5	Puebla, Mexico	0.61	1	CDRI	'95	O

*** Status Codes: O – Operating I – Idle C– Under Contract or Construction**

World Direct Reduction Plants (as of 12/31/22)

Source: Midrex Technologies, Inc.

Plant	Location	Capacity (Mt/y)	Modules	Product	Start-up	Status*
HYL/ENERGIRON *(Continued)*						
Ternium 4M	Monterrey, Mexico	0.68	1	HDRI/CDRI	'98	O
LGOK HBI-1	Gubkin, Russia	0.90	1	HBI	'99	O
Hadeed D	Al-Jubail, Saudi Arabia	1.10	1	CDRI	'99	O
Briqven	Matanzas, Venezuela	1.50	2	HBI	'00	I
Emirates Steel I (GHC)	Abu Dhabi, UAE	2.00	1	HDRI/CDRI	'09	O
Emirates Steel III	Abu Dhabi, UAE	0.20	1	CDRI	'10	O
Emirates Steel II (GHC)	Abu Dhabi, UAE	2.00	1	HDRI/CDRI	'11	O
Suez Steel	Adabia, Egypt	1.95	1	HDRI/CDRI	'13	O
Nucor Steel Louisiana	Convent, Louisiana, USA	2.50	1	CDRI	'13	O
Ezz Rolling Mills	Ain Sukhna, Egypt	1.90	1	CDRI	'15	O
Hebei Iron and Steel	Zhangjiakou, Hebei, China	0.55	1	CDRI	'23	O
Baosteel Zhanjiang	Zhanjiang, Guangdong, China	1.00	1	CDRI	'24	C
Mutún Steel	Puerto Suarez, SC, Bolivia	0.25	1	CDRI		C
Salzgitter AG	Salzgitter, Germany	2.10	1	HDRI		C
ArcelorMittal Dofasco	Hamilton, Ontario, Canada	2.00	1	HDRI/CDRI		C
		28.00	29			
PERED						
Shadegan Steel	Shadegan, Khouzestan, Iran	0.80	1	CDRI	'17	O
Mianeh Steel	Mianeh, East Azerbaijan, Iran	0.80	1	CDRI	'17	O
Neyriz Steel	Neyriz, Fars, Iran	0.80	1	CDRI	'18	O
Baft Steel	Baft, Kerman, Iran	0.80	1	CDRI	'19	O
Shanxi Taihang Mining	Jinzhong City, Shanxi Province, China	0.30	1	CDRI	'23	O
		3.50	5			
OTHERS						
FINMET						
BriqOri	Matanzas, Venezuela	2.20	4	HBI	'00	O
CIRCORED						
Arcelor Mittal Trinidad	Point Lisas, Trinidad & Tobago	0.50	1	HBI	'99	I
FIOR						
Operaciones RDI	Matanzas, Venezuela	0.40	1	HBI	'76	I

** JSW Salav has two reduction furnaces but only one reformer. The reformer can supply either reduction furnace, but not simultaneously.

Note 1: This list does not include plants that are inoperable or that have been dismantled.

Note 2: This list only includes plants processing feed materials with total iron content of 60% or higher and producing DRI with metallization of 85% or higher.

*** Status Codes: O – Operating I – Idle C– Under Contract or Construction**

2023 WORLD DIRECT REDUCTION STATISTICS is compiled by Midrex Technologies, Inc. annually as a resource for the global iron and steel industry.

Direct reduced iron (DRI) is a high-quality metallic product produced from iron ore used as a feedstock in electric arc furnaces, blast furnaces, and other iron and steelmaking applications. Hot briquetted iron (HBI) is a compacted form of DRI designed for ease of shipping, handling, and storage.

Midrex Technologies, Inc. is the world leader in direct reduction ironmaking technology and aftermarket solutions for the steel industry. As the technology provider of the MIDREX® Process for 50+ years, Midrex designs direct reduced iron (DRI) plants, providing engineering, proprietary equipment, and project development services. The MIDREX Process is unsurpassed in the industry in terms of production, reliability, and process flexibility to meet the constantly evolving nature of steelmakers and ore-based metallics providers.

The following organizations supplied or assisted in collecting data for this issue of 2023 WORLD DIRECT REDUCTION STATISTICS:

Sponge Iron Manufacturers Association – India
World Steel Association – Belgium
International Iron Metallics Association – UK
South East Asia Iron and Steel Institute – Malaysia
International Steel Statistics Bureau – UK
Kobe Steel Ltd. – Japan
All Individual MIDREX® Direct Reduction Plants
Other Direct Reduction Plants
Various company correspondence

For updates check **www.midrex.com**
For more information or general comments, please e-mail: **info@midrex.com**

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***World Steel Dynamics (WSD)** has audited Midrex's collection and preparation process of the "2023 World Direct Reduction Statistics", i.e. "The Booklet". It is our observation that at the present, Midrex receives inputs from all over the world from practically every known direct reduction producer either directly or indirectly through partner organizations. Midrex invites all producers to participate directly. In instances where plant information is not available directly from producers, Midrex deduces that information from publicly available data. WSD has reviewed the data collection and preparation procedures and can confirm the documentation substantiates the methodology and accuracy of the data to be published in The Booklet for the world direct reduction industry in 2023.*

Audited by
WSD WORLD STEEL DYNAMICS®
Englewood Cliffs, New Jersey, U.S.A.
Sept, 2024

MIDREX