2022 WORLD DIRECT REDUCTION STATISTICS

MIDREX

THE WORLD LEADER
IN DIRECT REDUCTION
TECHNOLOGY

CONTENTS

Audited by WSD WORLD STEEL DYNAMICS®

9.12.23

World DRI production reaches 127.36 Mt in 2022 sets new annual production record

Annual global direct reduced iron (DRI) production in 2022 was 127.36 million tons (Mt). DRI output was up almost 6.9% from the previous record of 119.2 Mt set in 2021. Once again, the combination of India and Iran produced well over half of the global DRI.

In the last six years, worldwide DRI output has grown by almost 55 Mt, or approximately 75%, driven by a 136% increase in DRI production in India (mainly coal-based DRI), a doubling of natural gas-based DRI production in Iran, and new natural gas-based plants in Algeria, Egypt, USA, and Russia.

The production of hot DRI (HDRI), which is fed directly to a nearby melt shop for energy savings and to improve productivity, was 13.9 Mt, a 0.5% increase compared to 2021, and made up 10.9% of the total in 2022. The production of hot briquetted iron (HBI) – a compacted form of DRI ideally suited for shipping and for use in the blast furnace – is estimated to have been 11.3 Mt, a 9% increase over 2021.

MIDREX® Plants produced 73.55 Mt of DRI in 2022, which is 3.8% more than the 70.85 Mt produced in 2021. Over 10 Mt of HDRI were produced by MIDREX Plants. The production total for 2022 was calculated from the 43.42 Mt confirmed by plants located outside of Iran and the estimated 30.13 Mt by plants in Iran derived from data reported by the World Steel Association (WSA).

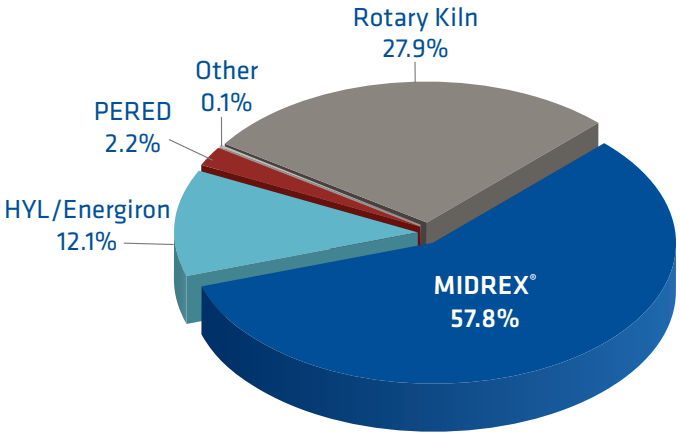
(Continued on page 3)

2022 Top 5 DRI Producing Nations

COUNTRY	PRODUCTION (Million Tons)
India	43.55
Iran	32.90
Russia	7.66
Saudi Arabia	6.48
Mexico	5.84

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

2022 World DRI Production by Process



Note: Percentages are rounded to the nearest decimal.

Total World Production: 127.36 Mt

	2020	2021	2022
MIDREX®	60.2%	59.5%	57.8%
HYL/Energiron	12.4%	12.7%	12.1%
PERED	2.9%(e)	2.2%(e)	2.2%(e)
Other	0.2%	0.1%	0.1%
Rotary Kiln	24.3%	25.4%	27.9%

(e) estimated

Source: Midrex Technologies, Inc.

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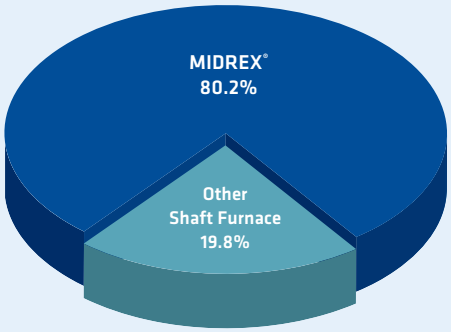
MIDREX® Technology continued to account for ~80% of worldwide production of DRI by shaft furnaces in 2022.

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. In 2022, approximately 70.1% of the DRI produced was natural gas-based (i.e., low CO_2 DRI), whereas the balance, 29.9%, was coal-based (i.e., high CO_2 DRI).

MIDREX Plants have produced a cumulative total of approximately 1,320 Mt of all forms of DRI (CDRI, HDRI, and HBI) through the end of 2022.

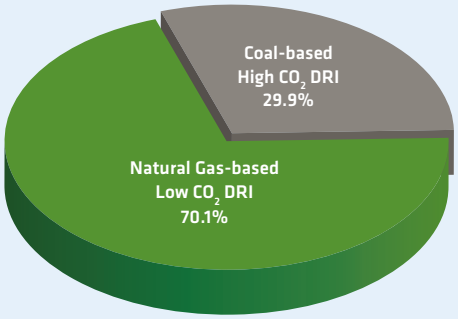
2022 World Shaft Furnace Production by Process



	2020	2021	2022
MIDREX®	79.7%	79.9%	80.2%
Other Shaft Furnace	20.3%	20.1%	19.8%

Source: Midrex Technologies, Inc.

2022 World DRI Production by CO_2 Emissions



	2020	2021	2022
High CO_2 DRI	26.2%	27.5%	29.9%
Low CO_2 DRI	73.8%	72.5%	70.1%

Source: Midrex Technologies, Inc.

BEHIND THE NUMBERS

Crude Steel Production

World crude steel production for the 64 countries reporting to the World Steel Association (worldsteel) was ~1,885.7 Mt in 2022, approximately a 1.5% decrease compared to 2021.

THE TOP 5 STEEL PRODUCING NATIONS IN 2022

China	1,018 Mt
India	125.4 Mt
Japan	89.2 Mt
USA	80.5 Mt
Russia	71.5 Mt

- Asia/Oceania produced 1,390.1 Mt, up <0.1% over 2021 production. Worldsteel includes Australia, China, India, Japan, New Zealand, Pakistan, South Korea, Taiwan, and Vietnam in Asia/Oceania.
- EU (27) produced 136.3 Mt in 2022, a decrease of 10.6% compared to 2021.
- Europe (Other) produced 45.8 Mt in 2022, a decrease of 10.5% compared to 2021. Worldsteel includes Bosnia-Herzegovina, Macedonia, Norway, Serbia, Turkey, and United Kingdom in Europe (Other).
- Russia & Other CIS + Ukraine production in 2022 was 85.8 Mt, down 18.8% from 2021. Worldsteel includes Belarus, Kazakhstan, Moldova, Uzbekistan in CIS.
- North & Central America produced 111.3 Mt in 2022, a 5.5% decrease compared to 2021. Worldsteel includes Canada, Cuba, El Salvador, Guatemala, Mexico, United States in North & Central America.
- Middle East produced 50.4 Mt in 2022, an increase of 22.3% over 2021. Worldsteel includes Iran, Qatar, Saudi Arabia, United Arab Emirates in Middle East.
- South America production in 2022 was 43.4 Mt, a 5.2% decrease compared to 2021. Worldsteel includes Argentina, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela in South America.
- Africa produced 21.1 Mt in 2022, an increase of 31.9% compared to 2021. Worldsteel includes Egypt, Libya, and South Africa in Africa.

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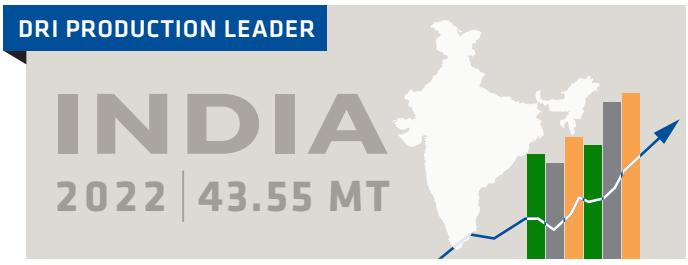
Direct Reduced Iron Production

India continued its streak as the number one DRI producer worldwide, producing a record 43.55 Mt of DRI – 35.39 Mt in rotary kilns and 8.16 Mt by gas-based processes – an 11.4% increase overall. According to the Sponge Iron Manufacturers Association (SIMA) of India, rotary kilns saw an 18% increase in 2022, after an 18.8% increase in 2021, and a 27.9% increase in 2020 over 2018-2019.



Production of DRI in Iran was 32.9 Mt in 2022, all from natural gas-based processes. This was a 3.3% increase compared to 2021. The MIDREX® Process accounts for ~90% of DRI production in Iran. PERED plants produced an estimated 2.76 Mt.

Russia maintained its 3rd place as a DRI-producing nation with 7.66 Mt, all from natural gas-based processes.

Saudi Arabia retained its 4th place with 6.48 Mt, and Mexico placed 5th with 5.84 Mt in 2022, compared with 6.13 Mt and 5.83 Mt, respectively, in 2021.

Among countries in the Middle East and North Africa region (MENA), Egypt led the way with 5.82 Mt, and Algeria increased its output, with Tosyali Algerie and Algerian Qatari Steel (AQS) combining to produce almost 4 Mt of DRI in 2022.

The continued ramp-up of the Cleveland-Cliffs HBI plant in Toledo, Ohio, also helped increase the DRI production in the U.S. to 5.24 Mt in 2022, a 4.6% increase over 2021.

In South America, Argentinian production of DRI improved 7.1%. Venezuela continued to produce well below rated capacity, due to limited availability of iron ore and spare parts. Venezuela is mainly making HBI for export.

2022 saw iron ore prices climb ~$25 per ton in the first quarter, experience a big drop (over $60 per ton) in the 2nd and 3rd quarters, and reach a minimum after the beginning of the 4th quarter before recovering and ending slightly lower than at the beginning of the year. In general, DRI/HBI prices peaked significantly around the middle of the year and fell back to lower values compared to the beginning of the year.

NEW CAPACITY ANNOUNCED IN 2022

MIDREX

Midrex and Paul Wurth were selected by H2 Green Steel to supply the world's first commercial 100% hydrogen-based DRI plant. The 2.1 million tons per year MIDREX H2™ Plant will be located in Boden, northern Sweden. H2 Green Steel will produce green steel, reducing CO_2 emissions by up to 95% compared to traditional steelmaking by replacing coal with green hydrogen produced by renewable electricity. Water and heat are the primary emissions from the plant, which is expected to begin production in 2025 and ramp up during 2026.

HYL/ENERGIRON

ArcelorMittal chose ENERGIRON DRI technology for its Dofasco steel mill in Hamilton, Ontario, Canada. Tenova and Danieli will design and supply a 2.0 Mt/y, hydrogen-ready ENERGIRON ZR direct reduction plant, which will use natural gas as the reducing agent with the possibility to mix it with hydrogen up to 100%. The plant will be designed to capture and sell CO_2. The plant is expected to start up in 2026.

Sinosteel Engineering & Technology Co., Ltd., located in Beijing, China, contracted Tenova for the design and supply of a hydrogen-based 1 Mt/y ENERGIRON plant. The plant will be installed at Baosteel Zhanjiang Iron & Steel Co., Ltd, located in the Zhanjiang Economic and Technological Zone, Guangdong Province, China. The ENERGIRON plant will use mainly hydrogen as reducing gas with the ability to mix it with natural gas and coke oven gas. The plant will be capable of capturing CO_2 for commercial sale.

Tata Steel selected ENERGIRON technology for its Heracless (Hydrogen-Era-Carbon-Less) project intended to transition to hydrogen-based steel production at its Ijmuiden, Netherlands facility. The company intends to use DRI plants to enable the facility to reach high-quality green steel production with the use of hydrogen. The DRI plants will be hydrogen-ready by design and can use hydrogen as reducing gas without equipment modifications.

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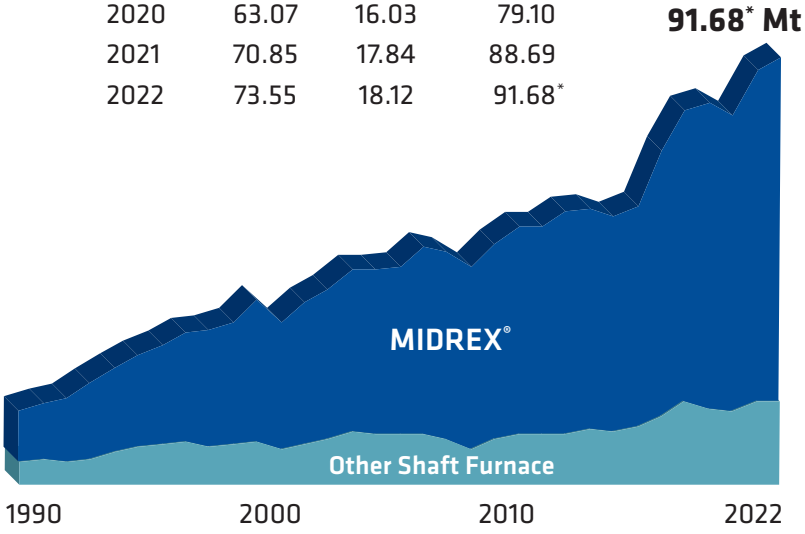
Shaft Furnace DRI Production by Process and by Year

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*



* Total is rounded to the nearest centesimal

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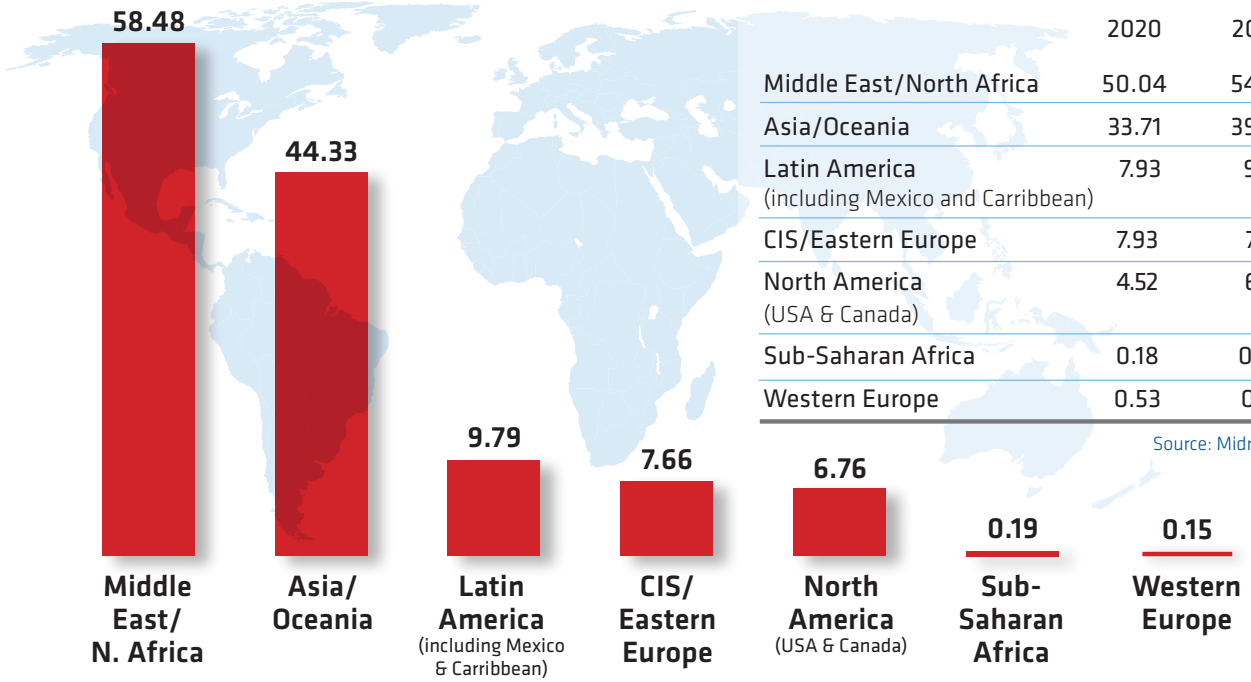
2022 World DRI Production by Region (Mt)



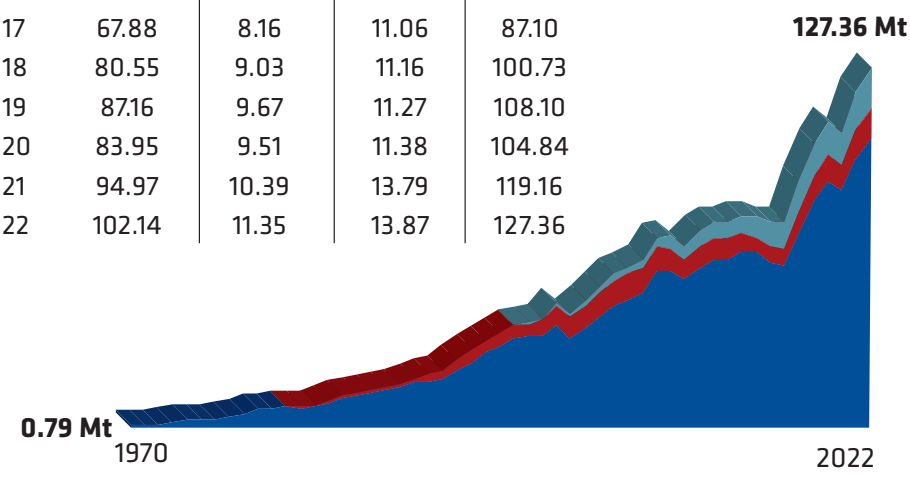
	2020	2021	2022
Middle East/North Africa	50.04	54.84	58.48
Asia/Oceania	33.71	39.47	44.33
Latin America (including Mexico and Carribbean)	7.93	9.61	9.79
CIS/Eastern Europe	7.93	7.89	7.66
North America (USA & Canada)	4.52	6.66	6.76
Sub-Saharan Africa	0.18	0.20	0.19
Western Europe	0.53	0.50	0.15

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					
'86	12.53	'05	56.87					
'87	13.52	'06	59.70					
'88	14.09	'07	67.12					
'89	15.63	'08	67.95					



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1970-2011 World DRI Production by Region (Mt)

Source: Midrex Technologies, Inc.

NAME	'70-'01	'02	'03	'04	'05	'06	'07	'08	'09	'10	'11
Latin America											
ARGENTINA	25.98	1.46	1.74	1.74	1.83	1.95	1.81	1.86	0.81	1.57	1.68
BRAZIL	7.93	0.36	0.41	0.44	0.43	0.38	0.36	0.30	0.01	–	–
MEXICO	75.73	4.90	5.62	6.54	5.98	6.17	6.26	6.01	4.15	5.37	5.85
PERU	1.06	0.03	0.08	0.08	0.09	0.14	0.09	0.07	0.10	0.10	0.09
TRINIDAD AND TOBAGO	16.74	2.32	2.28	2.36	2.25	2.08	3.47	2.78	1.99	3.08	3.03
VENEZUELA	82.95	6.89	6.90	7.83	8.95	8.61	7.71	6.87	5.61	3.79	4.47
Middle East/N. Africa											
ALGERIA	–	–	–	–	–	–	–	–	–	–	–
BAHRAIN	–	–	–	–	–	–	–	–	–	–	–
EGYPT	16.51	2.53	2.87	3.02	2.90	3.10	2.79	2.64	2.91	2.86	2.97
IRAN	35.37	5.28	5.62	6.41	6.85	6.85	7.44	7.46	8.20	9.35	10.37
LIBYA	11.73	1.17	1.34	1.58	1.65	1.63	1.64	1.57	1.11	1.27	0.30
OMAN	–	–	–	–	–	–	–	–	–	–	1.11
QATAR	12.58	0.75	0.78	0.83	0.82	0.88	1.30	1.68	2.10	2.16	2.23
SAUDI ARABIA	31.85	3.29	3.29	3.41	3.63	3.58	4.34	4.97	5.03	5.51	5.81
UAE	–	–	–	–	–	–	–	–	–	1.18	2.25
Asia/Oceania											
AUSTRALIA	2.25	1.02	1.95	0.69	–	–	–	–	–	–	–
CHINA	0.27	0.22	0.31	0.43	0.41	0.41	0.60	0.18	0.08	–	–
INDIA	45.51	6.59	7.67	9.37	12.04	14.74	19.06	21.20	22.03	23.42	21.97
INDONESIA	27.86	1.50	1.23	1.47	1.27	1.20	1.32	1.21	1.12	1.27	1.23
MALAYSIA	14.90	1.08	1.60	1.68	1.38	1.54	1.84	1.94	2.30	2.39	2.16
MYANMAR	0.47	0.04	0.04	0.04	–	–	–	–	–	–	–
PAKISTAN	–	–	–	–	–	–	–	–	–		–
North America											
CANADA	20.74	0.18	0.50	1.09	0.59	0.45	0.91	0.69	0.34	0.60	0.70
USA	15.63	0.47	0.21	0.18	0.22	0.24	0.25	0.26	–	–	–
CIS/Eastern Europe											
RUSSIA	27.11	2.91	2.91	3.14	3.34	3.28	3.41	4.56	4.67	4.79	5.20
Sub-Saharan Africa											
NIGERIA	1.53	–	–	–	–	–	–	0.20	–	–	–
SOUTH AFRICA	17.57	1.55	1.54	1.63	1.78	1.75	1.74	1.18	1.39	1.12	1.41
Western Europe											
GERMANY	9.20	0.54	0.59	0.61	0.44	0.58	0.59	0.52	0.38	0.45	0.38
Other Nations	0.47	–	–	–	–	–	–	–	–	–	–
WORLD TOTAL	501.94	45.08	49.48	54.60	56.87	59.70	67.12	67.95	64.33	70.28	73.21

1970-2011 World DRI Production by Process (Mt)

NAME	'70-'01	'02	'03	'04	'05	'06	'07	'08	'9	'10	'11
MIDREX®	313.23	30.10	32.11	35.01	34.96	35.71	39.72	39.85	38.62	42.01	44.38
HYL/Energiron	138.95	8.88	9.72	11.34	11.00	10.91	11.20	9.84	7.88	9.81	11.03
PERED	–	–	–	–	–	–	–	-	–	–	–
Rotary Kiln	37.62	4.43	5.04	6.41	9.17	11.53	14.90	16.92	17.33	18.12	17.32
Other *	12.15	1.67	2.61	1.66	1.70	1.53	1.29	1.33	0.76	0.34	0.48
WORLD TOTAL	501.94	45.08	49.48	54.60	56.87	59.70	67.12	67.95	64.33	70.28	73.21

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

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2012-2022 World DRI Production by Region (Mt)

Source: Midrex Technologies, Inc.

NAME	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21	'22
Latin America											
ARGENTINA	1.61	1.54	1.67	1.26	0.78	1.23	1.61	1.09	0.53	1.41	1.51
BRAZIL	–	–	–	–	–	–	–	–	–	–	–
MEXICO	5.59	6.13	5.98	5.50	5.31	6.01	5.97e	5.97	5.17	5.83	5.84
PERU	0.10	0.10	0.09	0.07	0.01	–	–	–	–	–	–
TRINIDAD AND TOBAGO	3.25	3.29	3.24	2.52	1.50	1.59	1.54	1.70	1.34	1.62	1.43
VENEZUELA	4.61	2.77	1.68	2.75	1.59	1.68	0.99	1.01	0.89	0.76	1.01
Middle East/N. Africa											
ALGERIA	–	–	–	–	–	–	0.11	1.54	2.23	3.08	3.88
BAHRAIN	–	0.78	1.44	1.23	1.26	1.26	1.60	1.45	1.38	1.51	1.42
EGYPT	2.84	3.43	2.88	2.73	2.82	4.67	5.22e	4.05	4.71	5.23	5.82
IRAN	11.58	14.46	14.55	14.55	16.01	20.55	25.75	28.52	30.21	31.85	32.90
LIBYA	0.51	0.95	1.00	0.45	0.69	0.56	0.61	0.87	0.83	0.88	1.10
OMAN	1.46	1.47	1.45	1.48	1.46	1.51	1.50	1.75	1.73	1.70	1.82
QATAR	2.42	2.39	2.64	2.71	2.58	2.63	2.63	2.49	0.78	0.79	1.62
SAUDI ARABIA	5.66	6.07	6.46	5.80	5.89	5.74	6.00	5.79	5.19	6.13	6.48
UAE	2.72	3.07	2.41	3.19	3.48	3.61	3.78	3.67	2.96	3.66	3.45
Asia/Oceania											
AUSTRALIA	–	–	–	–	–	–	–	–	–	–	–
CHINA	–	–	–	–	–	–	–	–	–	–	–
INDIA	20.05	17.77	17.31	17.68	18.47	22.34	28.11	33.74	32.98	39.11	43.55
INDONESIA	0.52	0.76	0.16	0.05	–	–	0.24	-e	-e	-e	-e
MALAYSIA	2.01	1.40	1.33	0.96	0.66	0.57	0.75	0.59	0.73	0.36	0.78
MYANMAR	–	–	–	–	–	–	–	–	–	–	–
PAKISTAN	–	0.06	–	–	–	–	–	–	–	–	–
North America											
CANADA	0.84	1.25	1.55	1.50	1.40	1.61	1.67	1.44	1.17	1.65	1.52
USA	–	–	1.30	1.10	1.81	2.99	3.35	3.24	3.35	5.01	5.24
CIS/Eastern Europe											
RUSSIA	5.24	5.33	5.35	5.44	5.70	6.99	7.90e	8.03	7.93	7.89	7.66
Sub-Saharan Africa											
NIGERIA	–	–	–	–	–	–	–	–	–	–	–
SOUTH AFRICA	1.57	1.41	1.55	1.12	0.70	0.93	0.83	0.66	0.18	0.20	0.19
Western Europe											
GERMANY	.56	0.50	0.57	0.55	0.60	0.63	0.56	0.47	0.53	0.50	0.15
Other Nations	–	–	–	–	–	–	–	–	–	–	–
WORLD TOTAL	73.14	74.92	74.59	72.64	72.71	87.10	100.73	108.10	104.84	119.16	127.36

2012-2022 World DRI Production by Process (Mt)

NAME	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21	'22
MIDREX®	44.76	47.56	47.12	45.77	47.14	56.65	61.96	65.37	63.07	70.85	73.55
HYL/Energiron	10.79	11.29	12.08	11.62	12.66	14.68	15.85	14.26	12.98	15.16	15.36
PERED	–	–	–	–	–	**	2.40	2.31	3.05e	2.67e	2.76e
Rotary Kiln	17.06	15.93	15.39	14.74	12.67	15.34	20.31	25.98	25.50	30.30	35.57
Other *	0.53	0.14	–	0.51	0.24	0.44	0.22	0.18	0.24	0.16	0.11
WORLD TOTAL	73.14	74.92	74.59	72.64	72.71	87.10	100.73	108.10	104.84	119.16	127.36

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

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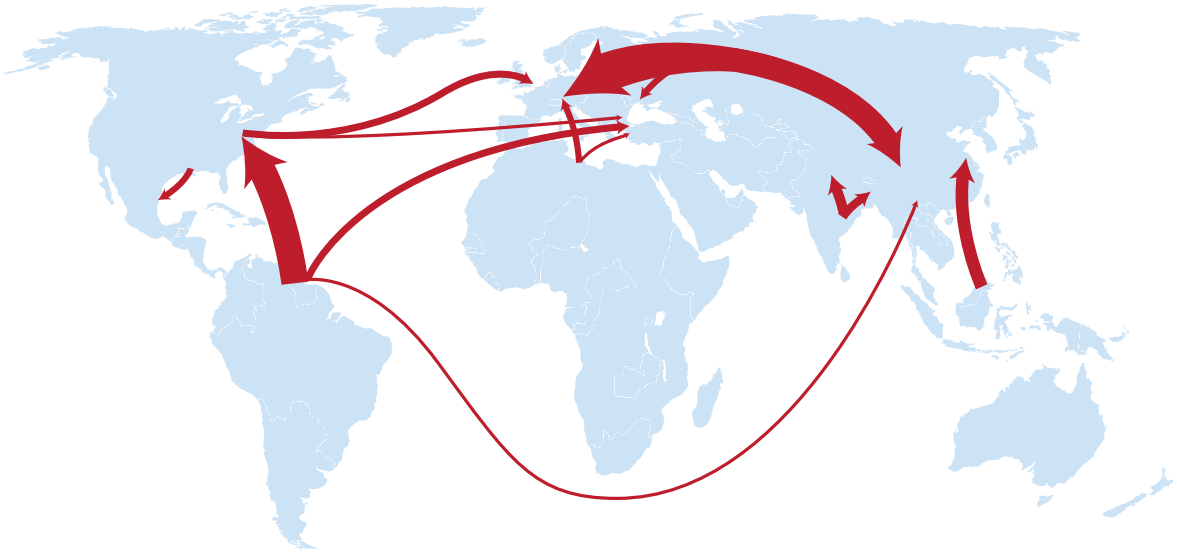
9.12.23

Major Trade Routes for International Trade of DRI



The map shows the major routes of international transport of DRI in 2022. 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:

Shipments of DRI increased to a record of 25.7 Mt in 2022, a 13% increase from the previous record of 22.8 Mt in 2021. Land shipments made up the majority of the total in 2022, amounting to 15.7 Mt. However, water shipments showed a 25% increase compared to 2021.

SUPPLIERS

Russia led all exporters with approximately 3.0 Mt of DR products. Trinidad and Tobago exported over 1.4 Mt of CDRI, all going to the USA. India exported approximately 1.0 Mt, and Iran, Malaysia, and USA rounded out the top six exporting countries according to data from the ISSB.

DESTINATIONS

According to data from ISSB, 31 countries imported significant quantities of DRI/HBI. The top three importers were USA, Italy, and China, with 1.5 Mt, 0.9 Mt, and 0.8 Mt, respectively.

OUTLOOK

The trade of DRI products in 2023 is expected to increase somewhat compared to 2022, tempered by governmental efforts to reduce inflation globally.

The relationship between scrap and HBI prices will remain volatile, with freight as another variable. HBI suppliers know what products they compete against and must adjust their prices to stay competitive with other ferrous feedstocks on a regional CIF basis.

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

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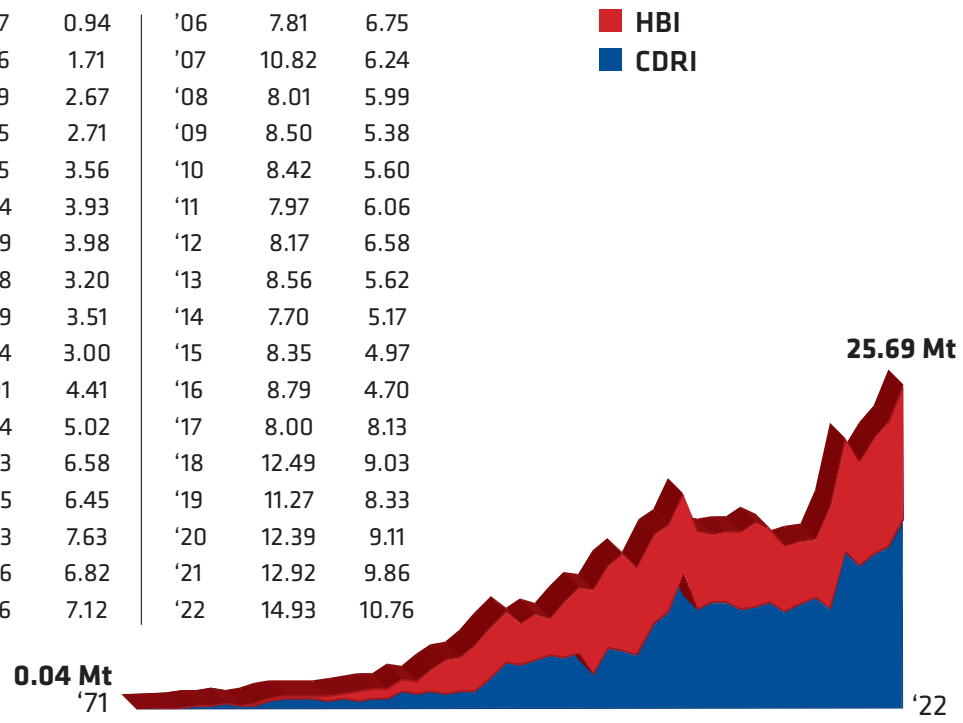
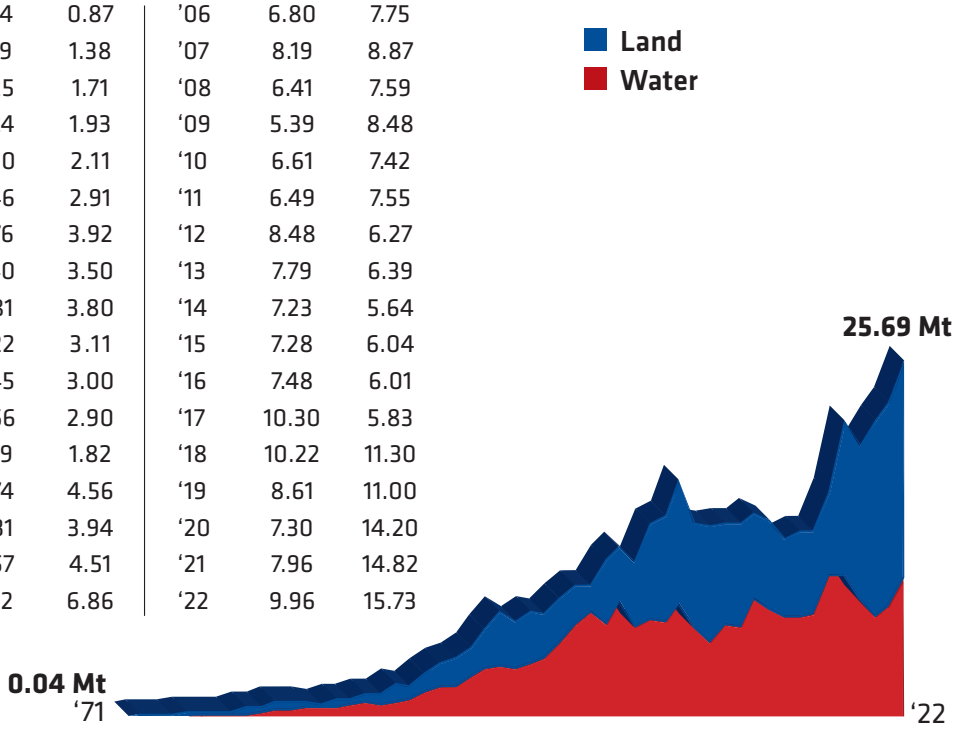
World DRI Shipments (Mt)

Source: Midrex Technologies, Inc.

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



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



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.

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

Source: Midrex Technologies, Inc.

Plant	Location	Capacity (Mt/y)	Modules	Product	Start-up	Status*
MIDREX®						
ArcelorMittal Hamburg	Hamburg, Germany	0.40	1	CDRI	'71	I
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	I
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

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.
Note 3: There are nearly 300 small rotary kilns in India with annual capacities of 10,000-30,000 tons per year that are not included on this list.
Note 4: Only a representative sample of rotary kiln facilities larger than 50,000 tons per year are shown.

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

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

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
Qaenat	Nimbolook, South Khorasan, Iran	0.80	1	CDRI		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
Tosyali Algerie 2	Oran, Algeria	2.50	1	HDRI/CDRI		C
Khouzestan Steel VI	Ahvaz, Khuzestan, Iran	1.76	1	CDRI	'23	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

** 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.

Note 3: There are nearly 300 small rotary kilns in India with annual capacities of 10,000-30,000 tons per year that are not included on this list.

Note 4: Only a representative sample of rotary kiln facilities larger than 50,000 tons per year are shown.

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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
Gulf Sponge Iron	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
Mutún Steel	Puerto Suarez, SC, Bolivia	0.25	1	CDRI		C
OMK	Vyksa, Russia	2.50	1	HDRI		C
Myingyan Steel	Myingyan, Myanmar	0.50	1	CDRI		C
Hebei Iron and Steel	Hebei, China	0.55	1	CDRI		C
Baosteel Zhanjiang	Zhanjiang, Guangdong, China	1.00	1	CDRI		C
ArcelorMittal Dofasco	Ontario, Canada	2.00	1	HDRI/CDRI	'26	C
		28.40	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	C
		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
ROTARY KILN						
SL/RN						
Piratini	Charquedas, Brazil	0.06	1	CDRI	'73	I
SIIL	Paloncha, India	0.06	2	CDRI	'80/'85	O
Siderperu	Chimbote, Peru	0.10	3	CDRI	'80	I
ISCOR	Vanderbijlpark, South Africa	0.72	4	CDRI	'84	O
Prakash Industries	Champa, India	0.40	2	CDRI	'93/'96	O
Nova Iron & Steel	Bilaspur, India	0.15	1	CDRI	'94	O
Ashirwad	Jamshedpur, India	0.05	2	CDRI	'00	O

Note 1: This list does not include plants that are inoperable or that have been dismantled.
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World Direct Reduction Plants (as of 12/31/22)

Source: Midrex Technologies, Inc.

Plant	Location	Capacity (Mt/y)	Modules	Product	Start-up	Status*
ROTARY KILN *(Continued)*						
Vandana Global	Siltara, Raigarh, India	0.05	1	CDRI		O
Prakash Industry	Champa, India	0.60		CDRI		O
JINDAL						
Jindal Steel & Power	Raigarh, India	0.90	6	CDRI	'93/'94/'95/'96/'00	O
Monnet Ispat	Ispat Raipur, India	0.30	2	CDRI	'93/'98	O
Rexon Strips Ltd.	Via Lathikata, India	0.06	2	CDRI	'93/'00	O
DRC						
Scaw Metals I	Germiston, South Africa	0.18	2	CDRI	'83/'89	O
Scaw Metals II	Germiston, South Africa	0.15	1	CDRI	'97	O
Tianjin Iron & Steel	Tianjin, China	0.30	2	CDRI	'97	I
CODIR						
Dunswart	Benoni, South Africa	0.15	1	CDRI	'73	O
Sunflag	Bhandara, India	0.15	1	CDRI	'89	O
TISCO						
Tata Sponge Iron, Ltd.	Keonjhar, Orissa, India	0.40	2	CDRI	'86/'98	O
Vallabh Steels	Ludhiana, Punjab, India	0.12	1	CDRI		O
SIIL						
Bellary Steel & Alloys	Bellary, Karnataka, India	0.06	2	CDRI	'92/'93	O
HEG	Borai, India	0.09	2	CDRI	'92	O
Kumar Met.	Nalgonda, India	0.06	2	CDRI	'93	O
Aceros Arequipa	Pisco, Peru	0.08	2	CDRI	'96	O
Rungta Mines	Barbil, India					
OSIL						
OSIL	Keonjhar, Orissa, India	0.10	1	CDRI	'83	O
Lloyd's Metals & Eng.	Ghugus, India	0.27		CDRI	'95	O
DAV						
Davsteel	Cullinan, South Africa	0.04	1	CDRI	'85	O
BGRIMM						
ArcelorMittal South Africa	Vanderbijlpark, South Africa	0.30	2	CDRI	'09	O
OTHER						
Mahalaxmi TMT Bars	Wardha, Maharashtra India	0.24	1	CDRI	'11	O
BMM Ispat Ltd	Danapura, Hospet, Karnataka, India	0.73		CDRI		O
Sarda Energy and Minerals, Ltd.	Siltara, Raipur, India	0.36		CDRI		O
Godawari Power and Ispat	Siltara, Raipur, India	0.50		CDRI		O
Nalwa Steel and Power Ltd.	Raigarh, Chhattisgarh, India	0.18		CDRI		O
Janki Corp., Ltd.	Sidiginamola, Bellary, Karnataka	0.18		CDRI		O
Andhunik Metaliks, Ltd.	Chadrihariharpur, Orissa, India	0.30		CDRI		O
Shyam SEL Ltd.	West Bengal and Odisha, India	0.80		CDRI		O

Note 1: This list does not include plants that are inoperable or that have been dismantled.
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World Direct Reduction Plants (as of 12/31/22)

Source: Midrex Technologies, Inc.

Plant	Location	Capacity (Mt/y)	Modules	Product	Start-up	Status*
ROTARY KILN *(Continued)*						
OTHER *(Continued)*						
Shri Bajrang Power and Ispat	Raipur, India	0.36		CDRI		O
Gallantt Metal, Ltd.	Kutch, Gujarat, India	0.20		CDRI		O
SKS Ispat, Ltd.	Raipur, Chhattisgarh, India	0.27		CDRI		O
Bhushan Power and Steel Ltd.	Sambalpur, Odisha, India	1.50		CDRI	11-'12	O
Tata Steel Ltd.	Angul, Odisha, India	1.50		CDRI		O
Electrotherm (India) Ltd.	Kutch, Gujarat, India	0.15		CDRI		O
Jayaswal Neco Industries Ltd.	Raipur, Chhattisgarh, India	0.25		CDRI		O
SMC Power Generation Ltd.	Jharsuguda, Odisha, India	0.20		CDRI		O
Electrotherm	Kutch, India	0.18		CDRI		O
PT Meratus Jaya	Kalimantan Selatan, Indonesia	0.32		CDRI		O

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.
Note 3: There are nearly 300 small rotary kilns in India with annual capacities of 10,000-30,000 tons per year that are not included on this list.
Note 4: Only a representative sample of rotary kiln facilities larger than 50,000 tons per year are shown.

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

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2022 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 that is 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 for 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 2022 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
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***World Steel Dynamics (WSD)** has audited Midrex's collection and preparation process of the "2022 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 2022.*

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