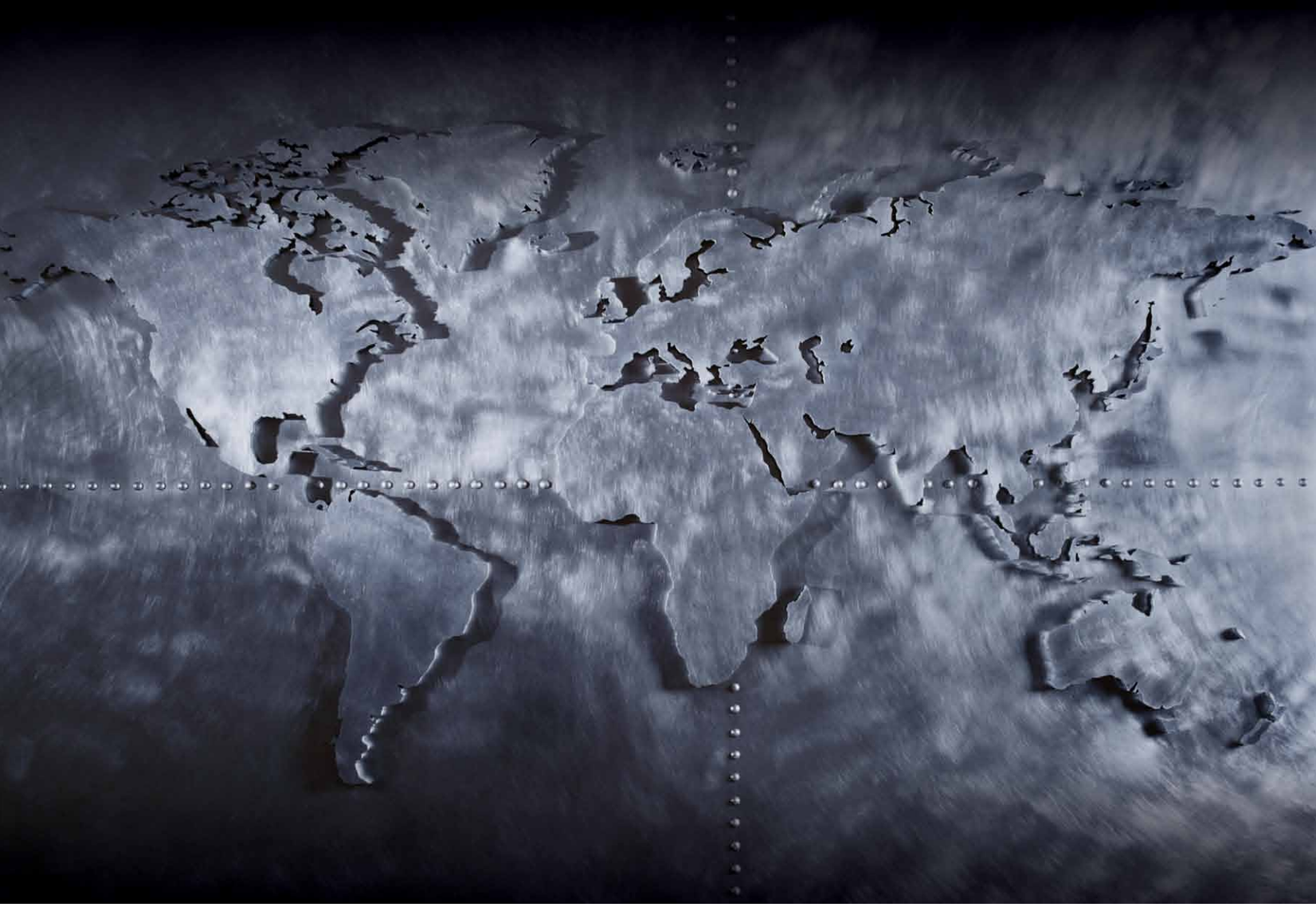
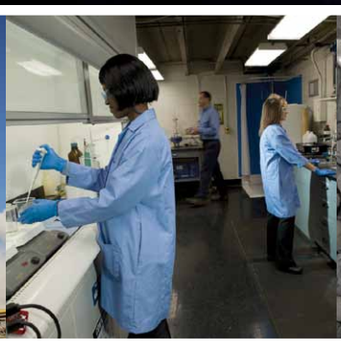
MIDREX

THE WORLD LEADER IN DIRECT REDUCTION





GLOBAL PLANT SUPPLY • TECHNOLOGY DEVELOPMENT • AFTERMARKET

CONTENTS

/Success/

Since 1969 more than 70 shaft furnace and rotary hearth furnace modules have been built across five continents. >

Argentina
Canada
Egypt
Germany
India
Japan
Libya
Malaysia
Mexico
Nigeria
Oman
Pakistan
Qatar
Russia
Saudi Arabia
South Africa
United States
Trinidad & Tobago
Venezuela

Innovation is our foundation...

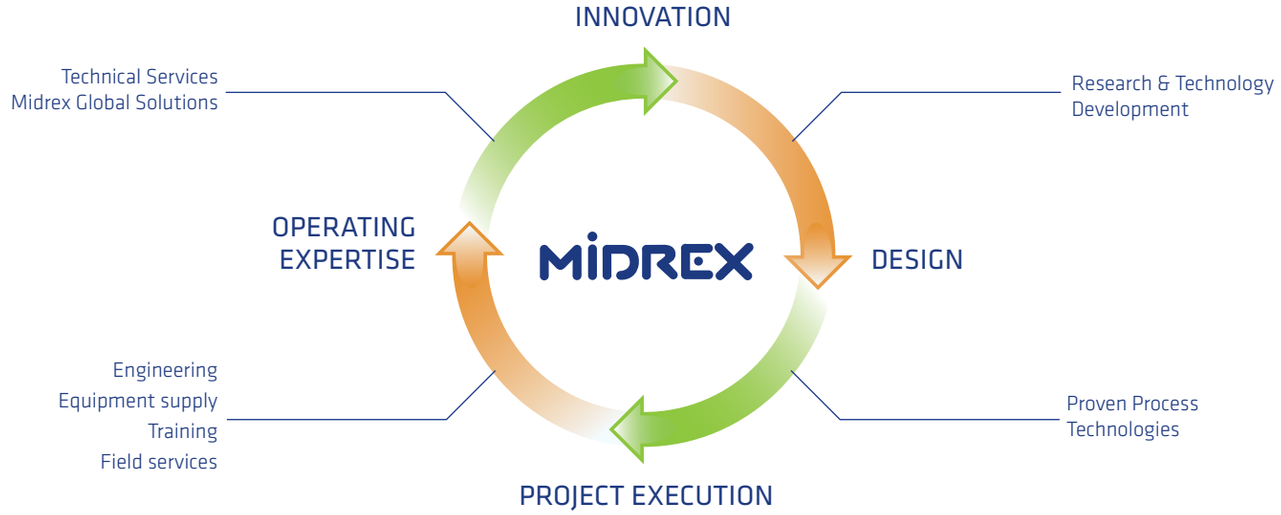
Midrex was founded on an idea. Dedicated pursuit of that idea led to our corporate success. Continuing to learn and adapt based upon our practical experiences fuels our innovation... and that in turn leads to new ideas.

The need for a new source of metallics in the global steel industry led to the development of the MIDREX® Process more than 40 years ago. Development of the technology was just the beginning as Midrex took this process and executed projects worldwide, overcoming technical, geographic and logistical obstacles.

Although we do not own and operate these plants, we stay involved with plant operation through our technical services and aftermarket support. This synergistic relationship enables us to continue to innovate by addressing new challenges and provide better solutions for our clients.

It is this continual improvement that made the MIDREX Process the world's leading technology for the direct reduction of iron ore. For more than two decades, MIDREX® Plants have produced 60 percent or more of the world's DRI each year and we continue to develop some of the industry's most efficient and successful technologies.

PROJECT LIFE CYCLE



/ Expertise /

Hadeed Works Module E in Saudi Arabia includes a 1.76 Mtpy MIDREX® Shaft Furnace and uses an Aumund hot transport conveyor to feed Hot DRI to the adjacent meltshop. The plant began operations in 2007 and provided dramatically increased meltshop productivity by reducing tap-to-tap times.

Global plant supply: Worldwide capabilities

Designing and supplying direct reduction plants is our primary business. To provide the best value for our clients we offer a range of services and options from technology packages to full turnkey supply.

From pre-feasibility studies and financing support, through design, procurement and on-site assistance, Midrex offers a blend of services to maximize the value of each project. Our confidence and expertise come from our technical know-how and successful record. Since 1969, Midrex has executed more than 50 projects across the globe with a combined capacity exceeding 40 million tons per year.

Midrex also draws on strategic alliances with firms worldwide that enhance and compliment our capabilities, products and services. This combination of exceptional people and partnerships enables us to supply plants and equipment that start up quickly, exceed performance guarantees and operate reliably year after year.

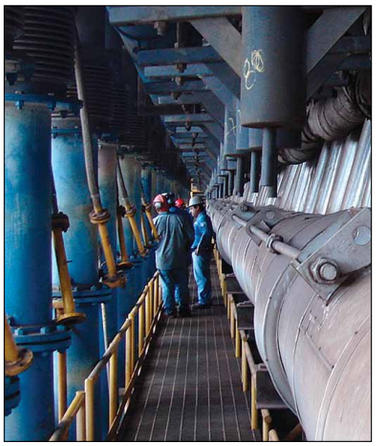
Hirohata FASTMET® Plant (Japan)


LGOK HBI II Plant (Russia)

ENGINEERING

Midrex's proprietary process and equipment design expertise is a major asset to our clients and is unique in the direct reduction industry. These engineering capabilities utilize a knowledge base that helped create the modern metallics industry. For more than 40 years, Midrex has pioneered technologies such as stoichiometric CO_2 reforming and hot briquetting of DRI, turning visionary concepts into bankable realities.

Midrex capabilities include high temperature refractory and equipment design, super-alloy selection and application, combustion systems, reforming, waste heat recovery systems and high temperature furnace applications. Since 1992 Midrex has had a strategic alliance with Jacobs Engineering India, to supply detail engineering such as piping, electrical and structural steel to augment our core capabilities. All design and engineering meets the strict requirements of our ISO 9001 Quality Management System.



PROJECT MANAGEMENT

Midrex has by far the largest project management experience base in the direct reduction industry. We overcome the challenges of project structure, geography, infrastructure and language. MIDREX® Plants have been constructed for private companies as well as government organizations and in locations ranging from the deserts of the Middle East to the frigid conditions of Russia and Canada. This successful project management requires seamless coordination with local companies, worldwide vendors and Midrex representatives that are sometimes half a world away.

Doing business in developing countries entails challenges such as currency exchange, logistics and other factors. Midrex project managers have more than 200 man-years experience in designing and starting up MIDREX Modules and other process plants worldwide and are more than capable to meet these challenges. This enables us to maintain the quality of work, meet schedules and comply with budget requirements despite the unique requirements of each Midrex project.

PROCUREMENT

Our in-house, full-service procurement organization has extensive experience in worldwide purchasing for fast track projects. Midrex's scope of supply typically includes a variety of engineered mechanical, electrical and instrumentation packages. It also includes specialty refractory and proprietary carbon steel and alloy fabrications. Our expediting group utilizes specific ISO 9001 procedures to ensure that vendors maintain their schedule commitments for drawings, documentation and equipment supply.

Midrex uses integrated software systems for purchasing, accounting, cost control and scheduling to ensure success. This along with our experienced staff enables us to handle procurement requirements ranging from small packages to multi-million dollar international projects.

We also have the experience and resources of Forwarding Services International, Inc. (FSI), a wholly owned subsidiary of Midrex that provides global logistics services. FSI has the expertise and a proven record in shipping by ocean-going ship, inland waterway, rail or truck.

FIELD SERVICES

Erection, operator training and commissioning are crucial for the success of a direct reduction project and Midrex provides valuable on-site assistance. Our field personnel carry with them a long history of successful projects, enabling us to work with clients, local and international construction companies and project partners at plant sites worldwide.

Midrex provides a unique training approach for plant operators that includes classroom instruction plus hands-on training at an operating MIDREX® Plant.

For plant commissioning, we assemble an on-site team of engineers and field specialists to provide the breadth of experience required to deal with any issues that may arise. Home office support, including human resources and analytical and design tools, are also available to support the commissioning team when needed.

STRATEGIC ALLIANCES

We have developed strong relationships with a number of worldwide partners including Siemens VAI Metals Technologies and SMS Siemag that assist with project development, engineering, equipment supply, construction, field services and financing. As a part of the Kobe Steel Group, Midrex works closely with Kobe Steel's engineering, project management and research groups.

These associations provide a range of options for supply of direct reduction projects—from a technology package to a full turnkey solution. They also ensure that critical equipment is designed and supplied to perform to the highest standard in each application.

FINANCING ASSISTANCE

For customers who wish to evaluate financing options, Midrex can serve as a liaison with financial institutions. We maintain contacts at principal international banks, export credit agencies and major insurance companies and have staff with international banking experience to assist our clients.

/Progress/

The first commercial FASTMET® Plant at Nippon Steel in Hirohata, Japan began operation in 2000 to process steel mill by-products and reclaim iron.

Technology development: A firm foundation and continuous improvement

The success of Midrex's ironmaking technologies can be attributed to two factors: (1) well-designed and efficient processes, and (2) continuous improvement through ongoing technology development.

Midrex pioneered shaft furnace direct reduction in the 1960s and we continue to develop innovative technology solutions. We benefit from a proven history of effective collaboration with our process licensees. Our shaft furnace and rotary hearth furnace processes have steadily advanced in terms of plant capacity, productivity, energy efficiency, raw materials and reductant flexibility, product form and emissions.

Our vision is to continue expanding direct reduction applications and provide a wide range of solutions for the steel industry.

DIRECT REDUCTION: *SHAFT FURNACE AND ROTARY HEARTH FURNACE (RHF)*

As the global technology leader in direct reduced iron (DRI) - a high-purity product for use in steelmaking, ironmaking and foundry applications - Midrex offers two types of furnaces for iron production and mineral processing.

The MIDREX® Direct Reduction Process employs a shaft furnace to convert iron ore into DRI using natural gas or syngas from coal. The MIDREX® Process is energy efficient and flexible, producing 60 percent of the world's DRI annually. Midrex offers three rotary hearth furnace-based technologies: FASTMET® provides for recycling of steel mill by-products with iron unit recovery; FASTMELT® processes steel mill by-products into hot metal or pig iron for steel mill use; and ITmk3® (pronounced "eye-tee" mark 3) produces high quality pig iron nuggets from iron ore.

FORMS OF MIDREX® IRON

Our technology development capabilities enable us to discover and commercialize solutions for the evolving steel industry. These efforts enhance our shaft furnace and RHF technologies, which are the industry's most successful. A major focus of recent efforts has been hot discharge of DRI, transport to the meltshop and hot charging to the EAF. We are currently working to further increase the capacity of the shaft furnace to more than two million tons per year - a technology known as the SUPER MEGAMOD®.

RESEARCH AND DEVELOPMENT TECHNOLOGY CENTER

An essential part of Midrex's technology development activities is the company's state-of-the-art technology center located near Midrex's headquarters in Charlotte, North Carolina, USA.

Capabilities include raw material evaluations, precise material characterization, determination of expected operating parameters and both bench-scale and pilot-scale testing. This enables clients to assess the viability of their projects and gain increasing confidence as project development proceeds. Analytical equipment includes automated surface area and carbon and sulfur analyzers, ICP-OES (Inductively Coupled Plasma - Optical Emission Spectroscopy) and XRF/XRD (X-Ray Fluorescence/X-Ray Diffraction) instruments.

In addition, Midrex performs research and testing to support shaft furnace and RHF plants and help them overcome problems that may occur during operations.

/Assistance/

Transporting cooling towers from the United States to Venezeula via an Antonov AN-124-100F (one of the largest cargo planes in the world), Midrex Global Solutions successfully executed the project for a MIDREX® Plant. Through quick response, expert assistance and international coordination, Midrex resolved what could have been a six to seven month ordeal in a few short weeks.

Aftermarket: Dependable global solutions

First-class plant operation is just as important to us as it is to our clients. Each MIDREX® Plant is backed by Midrex through our Technical Services group and aftermarket sales and support.

Our Technical Services staff consists of experienced professionals that are familiar with each client and understand how to design and operate MIDREX® Plants.

Midrex Global Solutions, our aftermarket services group, draws on our extensive experience and capabilities in the areas of engineering, new technologies, field services, procurement and logistics. It provides clients with the equipment and services they need to operate, maintain and enhance their facilities.

TECHNICAL SERVICES

Midrex's support of a plant continues well after commissioning. Our engineers visit plants regularly and are available to assist plant operations personnel to improve productivity, reliability, product quality and safety. Most technical issues can be handled remotely, but depending on the situation, on-site inspections and evaluations are available.

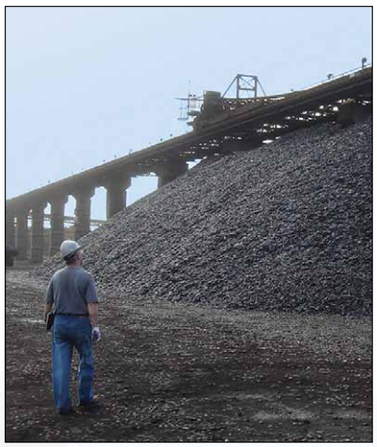
MIDREX GLOBAL SOLUTIONS

› *SPARE PARTS AND MATERIALS*

We understand the special requirements of replacement parts and consumables necessary during the operation of a shaft furnace or RHF plant. Therefore, Midrex maintains relationships with a large number of manufacturers and vendors worldwide, allowing us to globally source and provide a timely supply of spare parts and materials.

› *ENGINEERED SOLUTIONS*

Midrex assists clients in developing cost-effective, engineered solutions and equipment designs that increase plant productivity, reduce operating cost and enhance reliability. Examples include process evaluations, de-bottlenecking studies to increase plant capacity, detailed analyses of equipment and materials, and incorporation of new technologies.



› *MAINTENANCE, REPAIR AND OPERATIONS (MRO) SERVICES*

Midrex has a dedicated staff of professionals with extensive procurement capabilities for assisting plants with MRO parts and services on an ongoing basis. Some MIDREX® Plants have utilized Midrex to procure all items that must be acquired offshore, freeing up plant operations and administrative personnel from these time-consuming tasks.

› *FIELD SERVICES*

We maintain a roster of highly qualified personnel worldwide with extensive experience in various disciplines in the operation of MIDREX® and other ironmaking plants. We can provide personnel to support plant functions including construction management, operations, maintenance and purchasing.

/Responsible/

The LION Group's new MIDREX® Plant in Banting, Malaysia: the MIDREX® Process is an environmentally friendly technology for the production of iron. It produces only one third the CO_2 that a traditional blast furnace produces.

Environmental commitment: Achieving **green** results

One of our key corporate objectives is environmental responsibility through minimizing emissions from Midrex plants and offering recycling options. Along with our project partners, we have designed and supplied facilities that are successfully operating under some of the strictest environmental standards in the world, including those of Germany, Canada, the United States and Japan.

MIDREX® Direct Reduction Plants are designed for 100 percent recycling of process gases and water to minimize emissions and maximize energy efficiency. Emission levels for the MIDREX® Process are lower than all applicable World Bank standards and plants can be designed to meet even stricter local regulations.

Since natural gas is a clean and abundant fuel, the MIDREX® Direct Reduction Process plays an important role in today's environmentally focused steel industry, producing only one third the CO_2 that a traditional blast furnace produces.

Each year integrated steel complexes and mini-mills are finding it more and more difficult to dispose of ferrous and non-ferrous by-products from iron and steelmaking processes. These include iron oxide screenings, baghouse dust and mill scale. In addition, there are millions of tons of metal-bearing waste materials stockpiled around the world from various mining and processing operations. With the commercialization of our revolutionary FASTMET® RHF, we offer a cost-effective means of dealing with these wastes by recovering the valuable zinc and iron units.

Throughout Midrex's history we have been proactive in reducing the environmental impact of our ironmaking processes. Our continued focus is avoiding pollution through further technology development to reduce energy consumption and increase by-product recycling.

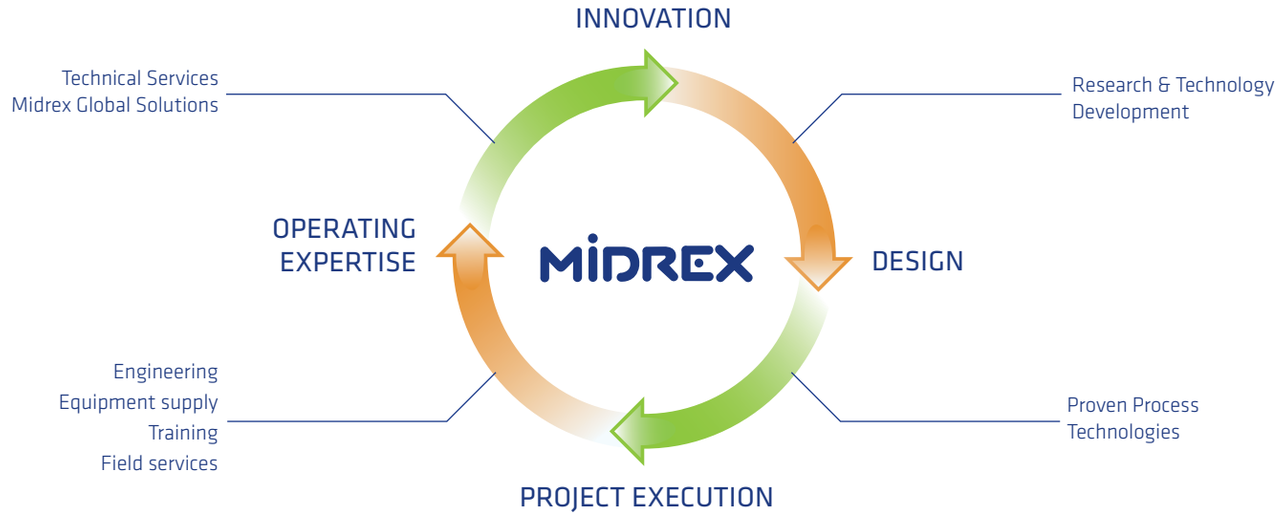
A tradition of excellence in direct reduction

As the global steel industry continues to advance, Midrex Technologies maintains its position as the world leader in the direct reduction of iron ore, but where others would be content, we strive for more.

In addition to supplying commercially proven, reliable and cost-effective direct reduction facilities, we continue to expand our technology development efforts and aftermarket services. From financing assistance at the start of a project, through engineering, equipment sourcing and delivery, to training and start-up assistance, we provide a total package for our clients. We continue our support through Midrex Technical Services and Midrex Global Solutions after the construction is completed. And together with our parent company, Kobe Steel, Ltd., we pioneer new advancements in natural gas and coal-based direct reduction technologies that promote green steelmaking.

For an ever-evolving industry demanding answers to problems both old and new, we have the experience, knowledge-base and resources to provide proven solutions.

PROJECT LIFE CYCLE



/The world leader in direct reduction/

Midrex Milestones ››

1966. Donald Beggs of the Surface Combustion Corp. conceives the idea for the MIDREX® Direct Reduction Process

1974. Midrex Corporation purchased by Korf Group and moved to Charlotte, North Carolina, USA

1978. Start-up of QASCO (now Qatar Steel) in Qatar- First Direct Reduction Plant in the Middle East

1984. Sabah Gas Industries (now Antara Steel Mills) starts up in Malaysia - First MIDREX® hot briquetting plant

1983. Kobe Steel, Ltd. acquires Midrex

1988. Iron oxide coating first applied at OEMK in Russia

10 million tons/year

1990. MIDREX® Plants exceed 10 million tons per year of DRI production

1990. Start-up of OPCO (now FMO Planta de Briquetas) in Venezuela - first MEGAMOD® and use of steam reformer

1995. FASTMET® demonstration plant built in Japan

1999. Essar Steel in India begins hot transport/ hot charging of DRI to EAF using insulated containers

1999. Saldanha Steel starts up world's first COREX®/ MIDREX® Plant

2003. Mesabi Nugget ITmk3® Demo Plant starts up in Minnesota, USA

2007. Hadeed Module E begins operations - largest MIDREX® module to date

500 million tons

2007. The world total of DRI produced using the MIDREX® Direct Reduction Process exceeds 500 million tons cumulative

2005. OXY+® Partial Oxidation System installed at OEMK in Russia

ONE billion tons

2017. MIDREX® Plants projected to produce 1 billion tons of DRI cumulative

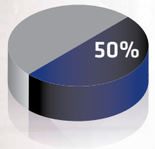
1960 | 1970 | 1980 | 1990 | 2000 | 2010

1969. First MIDREX® Plants built at Oregon Steel Mills in Portland, Oregon, USA

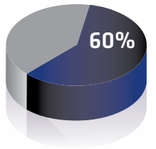
1976. Siderca (now TenarisSiderca) starts up in Argentina - First South American MIDREX® Plant

1979. Start-up of SIDOR II in Venezuela - First multiple module MIDREX® Plant

1979. MIDREX® Plants produce more than 50 percent of the world's DRI



1987. MIDREX® Plants produce more than 60 percent of the world's DRI



1994. First use of oxygen injection in a MIDREX® Plant at Acindar in Argentina

20 million tons/year

1996. MIDREX® Plants produce more than 20 million tons per year of DRI

2000. MIDREX® Plant production tops 30 million tons per year

30 million tons/year

2000. First commercial FASTMET® Plant starts up in Japan

2004. IMEXSA (now ArcelorMittal Steel Lazaro Cardenas) establishes world production record of 1.76 million tons of DRI from a single module

2007-2010. More than 15 Mt of MIDREX® Plant capacity commissioned. Includes three hot discharge/hot transport options.

2009. First commercial ITmk3® Plant built in Minnesota, USA.