

Decarbonisation roadmap

South Africa
JANUARY 2023



ArcelorMittal



The ArcelorMittal South Africa decarbonisation roadmap

In our 2021 inaugural Environmental, Social and Governance (ESG) report, we communicated how we, as ArcelorMittal South Africa, were planning to play our part in achieving the ArcelorMittal group's 2050 net-zero carbon ambition.

This roadmap will guide our work to reach our decarbonisation objectives. It is a bold endeavour but we are confident of its successful conclusion.

We publish this roadmap in the context of geopolitical upheaval and global recession. The South African economy continues to experience enormous and mounting pressure and declining output.

We are working to make our operations carbon neutral. By 2030, we aim to reduce our carbon intensity by 25%, from a 2018 baseline of 2.90 tonnes of carbon dioxide (tCO₂e) per tonne of crude steel to 2.16 tCO₂e/t crude steel, and 86% by 2050 to 0.40 tCO₂e/t crude steel. The costs and uncertainties attached to achieving this will be considerable, but we are determined and are increasingly confident of success.

A sustainable roadmap for development

Our company is a proud and increasingly active implementer against the United Nations Sustainable Development Goals (SDGs). As a large industrial concern, employer, customer and supplier, our actions and investments can have material effects on furthering or hindering South Africa's contribution towards achievement of the SDGs.

We believe that our carbon journey will support, in particular, five SDGs.

These are:



We strive to execute against the ArcelorMittal group's 10 SD outcomes, one of which is to have "Our contribution to society measured, shared and valued".





The ArcelorMittal South Africa decarbonisation roadmap continued

Planning and implementing a radical departure from the basic tenets of how we have operated for almost a century is daunting. We are not alone in facing a task which will rely on technologies that are as yet commercially and/or economically unproven. Every steel company in the world that is serious about decarbonising is currently grappling with these same challenges. What we know for certain is that being part of the world's leading, most innovative, steel producer gives us a distinct advantage over others.

Faced with these realities and uncertainties, it will be appreciated that we favour 'no-regret' options, over as yet unproven methodologies. ('No-regret' options are initiatives with clear technological and economic viability.)


We will continuously and diligently test assumptions and the magnitude of impacts: present, anticipated and emerging.

Our realising net-zero will be significant, for our company, its stakeholders and for our country.

To assist the reader, we reproduce here summaries of key elements of the decarbonisation disclosure contained in our ESG  report, which was released in April 2022.

Our decarbonisation roadmap will be subject to regular updates and changes as breakthrough technologies emerge and are proven.

Developing our roadmap

Steel is a hard-to-abate industry that accounts for 7% to 9% of worldwide carbon emissions. The ArcelorMittal group has made a series of decarbonisation commitments, subject to the necessary government and funding support being secured. 

Since the second half of 2021, ArcelorMittal South Africa has made significant progress on developing various roadmap options to achieve a material reduction in carbon intensity by 2030 and net-zero by 2050. Numerous bankable 'no-regret' opportunities have been identified. Central to these is energy-efficiency improvement, both of a non-capital and capital-intensive nature.

In April 2022, we published details of our 2021 carbon outputs, including total emissions and Scope 1 and Scope 2 emissions per tonne of steel produced. Our 2022 ESG and integrated report will contain updated 2022 figures, including the detailed level of disclosure pursued in the past. We anticipate that this roadmap will be further updated in these annual reports.

The ArcelorMittal South Africa decarbonisation roadmap continued

In 2021, we:

- Established a dedicated carbon abatement office
- Initiated detailed mapping of the impacts of a steel Just Transition on employees, communities and suppliers
- Began discussions with development finance institutions and others on opportunities for possible preferential funding
- Concluded a joint development agreement with a prominent development finance institution on the production of low carbon intensity steel in Saldanha
- Signed a memorandum of understanding with the Council for Scientific and Industrial Research (CSIR) on developing strategies for green hydrogen as well as green innovative direct reduced iron (DRI) and low carbon intensity steel based on renewable hydrogen
- Our CEO, Kobus Verster, was appointed to the government's multiparty Green Hydrogen Panel
- Interacted closely with group technology and climate-change experts
- Established working groups with various role players on carbon capture and utilisation and green hydrogen.


 A graphic element consisting of a blue square with the year '2021' in white, partially overlapping a red and orange curved shape.

2021


The following initiatives are all subject to confidentiality agreements with various counterparties and, therefore, we are unable, at this stage, to identify most of these parties or to disclose the substance of our discussions or cooperation. We look forward to disclosing further detail in due course.

Since publishing our 2021 ESG report we have:

- Announced a partnership with Sasol to develop carbon capture and utilisation (CCU) technology using process carbon produced at our Vanderbijlpark Works plant and to advance the production of low carbon intensity steel using green hydrogen (see overleaf)
- Further explored opportunities with various role players to source large amounts of renewable energy
- Explored with raw material suppliers mutually beneficial opportunities arising from low carbon intensity steel
- Scoped CCU opportunities with multiple industrial concerns other than Sasol
- Held wide-ranging talks with local role players, including government and civil society groupings in the Vaal and West Coast regions
- The ArcelorMittal group has signed a memorandum of understanding with a top international developer of transformational energy solutions to advance the production of green DRI at our Saldanha Works plant
- Launched projects to generate 200 megawatts of renewable power at available land on our premises.

We now believe that, by 2030, we will reduce our Scope 1 and Scope 2 carbon intensity by 25%. (Readers will recall that the ArcelorMittal group requires its operations outside of Europe, including ourselves, to achieve a 25% reduction in carbon intensity by 2030).

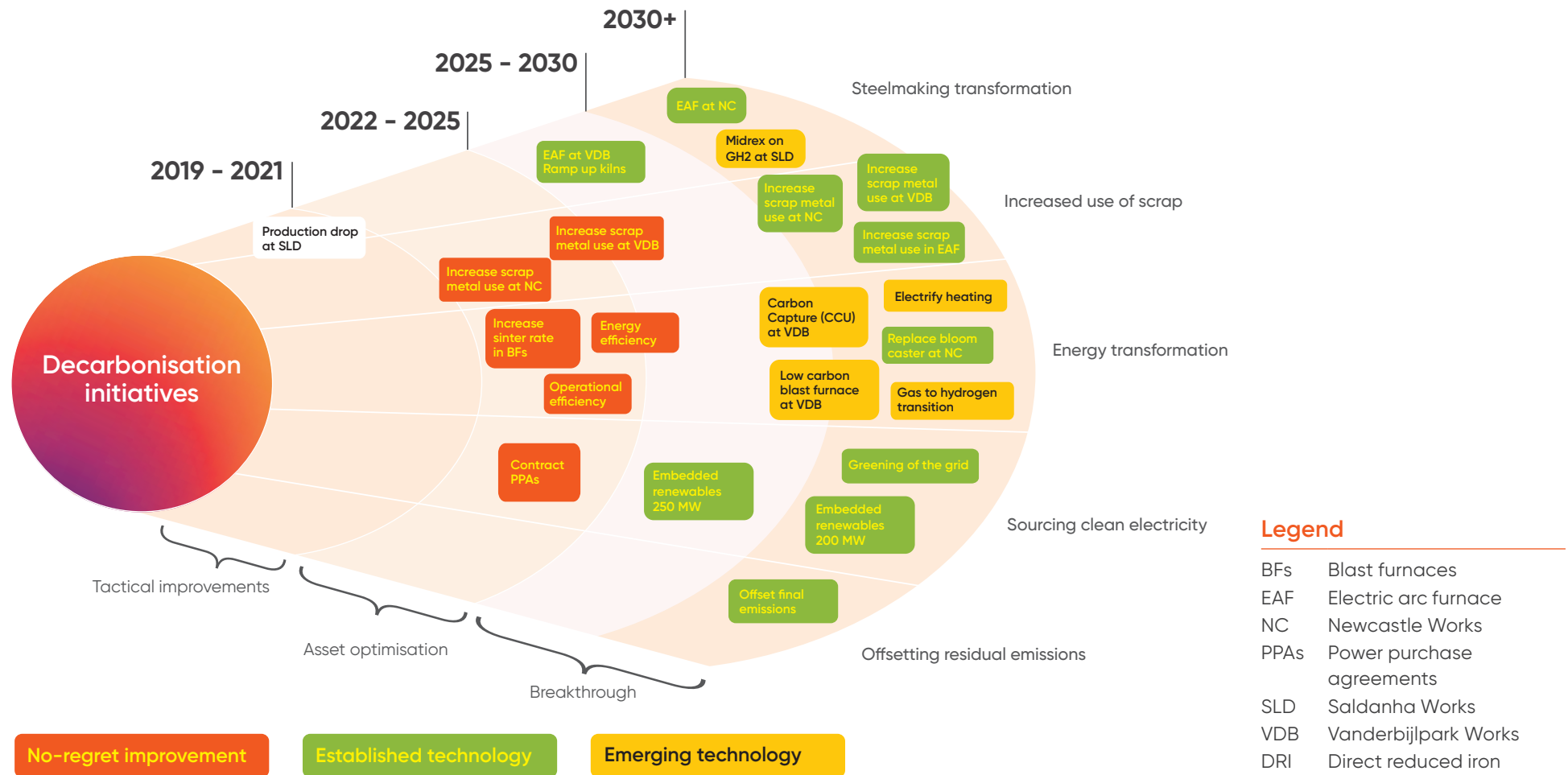
We are committed to at least meeting the ArcelorMittal group target to reduce carbon intensity by **25%** by 2030


 A graphic of a white wind turbine against a background of a large orange and red sun. The turbine is positioned in the lower right corner of the page.

Our roadmap

The graphic below captures decarbonisation initiatives and opportunities available to us and which we plan to utilise. Starting with 'no-regret' options, over which we have considerable control and predictability. The graphic indicates time horizons and the current status of key technologies.

Decarbonisation initiatives



The roadmap detail

The following is disclosed to address the information needs of multiple stakeholders who have legitimate interests in our business, in our value-creation strategy and our impacts on the natural environment and society.

This information is published to give readers meaningful insight into the latest thinking of ArcelorMittal South Africa’s management on

decarbonisation, on what we consider is realistically achievable and an evaluation of our most promising options.

We caution that this roadmap is by no means cast in stone and, as stated above, how we eventually implement our energy transition will almost certainly differ, in both detail and substance, from that outlined here.

Our decarbonisation roadmap envisages Blast Furnace D undergoing a ‘no-regret’ reline and upgrades, between 2027 and 2030 and the commissioning of a suitable electric arc furnace (EAF) in Vanderbijlpark. In 2030, Blast Furnace C will then be permanently closed and Blast Furnace D returned to service as a low-carbon enabled furnace.

World-leading research and development work by the ArcelorMittal group into the development of low-carbon enabled furnaces is showing promise and is progressing at pace. Radically lowering the carbon profile of these furnaces will be achieved by reducing coke rates, injecting hydrogen into the furnace and (potentially) using biomass as an additional energy source. (Continuing to use the traditional blast furnace-basic oxygen furnace method, carbon capture and usage will be essential to reducing carbon intensity.)

The extent to which it will be possible to deploy each of these levers will be determined by technological advances.

The company operates in a sub-Saharan Africa context with its own challenges relating to poverty alleviation, economic development needs and constrained infrastructure, to name but a few. This context is very different to those prevailing in Europe and North America. As evidenced by fixed capital formation trends, investments in coal and carbon-intensive steelmaking in sub-Saharan Africa continues at pace. It is in both the existing and these new investments that we compete against, but without the same level of funding support as that enjoyed by our developed country peers. It also raises questions about whether our traditional markets will continue to consume carbon-intensive steel and how geopolitics will affect steel’s decarbonisation trajectory.



This graphic is intended to give a snapshot view of the roadmap, including ‘no-regret’ improvements and our utilisation of technologies that are already proven, and emerging technologies.

We have two blast furnaces at Vanderbijlpark, named C and D. These have annual production capacities of 1.3 million tonnes and 1.9 million tonnes respectively of molten iron. In 2021, the blast furnaces accounted for a significant amount of our scope 1 and scope 2 carbon emissions.

The roadmap detail continued

The expectation today is that greener blast furnaces (using the traditional blast furnace/basic oxygen furnace arrangement) will soon be able to operate with the same climate-change impacts as EAFs using DRI produced with natural gas.

Additionally, CCU is being explored to further reduce the carbon footprint of current and future facilities, edging towards net-zero carbon status.

ArcelorMittal South Africa anticipates that the joint development agreement with Sasol will provide the necessary platform for the development of CCU technology (including home-grown solutions – see [The Vaal CCU opportunity](#)).

In conjunction with the exploration of emerging transformational technologies, we will remain focused on investing in tactical improvements and ongoing asset optimisation. ArcelorMittal South Africa's production infrastructure will undergo wide-ranging changes to improve efficiencies, in particular regarding energy. These changes will include adaptations to increase our use of scrap steel and our sinter rate. (Sintering is the process of combining – 'agglomerating' – fine pieces of iron ore and other inputs into lumps for feeding into a blast furnace; higher, more efficient sintering reduces energy consumption.)

Electricity – the key

The current roadmap strategy will require the substantial transformation of our current electricity supply. It will require an active, real transition from coal-based electricity to electricity from renewable and other clean sources. The renewable energy strategy currently does not consider vast investment in storage capacity but aims to achieve maximum transformation through a strategic blend of multiple solar and wind sources.

The waterfall graph on page 7 illustrates how implementation of this roadmap can move our carbon intensity from a baseline 2.9 tonnes of carbon dioxide per tonne of crude steel (tCO_2/tCS) in 2018 to 2.16 tCO_2/tCS by 2030 and a residual 0.4 tCO_2/tCS by 2050. If these gains are achieved, we will have succeeded in reducing our carbon intensity by 86% with residual emissions in 2050 being offset by yet-to-be-developed technologies and/or carbon offset arrangements.

As a very large industrial concern, ArcelorMittal South Africa has the ability to catalyse the development of a thriving domestic green hydrogen economy, one that creates significant employment by competing and exporting internationally.

We can play an important role in driving such development by providing a large, early market (offtake) for green hydrogen.

However, it needs to be stressed that the financial viability of our renewables procurement will be influenced by Eskom/Nersa's pricing structures, as well as wheeling charges.

Clearly loadshedding or the continued unreliable supply of grid electricity will be a serious impediment to South Africa realising its decarbonisation ambitions. The extent to which Eskom is able to green its electricity generation, and the pace at which it rolls out renewables, will have a bearing on our decarbonisation efforts, and those of most manufacturing industries.

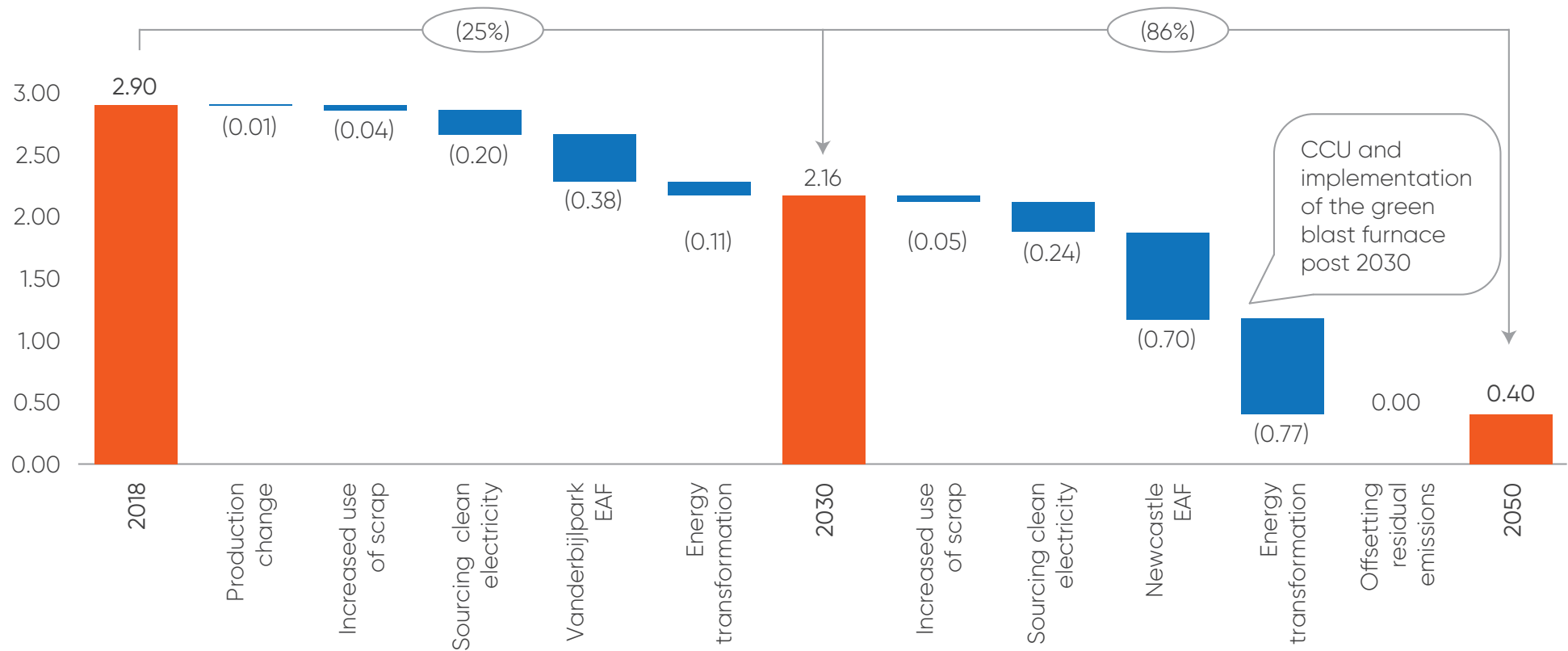
(While we are one of only a few jurisdictions in the world where emitters pay carbon taxes directly to the authorities, unlike Canada and the European Union (EU), in South Africa there is no fiscal support for the very sizeable private-sector investments required to achieve decarbonisation. Most regrettably, in this country, the proceeds from carbon taxes are not ring-fenced for such purposes as in other countries. We believe that this should change.)



The roadmap detail continued

Roadmap projected intensity by category

tCO₂e/t crude steel, 2018 baseline – 2050



The roadmap detail continued

The Saldanha opportunity

In April we reported that we envisaged Saldanha Works initially producing lower carbon steel and, subsequently, DRI, using green hydrogen. These operations, we said then, would be centred on Saldanha's advanced Midrex plant (the only such plant in Africa), using natural gas.

We reported that the second leg of the 'Saldanha low carbon intensity steel opportunity' entailed 'the Conarc plant being restarted as a scrap smelter (EAF) using renewable energy, for continuous

casting and rolling'. Subject to regulatory and funding arrangements being made and affordable renewable energy and rail transport being secured, we suggested that Saldanha could produce 600 000 tonnes of steel per year by as early as 2023.

At 104 000 tonnes per annum, we projected that Saldanha Works could account for South Africa's largest single private-sector off-taker of green hydrogen, catalysing the development of a green hydrogen industry.

2021

South Africa's natural endowments must be exploited to ensure that this country competes effectively in the emerging green hydrogen economy. Various government initiatives have been implemented to support the development of green hydrogen technology, for which ArcelorMittal South Africa projects will form a key anchor.

Previously using process gases produced by Saldanha's Corex plant, the Midrex is capable of being converted to a traditional natural gas-based Midrex – based on the affordability and availability of natural gas in the Western Cape. Midrex technology is flexible enough to allow for the incrementally greater use of green hydrogen as the economic viability and availability of such gas improves.

We continue to seek opportunities to restart steel production at the Saldanha Works on a commercially sustainable basis. This work is ongoing but what is clear is that Saldanha will have a key role to play as we decarbonise. This role could include participation in the energy transition to green hydrogen and playing a supporting but pivotal role in progressing the development of DRI and steel.

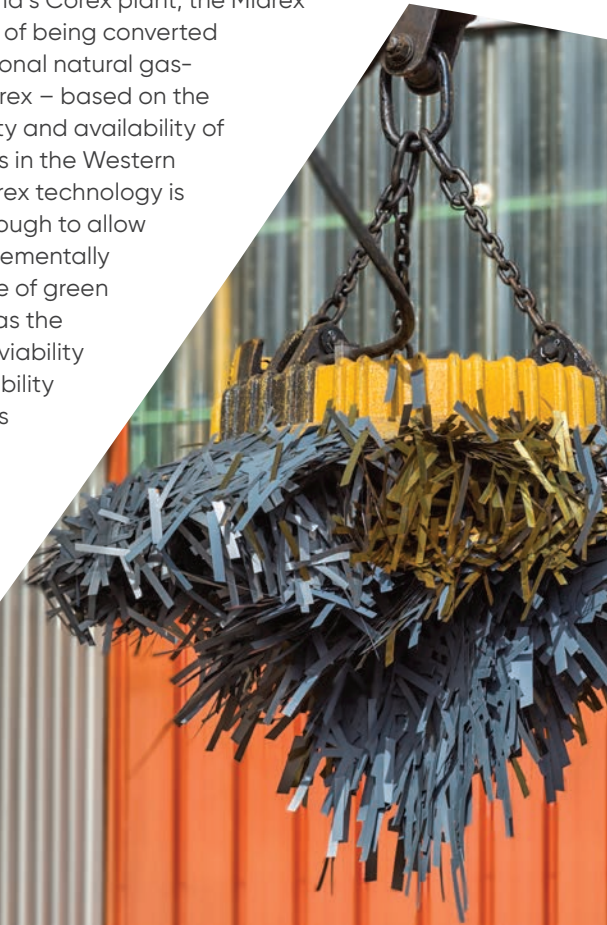
Collaborative partnerships

On 18 October 2022, we announced, with Sasol, a partnership to advance studies into developing Saldanha as a hub for the production and export of green hydrogen and derivatives. Together, we will explore how our two companies can exploit the opportunities that the expected worldwide uptake

of green hydrogen will present, in particular, for the West Coast.

We are serious about this work and are investing substantial human, intellectual and financial capital into making the Saldanha green hydrogen opportunity a reality as quickly as commercially possible.

ArcelorMittal South Africa enjoys the backing of the ArcelorMittal group in terms of research and development for the manufacture and use of green hydrogen in the steelmaking processes. Most noteworthy of the prospects for using green hydrogen in our processes are its use in the Midrex process for producing DRI and for the production of 'greener' hot metal in the traditional blast furnace process.



The roadmap detail continued

Green hydrogen

A switch to green hydrogen in Saldanha will likely mean that we will become the first African producer of low-carbon intensity steel.

The Midrex provides a unique opportunity for exporting green DRI products, produced using green hydrogen, to developed markets. Our roadmap taps into this source of green DRI for our own planned EAF capacity from 2034 while also presenting the opportunity to export green DRI in the interim.

In 2034 we plan to close our Blast Furnace N5 in Newcastle, replacing it with the second of two EAFs planned over the course of the decarbonisation roadmap.

Beyond 2030 to 2050 and the relative comfort of 'no-regret' solutions, we will rely on technologies and processes that are today largely unproven on a commercial scale or where costs currently do not justify implementation. Green hydrogen is one such pathway. In July 2021, the group's Carbon Action Report 2 noted:

Hydrogen DRI technology continues to advance, yet at today's green hydrogen cost of USD3.5/kg to USD5.0/kg, we estimate that green hydrogen-based DRI production would increase the cost of steel production by USD150 to USD250 per tonne compared to natural gas-based DRI. On a like-for-like basis (excluding CO₂ costs), hydrogen would need to fall below USD1.0/kg to compete with natural gas DRI in Europe, and below USD0.7/kg to compete in the USA.

If renewable energy costs – the highest contributor to green hydrogen costs – continue to fall, we estimate green hydrogen costs could drop to approximately USD1.5/kg by 2030. This still means that green hydrogen DRI would require significant public support beyond 2030 to be competitive versus other carbon neutral steelmaking routes.

As the ArcelorMittal group's Carbon Action Report 2 noted, there is lower confidence in green hydrogen at present than in other decarbonisation methods that we will employ up to 2030. In Europe and elsewhere, including South Africa, green hydrogen DRI will

require significant public support. In developing a green hydrogen economy, our country's natural endowments give it distinct advantages over the northern hemisphere. Green DRI produced in Saldanha must be an important part of developing that economy but it is beyond ArcelorMittal South Africa's means to do so on its own.

The Vaal CCU opportunity

2021

In April we wrote about CCUS. CCUS stands for carbon capture, usage and storage. The 'S' in CCUS no longer features in our roadmap.

CCU seeks to convert CO₂ into substances or products such as plastics, cement or biofuel while retaining the carbon neutrality of the production processes.

Recently the ArcelorMittal group signed a memorandum of understanding with international energy firm, Equinor, to develop value chains in carbon capture and storage. Much of the work going into developing such value chains will focus on logistics, including key issues around the costs of moving captured carbon to sites for conversion and production.

The roadmap detail continued

Sasol and ArcelorMittal South Africa are this country's second and third largest carbon emitters. Working together, we now have a unique chance to reverse that reality and turn it to our country's economic, environmental and social benefit.

Vanderbijlpark Works has large amounts of process carbon available for capture and conversion into various much-needed sustainable energy and chemical products – as much as 1.5 million tonnes per year. Partnering with Sasol, our collaborative work to develop CCU will radically reduce our carbon impact.



On 18 October, a joint communique issued by ourselves and Sasol noted:

The Vaal Triangle in South Africa has been home to fossil fuel-based industrial operations that have been crucial to the country's economic development, supporting many livelihoods through job creation and contribution to the country's GDP. Many of the assets in these operations can pivot to sustainable operations.

It is well known that the region which Vanderbijlpark is part of, has for more than a decade suffered from economic and infrastructural malaise. Along with multiple stakeholders, including Sasol, civil society, local, provincial and national government and organisations such as the Industrial Development Corporation and the Council for Scientific and Industrial Research, we are determined to work for the economic upliftment of the Vaal Triangle.

Again, quoting from the announcement of 18 October:

The two potential projects will drive the re-industrialisation of both the Saldanha and the Vaal regions, seeding the opportunity for the development of a green hydrogen ecosystem, thereby enabling long-term, sustainable benefits for communities and the country. They are expected to provide a large number of jobs as well as infrastructure investment and skills development in the country, thus enabling a Just Transition.

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In December 2022, the ArcelorMittal group launched its €200 million 'Steelanol' CCU project in Ghent, Belgium, to produce advanced bioethanol. Once production reaches full capacity, the Steelanol plant will produce 80 million litres of valuable bioethanol while reducing annual carbon emissions from the Ghent plant by 125 000 tonnes.

Revitalising the Vaal

The carbon we produce at Vanderbijlpark will be transported by pipeline to Sasol's nearby processing and production facilities in Sasolburg.

The technologies now being developed that will use our carbon will be fundamental to catalysing the economic rejuvenation of the Vaal Triangle, positioning the region as a job-creating centre of excellence, even leadership, in the South African net-zero economy.

The global climate crisis could play to the benefit of the Vaal. We commit to playing our part in its upliftment, even transformation and, subject to commercial and legal considerations and the interests of our multiple partners, to communicate frequently and openly on our progress on the CCU opportunity.

The economics of cutting carbon

The costs attached to achieving our 2030 target of a 25% reduction will be significant. ArcelorMittal group experts calculate that it will cost USD10 billion for the whole group to meet its 2030 reduction targets.

2021

As a going concern, we consistently reinvest in our infrastructure and assets. Strategic investment will be redirected towards the low-carbon asset footprint as part of our investment plan. However, the roadmap also contains capital intensive initiatives that are additionally required over and above. These investments will be done based on firm economic viability.

The two EAF projects transforming the steelmaking footprint from blast furnace to electric arc furnace-based production within the decarbonisation plan are likely to be covered largely by redirected capital, instead of scheduled blast furnace reline and major coke plant investments. Additional initiatives include CCU at Vanderbijlpark and converting the Midrex plant in Saldanha to produce DRI using natural gas and, subsequently, to using green hydrogen, as well as CCU to lower the effective carbon footprint of the one remaining blast furnace in the roadmap in the roadmap. The Midrex will need to be modified to produce direct reduced iron to our second EAF project. The technical and economic viability associated with the additional initiatives are expected to develop into the next decade.

Collaboration and partnerships, where resources and knowledge are shared, will be absolutely essential to the development and implementation of decarbonisation initiatives. In essence, for us this means that new decarbonisation investments will not all need to be funded from our balance sheet. One example of such partnerships, in which the costs of developing, proving and commissioning new and nascent technologies are shared between partners, is our collaboration with Sasol on CCU (page 10). Another is the recently announced (October 2022) partnership between the ArcelorMittal group, the BHP mining group and others (page 13).

Preparation of
concrete wind tower



The economics of cutting carbon

continued

Timing big-ticket outlays

Under the roadmap, major capex investment into electric steelmaking technology will be aligned with scheduled major relines of the current blast furnace fleet, redirecting the required investment where sensible to do so, while at the same time reducing our carbon footprint. Replacing Blast Furnace C (in Vanderbijlpark) by 2030 with DRI and EAF technology also allows a reduction in the investment required in the coke battery fleet. By 2034, Newcastle Blast Furnace N5 will be considered for replacement, resulting in a similar balance of capital being saved for the required investment in the second EAF project within this roadmap.

The additional investment in the Midrex at Saldanha is considered in support of the technical and economic viability of the later EAF. Economically viable supply of DRI or other alternatives is considered a gatekeeper in the expansion of the EAF asset base.

We are working together with the ArcelorMittal group on the technology, as well as with Sasol (joint development agreement) and others, to firm up and expedite the economic viability of producing DRI at carbon intensity below the recent norm. Doing so will be done with the aim of benefiting from the growing low-carbon intensity DRI export opportunity to Europe and other parts of the world, eventually in support of a local economically viable transformation.

Decarbonising will be essential to reduce and avert a substantial and potentially crippling tax burden. In 2022, carbon tax is set at USD8/tonne CO₂. The level of universally applied tax allowances, as is applied across all qualifying South African industry, is expected to fade significantly from 2026 onwards, although the trajectory is still uncertain. By 2030, based on current legislation and without significant intervention, we anticipate that our carbon tax is set to increase to USD30/tonne CO₂, a level that could undermine our sustainability – an important incentive informing the development of this Roadmap.

The imperative of avoiding global warming is driving the rapid development and deployment of decarbonisation technology. As technology is deployed and uptake increases, economic viability will improve.



Group dynamics

We have consistently argued, as a large primary steel producer, how strategically important our company is to South Africa. The decarbonisation imperative has brought this importance into stark relief.

It is impossible to overstate how important membership of the ArcelorMittal group is to our net-zero work. Professionals in our South African carbon abatement office liaise closely with their colleagues at group head office and around the world. Being part of the world's largest steelmaker, we benefit from the most advanced, often proprietary, technology and resources. As we progress towards net zero, our implementation of the ArcelorMittal group's systems, technology and intellectual property will represent real knowledge transfer to South Africa. Confidence in our ability to achieve net zero, is substantially bolstered by the work of the group's many experts.

Below we list some of the work being pursued by the group and member companies

- A €1 billion green hydrogen DRI plant in Gijón and a hybrid EAF in Sestao (both in Spain) will create the world's first full-scale net-zero carbon emissions steel plant, producing 1.6 million tonnes of zero-carbon flat steel by 2025
- Announced a project to create a "hydrogen-ready" 2.5 million tonne DRI furnace initially using natural gas in Ontario, Canada, reducing annual carbon emissions by 3 million tonnes
- A group facility in Hamburg, Germany, is Europe's only DRI-EAF steel plant. It is today preparing to switch from natural gas to hydrogen
- In 2021, a DRI facility in Quebec, Canada, began testing hydrogen injection
- A top engineering consultancy has been engaged to work on producing green DRI in Saldanha
- In October 2022, the group partnered with minerals giant, BHP, to test CCU technology.
- Through its XCarb® Innovation Fund invested USD25 million in nuclear innovation company TerraPower, founded by Bill Gates in 2008.



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Forward-looking statements

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