INFRASTRUCTURE,
ENERGY & MATERIALS

DRIVING A SUSTAINABLE STRATEGY FOR GREEN STEEL PRODUCTION

Accelerate your roadmap to steel decarbonization through virtualization, from design to delivery



DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

DASSAULT SYSTEMES

DECARBONIZING STEEL



DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

DECARBONIZING STEEL PRODUCTION

Steel is a long-term industry. Timelines are typically measured in decades not days. The way steel is made has not changed significantly over the past 150 years. But steel needs to change. It is a heavy industry with a heavy burden, responsible for around **7% of total global GHG emissions and about 11% of total global CO2 emissions .**

Steel producers know this. Across the world companies are setting out plans to decarbonize their processes to meet looming reduction goals, but there remains a long way to go. There are more than 900 steel plants globally, and **75% of steel is produced using coal fired furnaces.**

While recycling steel must play a greater role in steel production plans, **saving up to 72% of the energy** used to produce new steel, it cannot be the sole solution, especially if we want to deliver the grades currently required. Legacy systems and processes need to be changed and ultimately replaced, with aging infrastructure phased out to make steel making more manageable, measurable, and sustainable.

DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

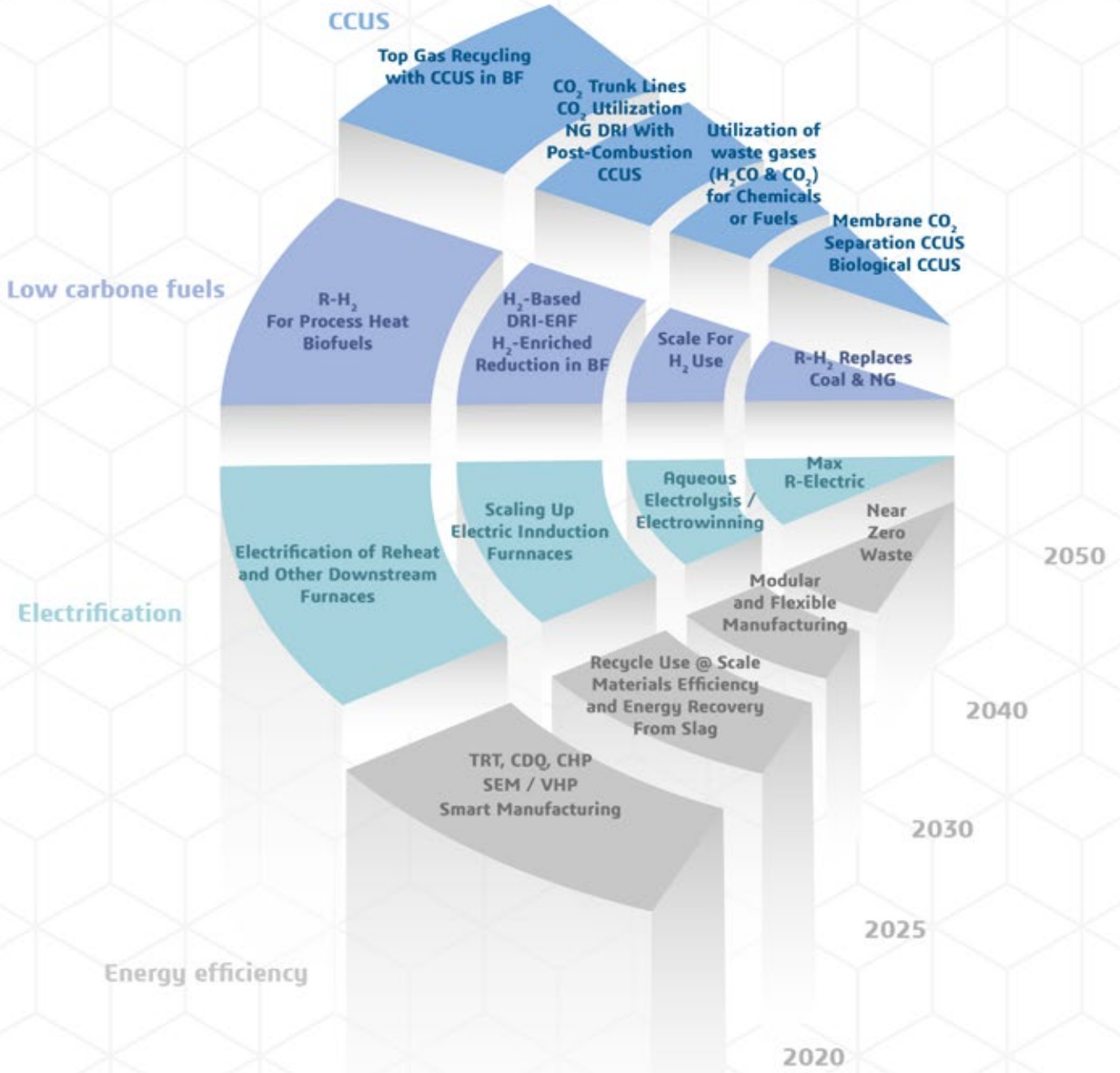
CONCLUSION

TIMELINE TO DECARBONIZE THE STEEL INDUSTRY

There are four routes to decarbonizing steel production that, combined, can pave the way to green steel.

These are increasing energy efficiency, electrification of reheat and other furnaces, low carbon fuels, and carbon capture utilization and storage (CCUS).

Each has multiple steps that need to be planned, delivered and, assessed to reach net zero by 2050.



DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

82%

of metal companies see digital as a top priority in their strategy

Source: McKinsey & Co

DE-RISK TRANSFORMATION THROUGH DIGITIZATION

Digital transformation has been slow in steel production but is vital if the industry is to drive a sustainable transition to green steel. The International Energy Agency (IEA) says **steel-related emissions reductions must accelerate significantly to reach net zero by 2050**, but a lack of connectivity in equipment, in processes, and between locations makes it incredibly challenging to accurately understand the risks and benefits associated with any change. It's only through the capture, analysis, and application of data that we can plot a route to decarbonization that is attainable, applicable, and affordable.

This is why steel makers have increasingly been turning to digital technology – to gain greater visibility of how their existing operations and assets are working; to optimize their current value chains and model and test future ones; and to mitigate the risks of transformation before they occur.

But steel companies need to look beyond sensors and monitoring if they want to untap the true potential of digitization. Through a cloud-based platform like **3D**EXPERIENCE®, disparate data sources can be connected giving multiple stakeholders a holistic view of not just their facilities but the entire value chain. And by creating virtual twins, any operational changes, whether planned or responsive, can be simulated, visualized and assessed so the implications of even the smallest incremental adjustment can be predicted and perfected.

DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

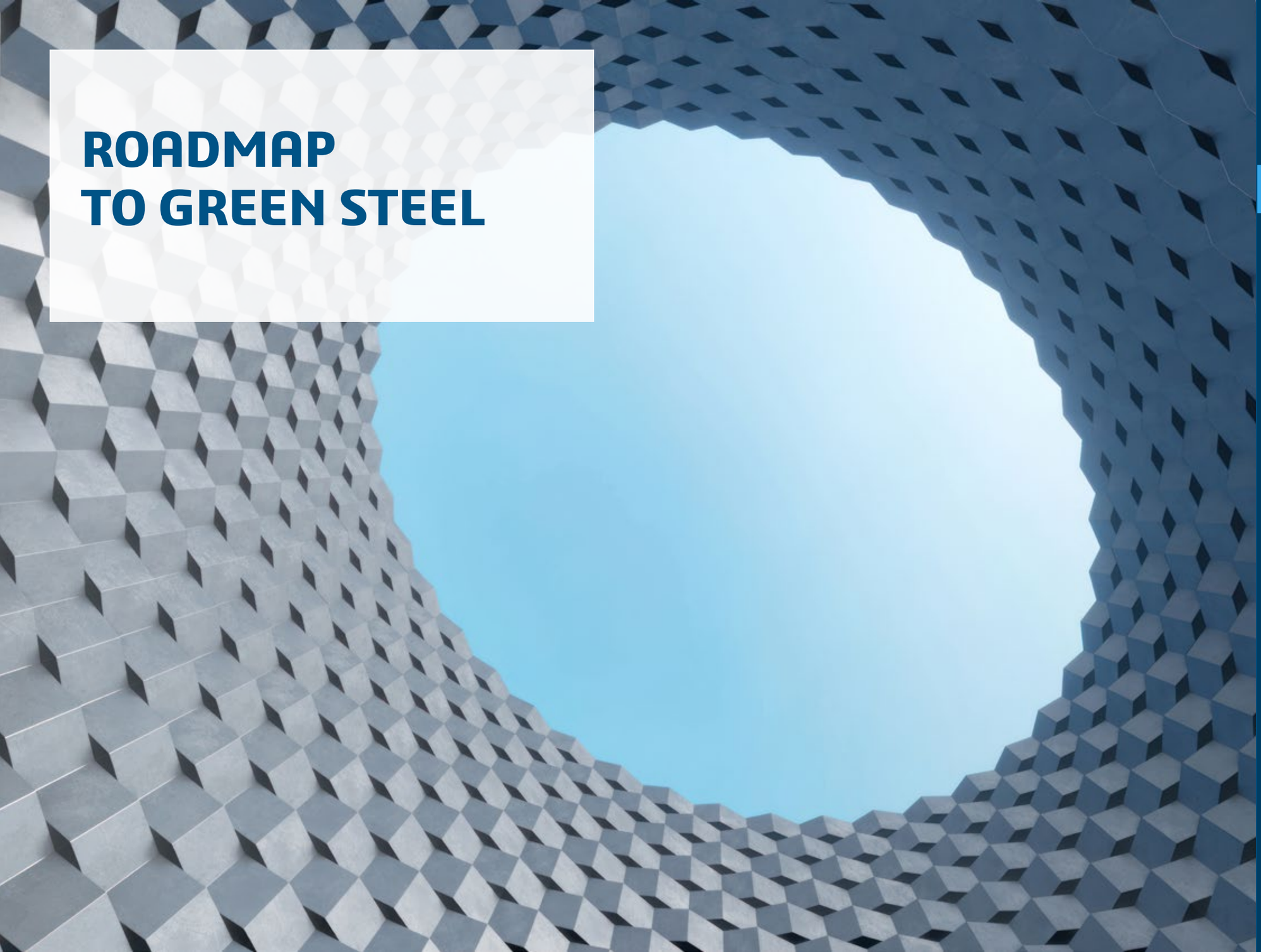
Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

ROADMAP TO GREEN STEEL



DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

A THREE-PHASE DIGITAL PROCESS TO OVERHAUL YOUR STEEL OPERATIONS

As steel companies lay out their plans to decarbonize their production processes, there can be a risk of purely looking to the long term – at the big fundamental infrastructure changes that take years in the making, rather than any quick wins that could be made along the way.

The power of developing a digital decarbonization roadmap is that you can identify and realize short term benefits while remaining on track to achieve your long-term plans. The more information you amass about your operations, the more you can leverage digital solutions. From improving visibility and optimizing existing operations, to developing virtual twins of your processes, plants, and supply chains, giving you the ability to test scenarios for any new strategy you are considering implementing.

"By developing a digital roadmap, steel companies can improve efficiency and productivity, reduce costs, and improve product quality as part of the journey to decarbonization."

DELPHINE GONDOIN
Decarbonization of Process Industries
Business Consultant Manager





DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

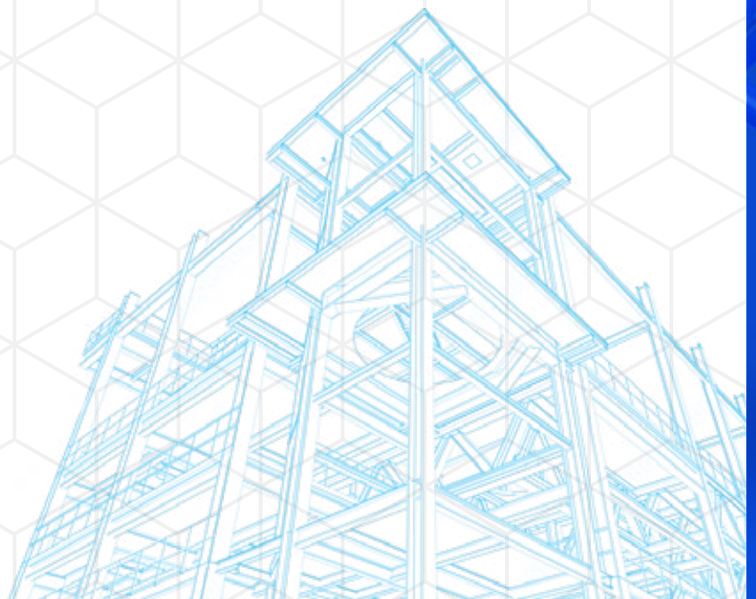
Phase 3: Future-proofing

CONCLUSION

SING FROM THE SAME DIGITAL SHEET

The **3D**EXPERIENCE platform provides a central hub that brings together applications and software solutions across the entire steel manufacturing process according to your specific needs. It connects project management tools, operations software, and CAD solutions, consolidating them into a full virtual twin of your operations that can be accessed by every relevant department.

This ability to connect every step of the process, optimizing individual elements with full clarity over the impact on the rest of the business, is critical to gaining a true understanding of your business. It gives you a risk-free environment in which to model the potential implications of any change initiative. From ensuring your supply chain is as efficient as possible, right through to full delivery of a new hydrogen direct reduction reactor.



0 1 2 3

STEEL CO

STEEL CO'S STEP-BY-STEP DECARBONIZATION ROADMAP

'Steel Co.' is an end-to-end steel manufacturer operating across several different locations. It has been assessing the best way to decarbonize operations to meet global sustainability targets and has turned to digital solutions to help it achieve this. Following the company on its digital decarbonization journey and the incremental improvements it achieves at each phase along way.

DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION



Digital solutions provide a secure and risk-free platform for modelling the potential impact of any change initiative, even down to day-to-day steel plant operations.

DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

10/15%

Reduction in lead times using 3DEXPERIENCE

PHASE 1: QUICK WINS

OPTIMIZE EXECUTION FOR SUSTAINABLE OPERATIONS

The initial focus of a digital decarbonization strategy is on optimizing individual elements of the planning process to reduce waste. By connecting data sources to the **3DEXPERIENCE** platform, you can analyze how they perform and interact, and highlight where efficiencies can be achieved. By plugging in modules for every element of the steel production process, from project management to operations software, you can quickly and easily identify the most effective actions to take.

For example, Dassault Systèmes company planner solutions are designed to seamlessly integrate all planning activities in a steelmaking plant to provide end-to-end visibility of its operations. By doing so, you can integrate and improve medium and short-term planning; optimize resource usage; quickly identify and eliminate production bottleneck; and keep working capital in the supply chain at a healthy level.



DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

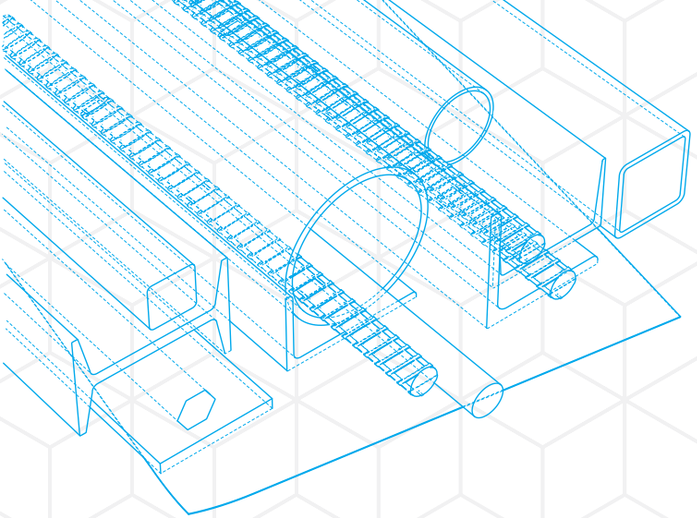
ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION



These efficiencies translate into quick wins when it comes to meeting your decarbonization targets. Such as through consolidating multi-site ordering, reviewing transport routes to reduce double handling, or amending production schedules to pre-emptively react to market events and significantly reduce energy use.

Efficiencies realized in the planning stage are also directly applicable to production, enabling the Manufacturing Operation Management or Manufacturing Execution System to streamline production schedules, work orders, and even traceability – automatically capturing data throughout the process to ensure any quality issues can be quickly and easily traced back to source and addressed with minimal disruption. This system can automate the master production scheduling, looking at upcoming batches and automatically issue work orders, product by product, line by line, and batch by batch, reducing waste.

The cost savings that can be achieved through these seemingly small incremental improvements add up to significant, quantifiable wins that can demonstrate the value of progressing to the next phase of the decarbonization process.

0 1 2 3

STEEL CO

PHASE 1: STEEL CO IDENTIFIES A SCHEDULING PROBLEM

Through the data gathered on their hot charging process, Steel Co. identified it as a significant cause of excess energy usage and carbon production. During this step, slabs of solid steel are produced and cooled to room temperature. However, in the next phase of the process, the steel must be reheated in a preheated furnace to be sufficiently malleable for hot rolling. By identifying this inefficiency, Steel Co. were able to model the steps in the **3D**EXPERIENCE platform and confirm that an optimized scheduling could enable the steel to move to the milling process with limited temperature loss, reducing the significant time, cost, and carbon impact of reheating.

DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

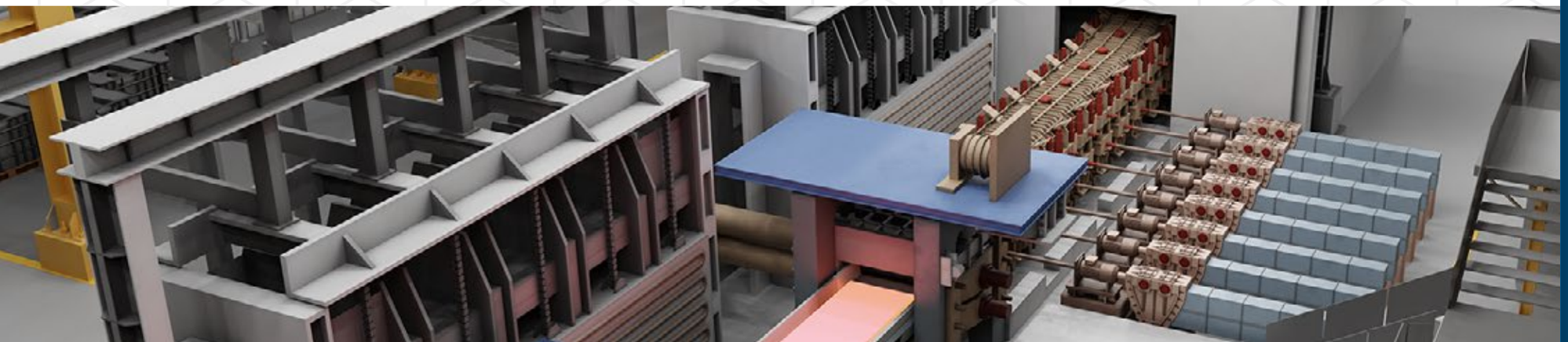
PHASE 2: INCREMENTAL CHANGE

EXTEND COLLABORATION AND DATA DRIVEN DECISION MAKING

Once all available data sources have been consolidated onto the **3D**EXPERIENCE platform, it enables you to create a like-for-like virtual twin of your entire operation. Every element of your people, processes, and facilities can be duplicated in the virtual environment for a fully end-to-end view of production.

The platform provides access to customizable dashboards showing energy consumption, scheduling, line failures, production bottlenecks, and much more. These can be directly connected to their relevant KPIs for a quick and simple view of exactly where improvement is needed and where emissions can be reduced. It allows you to instantly see any downtime as and when it occurs across any line or facility and visualize the metrics, adjust the financial information on the behavior of the lines, and avoid errors before they occur.

If the system flags a delay you can focus on that element to identify exactly which part is an issue, understand why, and launch investigations to solve it. The platform can not only create maintenance work orders and alert workers to the required fix, but can even automate the cost comparison, delivery timelines and installation needs for any replacement parts.



DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

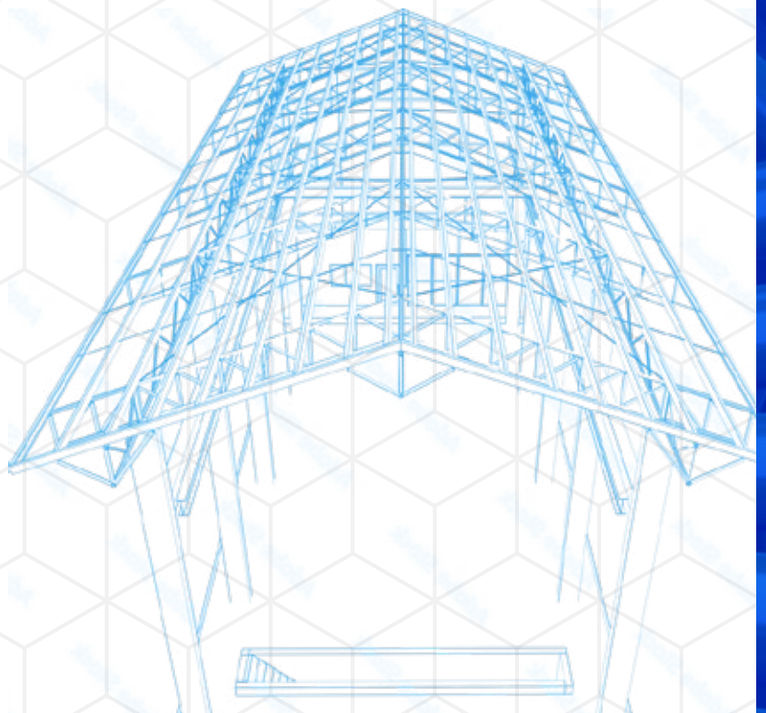
Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

The addition of the visualization element is truly game changing – you can hover over any item on the dashboard to instantly see where it sits in the physical world. This enables the trial of new or replacement equipment or processes with real-world outcomes, but none of the risk of making the physical change.
This can enable myriad improvements from identifying process bottlenecks to planning larger-scale equipment replacement with minimal downtime.

By enabling the simulation of products and processes and optimizing "first time right" plans through data-driven decision-making, steel companies can bring sustainability to the forefront of their thinking by measuring the relevant key performance indicators, such as pollution & CO2 emissions, scrap, and raw material usage.



0 1 2 3

STEEL CO

PHASE 2: STEEL CO RETHINKS THE FACTORY FLOOR

Utilizing the virtual twin of their primary manufacturing facility, Steel Co. were able to identify that the highest concentration of workplace accidents took place where storage of product between processes was impinging on routes workers needed to use to move around. By adjusting the layout of the floor plan virtually, Steel Co. were able to trial several different options for relocating the product and the traffic routes. Understanding the knock-on effect of each option and identifying the most effective approach enabled Steel Co. to drastically reduce workplace incidents while minimizing double handling of materials.

DECARBONIZING STEEL

Timeline to decarbonization
Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins
Phase 2: Incremental change
Phase 3: Future-proofing

CONCLUSION



Steel companies can achieve 'first time right' precision and elevate their commitment to decarbonization through simulation.

DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

PHASE 3: FUTURE-PROOFING YOUR PLANT

PLAN AND DELIVER THE TRANSITION TO GREEN STEEL

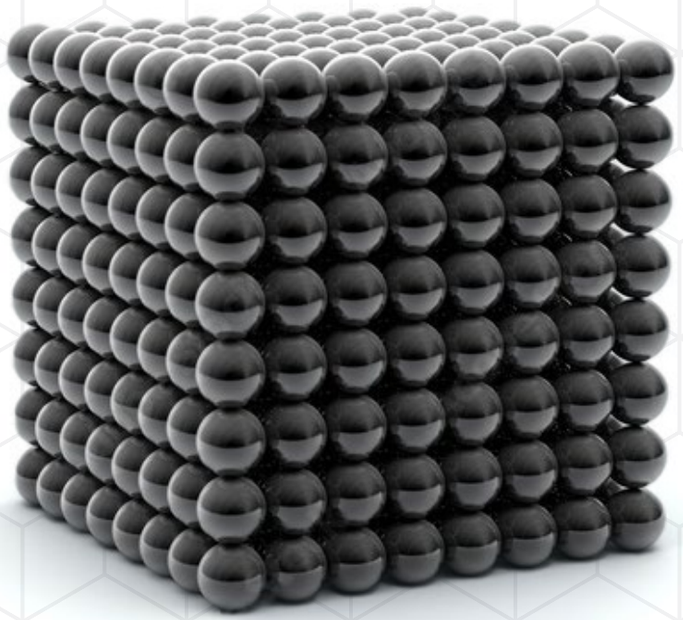
Once you've fully optimized your supply chain, production processes and operations, it's time to look to the future of the industry. Incremental change can have a transformative impact on your business, and your existing carbon footprint, but to truly make the transition to green steel manufacturing, bigger steps are needed.

For example, the most significant carbon contributor in steel production is the blast furnace that reduces the iron ore to pure iron at the start of the process. Processing the iron ore into pellets creates about 20% of this approach's CO2 emissions, while the blast furnace itself produces around 70%.

Replacing a coal-powered furnace with hydrogen-based reduction means the waste product is no longer carbon dioxide, but instead, simply water. Of course, this is not a simple swap, there are a huge number of factors to consider including the specific type of furnace, its placement and whether it can be installed alongside, or prior to, demobilizing the coal furnace for a seamless transition.

Differences in the processes mean much of the surrounding infrastructure and ways of working will also need to adapt, from adjusting the continuous casting process, to modelling the cost and impact of forecast hydrogen supply.

These major changes may be essential, but they don't happen overnight. Expert planning and dedicated investment are required for any significant change initiative, whether that's replacing a blast furnace with direct reduction, building a new site, or adding lines.



DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

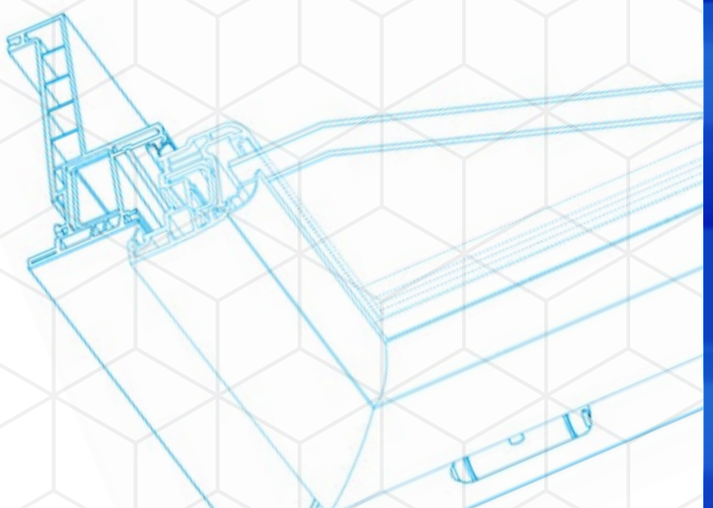
Phase 3: Future-proofing

CONCLUSION

The unique ability of the **3D**EXPERIENCE platform to visualize the specific implications of any action means you can fully explore the options before any money is spent, assessing potential expansion sites for the optimal topography, viable locations for hydrogen or wastewater pipes, right down to the specific paths of cranes across the site and how they might impact movement.

Not only can you test and learn across all the different options, seeing the physical, environmental and budgetary impacts in real time, but you can even get a quick view of the major impacts with graphical overlays that show you exactly how two options compare. It is a truly end-to-end solution where you can ensure a seamless transition to green steel by testing in the virtual world so that you perfect it in the real one.

There are four routes to decarbonizing steel production that, combined, can pave the way to green steel. These are increasing energy efficiency, electrification of reheat and other furnaces, low carbon fuels, and carbon capture utilization and storage (CCUS). Each has multiple steps that need to be planned, delivered and assessed to reach net zero by 2050.



0 — 1 — 2 — 3

STEEL CO

PHASE 3: STEEL CO PLOTS A VIABLE PATH TO DECARBONIZATION

The initial phases of the process enabled Steel Co. to realize significant operational and cost benefits including 15% less scrap produced across their operations, and 20% reduction in energy use from avoiding reheating in the milling process. With the virtual twin of their operations fully running on the **3D**EXPERIENCE platform, Steel Co. could now move to the next phase of the process confident of planning a seamless production transition. They started by assessing the challenges and opportunities of replacing their blast furnaces across all sites to develop a quantifiable plan of attack, including which sites to target first based on complexity and output impact. Steel Co. then developed a manageable plan to work systematically through all their sites, setting attainable deadlines on their way to decarbonization.

DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

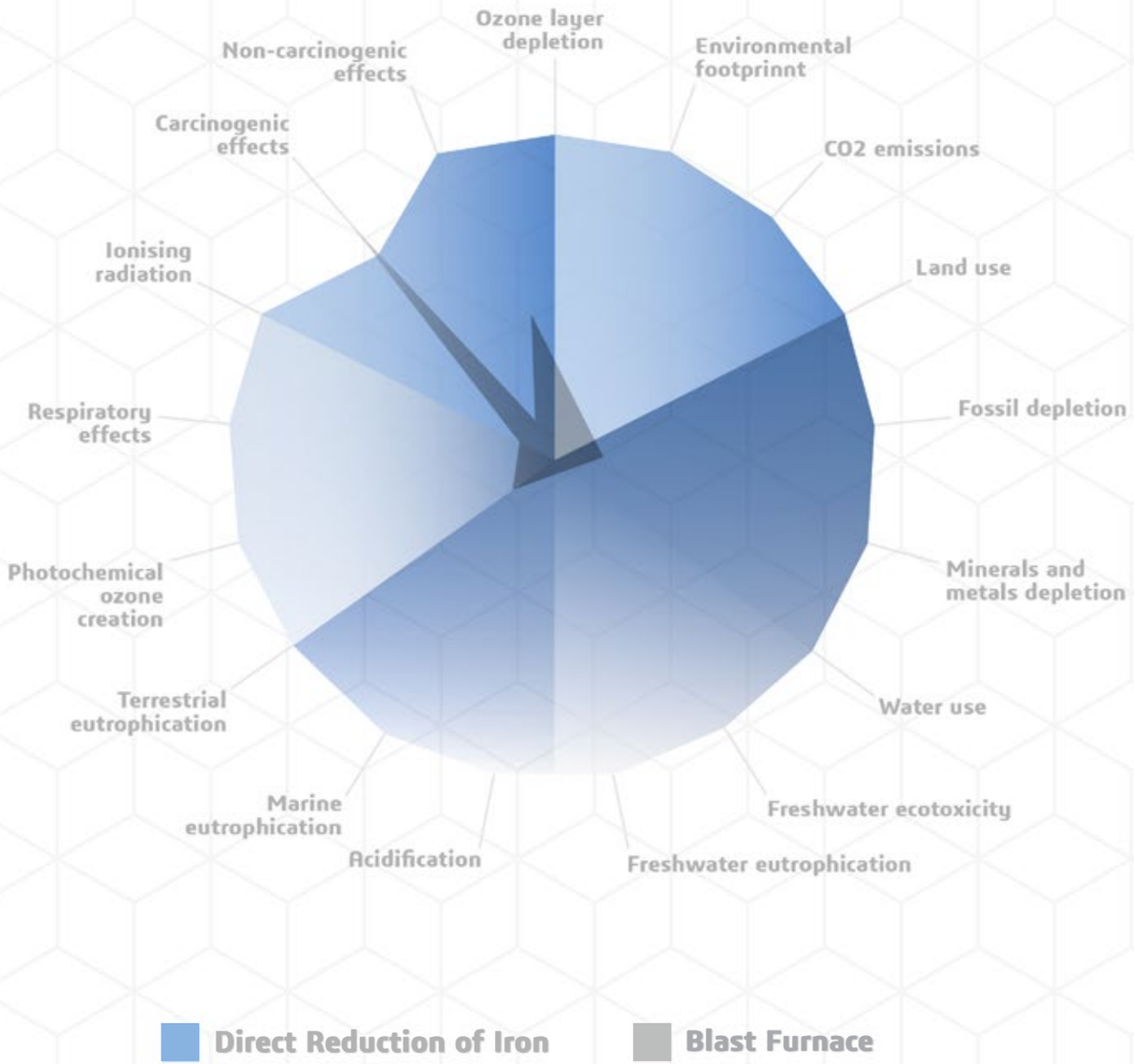
Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

COMPARING THE ENVIRONMENTAL IMPACT OF BLAST FURNACES AND ELECTRIC ARC FURNACES

In this graph, developed on the **3DEXPERIENCE** platform, a steel manufacturer compares the impact of using traditional blast furnaces versus direct reduction of iron. The result shows that the direct reduction of iron scores better across all environmental metrics.



DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

CONCLUSION



DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

Phase 3: Future-proofing

CONCLUSION

NOW IS THE TIME TO ACT FOR A SUSTAINABLE STEEL INDUSTRY

The journey to a truly green steel industry won't happen overnight. It is complex. It is expensive. And it is a collective effort. But it doesn't have to be guesswork. That is where digitization plays such a critical role. The **3D**EXPERIENCE platform gives steel makers a truly holistic view of every aspect of the production process, meaning they can develop a practical roadmap to green steel where both environmental sustainability and economic viability can be efficiently and effectively achieved along the way.

It is about de-risking decarbonization through digitization, benefitting at every stage:

1. Quick wins - Optimizing planning, logistics, supply chain and execution for sustainable operations through connected data sources and instant wins

2. Incremental change - Extend collaboration and data driven decision making through the ability to virtually recreate your entire operation, and trial options with zero outlay or downtime

3. Future-proofing – Plan and deliver the complete transition to green steel across all sites and processes by performing endless 'what if' scenarios to mitigate risks.

"Green steel is the future of the steel industry. It is not a choice, it is a necessity if we are to make the industry more environmentally responsible."

DELPHINE GONDOIN
Decarbonization of Process Industries
Business Consultant Manager

DECARBONIZING STEEL

Timeline to decarbonization
Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins
Phase 2: Incremental change
Phase 3: Future-proofing

CONCLUSION

ABOUT THE AUTHOR

DELPHINE GONDOIN, DECARBONIZATION OF PROCESS INDUSTRIES BUSINESS CONSULTANT MANAGER

Delphine Gondoin brings with her 12 years of experience in her current role at Dassault Systèmes. She delivers value in the company's initiatives related to the Infrastructure, Energy & Materials industry by leveraging her expertise in earth resources and engineering and an acute sense for taking challenges apart and addressing them innovatively.





DECARBONIZING STEEL

Timeline to decarbonization

Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins

Phase 2: Incremental change

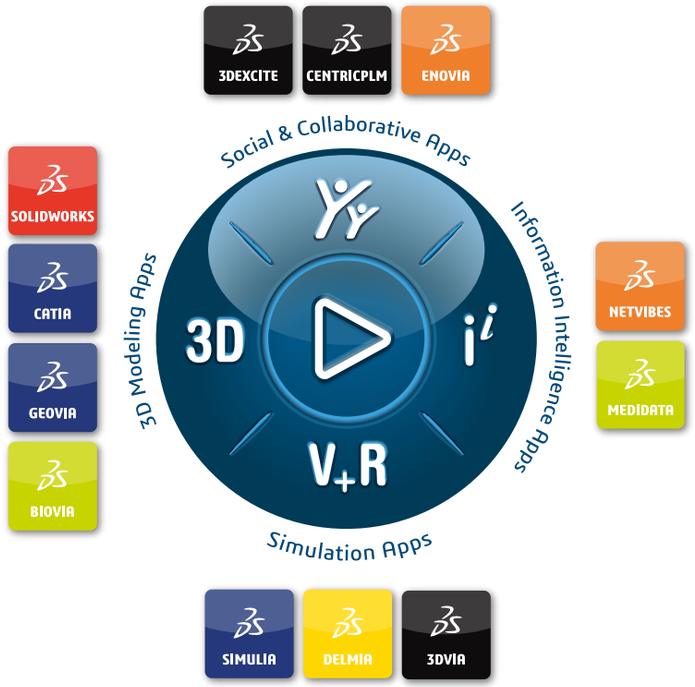
Phase 3: Future-proofing

CONCLUSION

Our **3D**EXPERIENCE® platform powers our brand applications, serving 12 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3D**EXPERIENCE Company, is a catalyst for human progress. We provide business and people with collaborative virtual environments to imagine sustainable innovations. By creating virtual twin experiences of the real world with our **3D**EXPERIENCE platform and applications, our customers can redefine the creation, production and life-cycle-management processes of their offer and thus have a meaningful impact to make the world more sustainable. The beauty of the Experience Economy is that it is a human-centered economy for the benefit of all –consumers, patients and citizens.

Dassault Systèmes brings value to more than 300,000 customers of all sizes, in all industries, in more than 150 countries. For more information, visit **www.3ds.com**.



DASSAULT SYSTEMES

Europe/Middle East/Africa
Dassault Systèmes
10, rue Marcel Dassault
CS 40501
78946 Vélizy-Villacoublay Cedex
France

Asia-Pacific
Dassault Systèmes
17F, Foxconn Building,
No. 1366, Lujiazui Ring Road
Pilot Free Trade Zone, Shanghai 200120
China

Americas
Dassault Systèmes
175 Wyman Street
Waltham, Massachusetts
02451-1223
USA

©2024 Dassault Systèmes. All rights reserved. **3DEXPERIENCE**, the 3DS logo, the Compass icon, IFWE, 3DEXCITE, 3DVIA, BIOVIA, CATIA, CENTRIC PLM, DELMIA, ENOVIA, GEOVIA, MEDIDATA, NETVIBES, OUTSCALE, SIMULIA and SOLIDWORKS are commercial trademarks or registered trademarks of Dassault Systèmes, a European company (Société Européenne) incorporated under French law, and registered with the Versailles trade and companies registry under number 322 306 440, or its subsidiaries in the United States and/or other countries.

DECARBONIZING STEEL

Timeline to decarbonization
Transformation through digitization

ROADMAP TO GREEN STEEL

Phase 1: Quick wins
Phase 2: Incremental change
Phase 3: Future-proofing

CONCLUSION