

360° Approach to support digital transformation to green steel production

DECARBONIZATION & ENERGY MANAGEMENT SERVICES

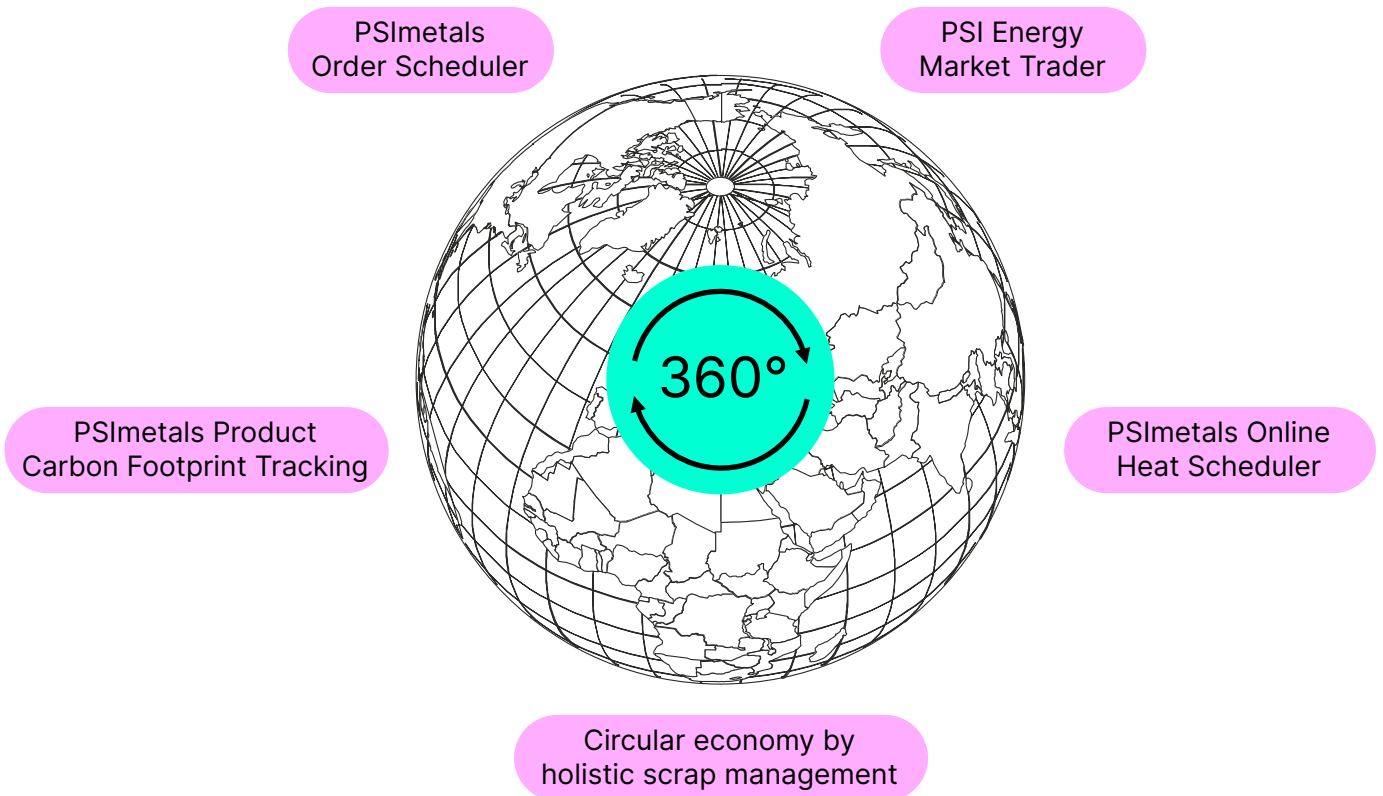


PSI - Software excellence for steel & aluminum producers

Step on your green digital transformation journey with PSImetals!



PSI supports digital transformation to green production management



Discover our product portfolio for sustainable production management.

PSImetals covers classical Planning & Scheduling services:

- ✓ Optimizing and balancing of process flows and resource usage
- ✓ Using efficiency KPIs as optimization targets
- ✓ Enhancing cost effectiveness which increasingly implies sustainability

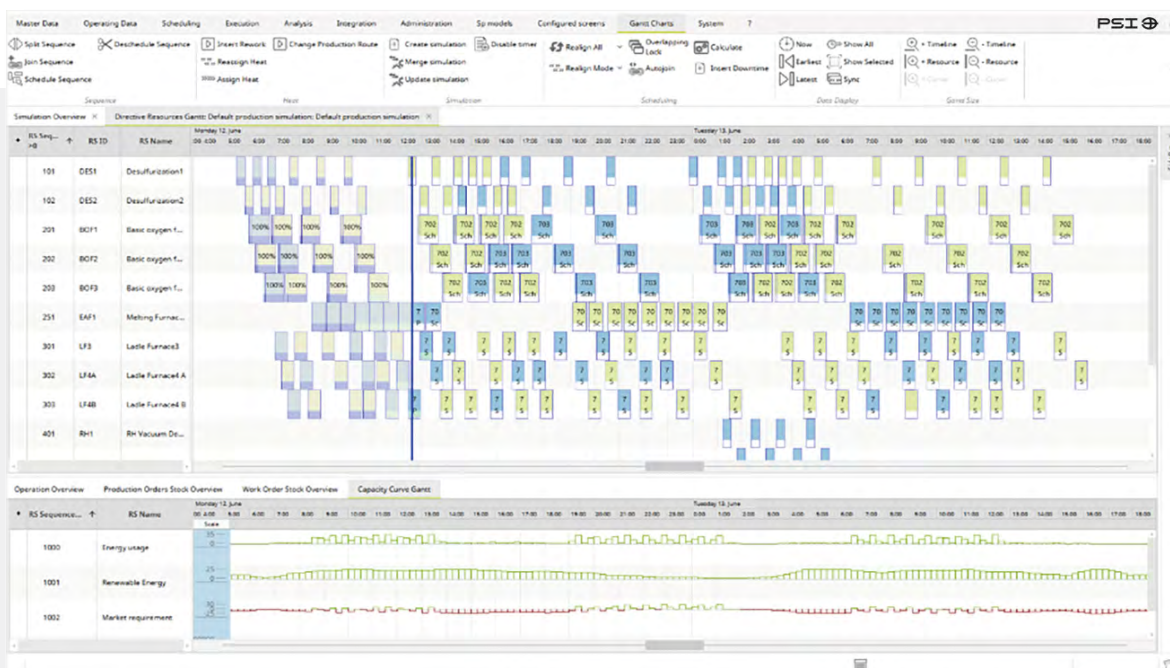
With PSImetals, we are setting a new impulse:

- ✓ PSImetals supports various requirements with a flexible infrastructure that can run services in any environment as needed
- ✓ Following the concept of edge computing, services can be shifted between environments
- ✓ It also offers comprehensive Charge & Alloy optimization and internal production scrap tracking

Manage the complexity of hybrid steel plants

A hybrid steel plant allows gradual transition to green steel. However, when combining the blast furnace (BF) and basic oxygen furnace (BOF) with Direct Reduced Iron (DRI), Smelters and Electric Arc Furnace (EAF) technology to produce steel in one plant, it becomes complex to operate

due to conflicting KPIs. Producing steel with this new technology requires careful material allocation and energy management, which can be managed with PSImetals Online Heat Scheduler.



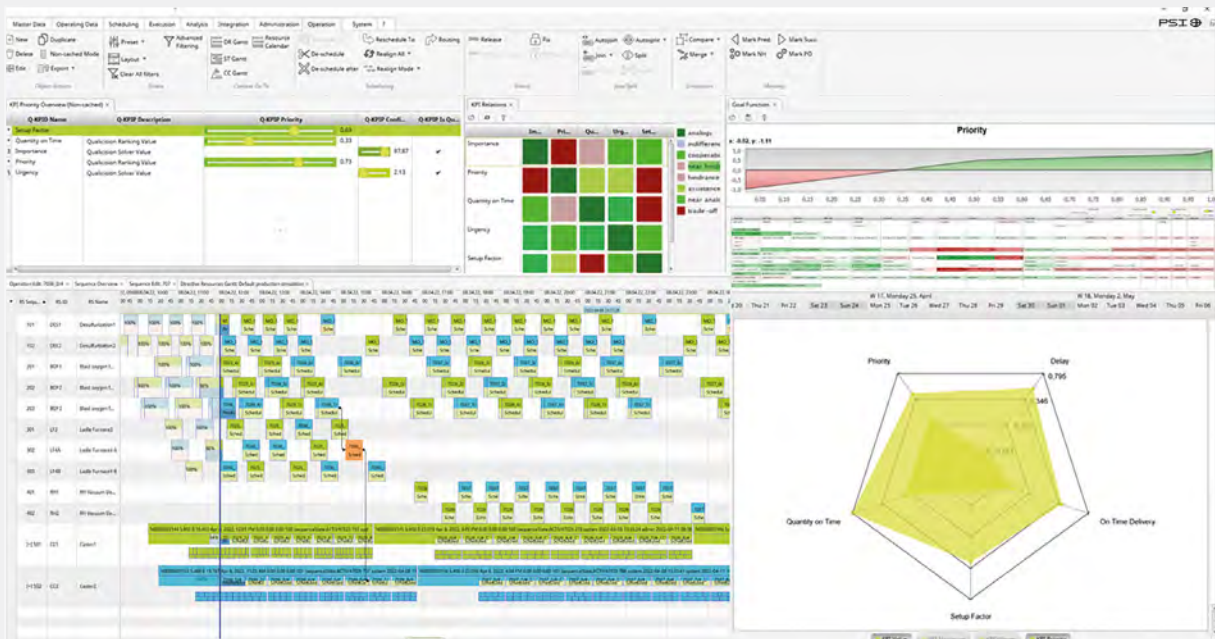
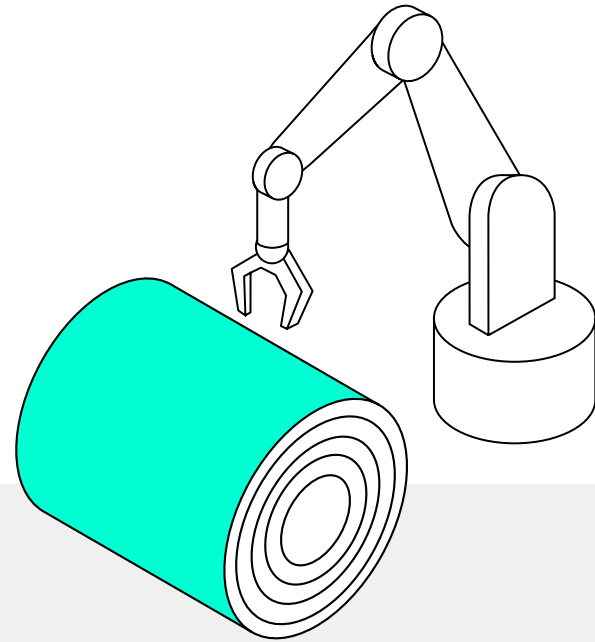
Online Heat Scheduling – forecasts in PSImetals Virtual Factory.

Key facts & benefits of PSImetals Online Heat Scheduler:

- ✓ Offers transparent graphical overview of heat schedule, hot metal, DRI and energy demand
- ✓ Aligns schedules and routes depending on energy, resource availability and flow
- ✓ Manages scenarios to analyze and compare schedules with different KPI settings

With PSImetals Online Heat Scheduler you can:

- ✓ Influence the optimization result by different weightings of defined KPIs
- ✓ Overwrite the proposed optimizer results by manual interactions in simulation mode
- ✓ Get an overview of KPI achievements of the proposed and simulated solutions
- ✓ Access energy demand forecasts for energy procurement and/or consider sending them to the energy provider

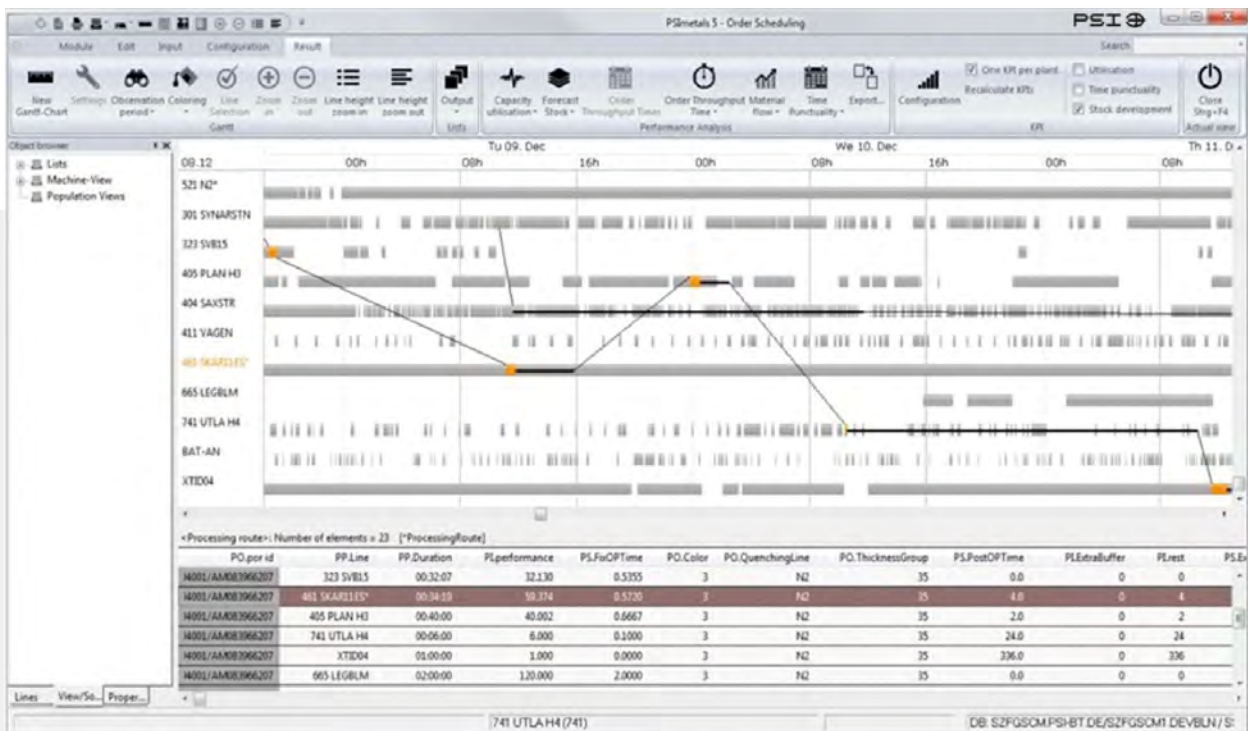


PSImetals Online Heat Scheduler – KPI-Driven optimization and display of scheduling results to the user.

Detailed line scheduling task

Plant managers have to balance available resources with demand from the amount of open customer orders. This requires that for each production step of the order book, the

best starting time is calculated, with the production targets from the flow planning and campaigns considered.



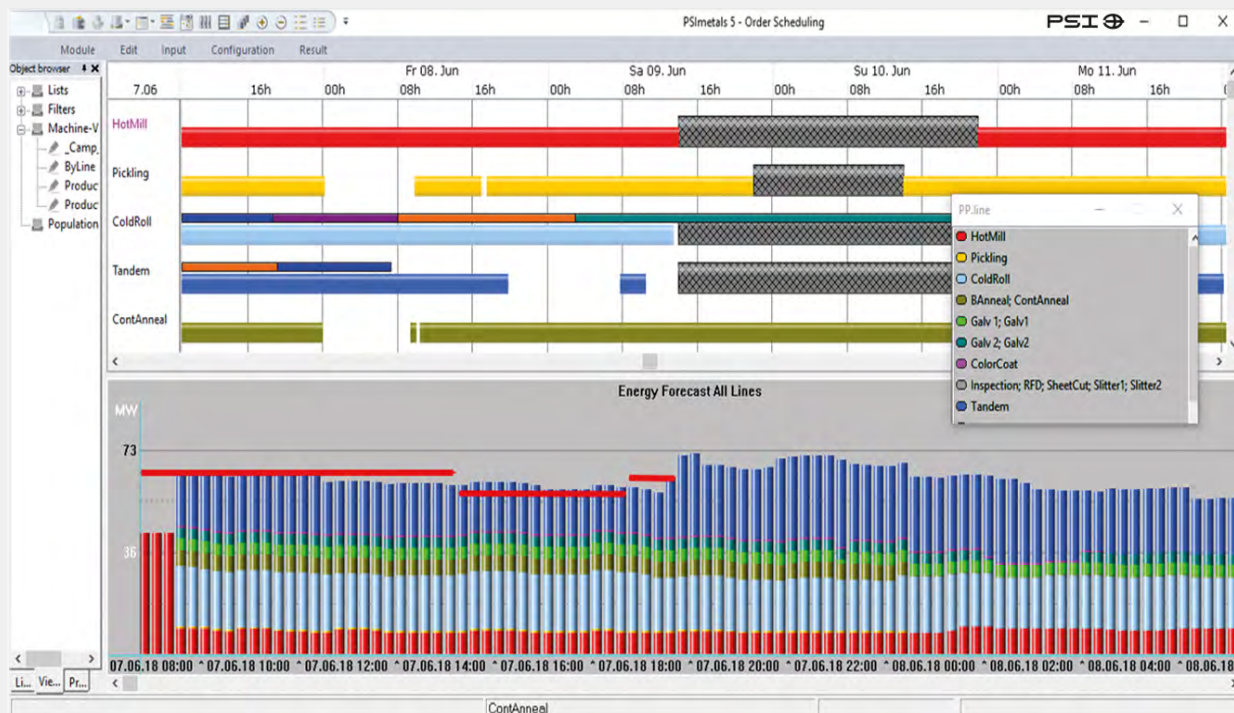
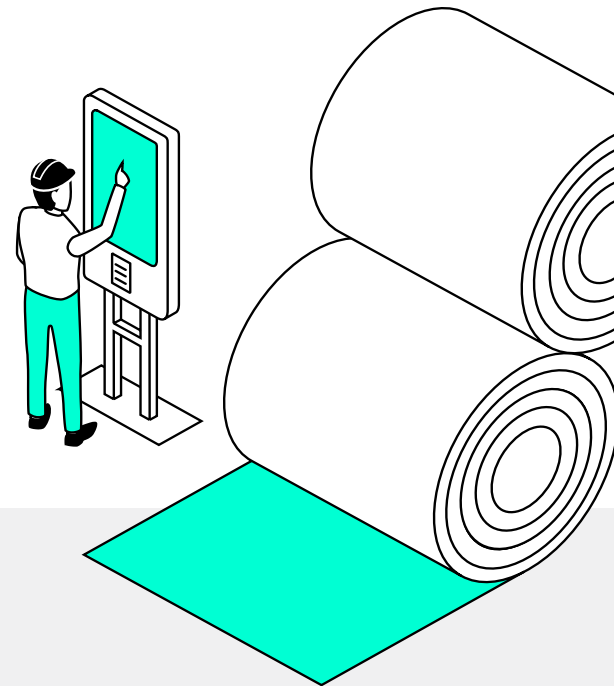
Cross-Plant Order Scheduling with PSImetals.

Key facts & benefits of PSImetals Order Scheduler:

- ✓ Adjusts campaigns according to the material flow
- ✓ Balances workload between production resources, production flow and efficiency targets
- ✓ Projects completion date of all production orders based on detailed production line schedules and production status

With PSImetals Order Scheduler you can:

- ✓ Predict overall energy demand based on specific energy demand by product, production step and resource
- ✓ Apply statistical methods to derive a more accurate energy forecasting for planned schedules
- ✓ Compare projected energy demand to energy availability, costs and possible limits to adjust the scheduled production accordingly
- ✓ React to actual production deviations with transparency of the impact on energy consumption



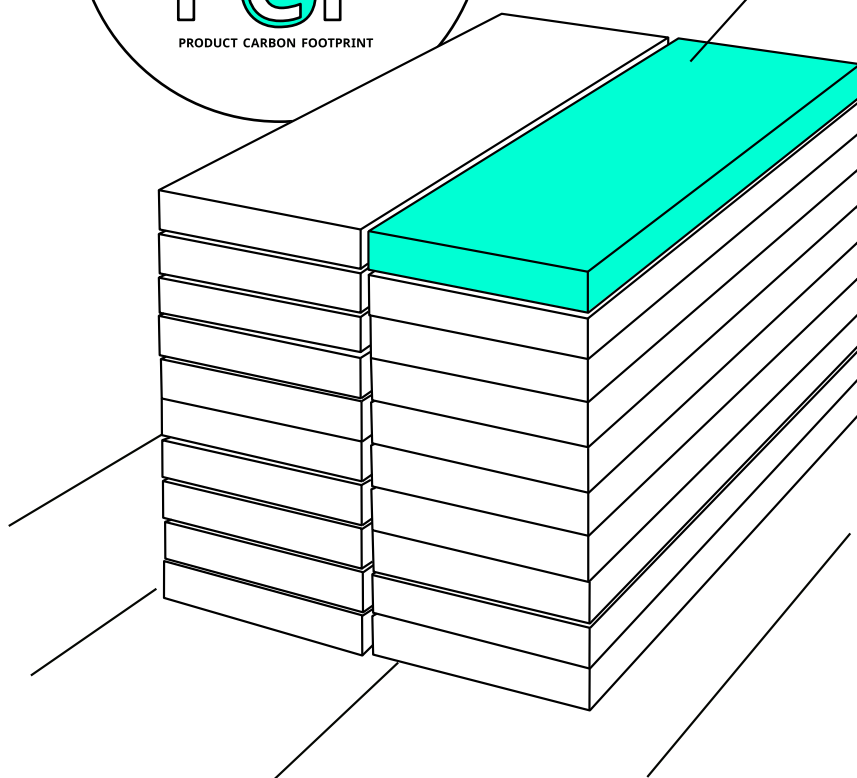
Forecast of overall electrical energy demand which is color-coded by contribution of the individual production lines.

Transparent calculation and tracking of emissions at piece and product level

The Product Carbon Footprint (PCF) Tracking approach, based on PSImetals Quality Process Snapshot, is the next step to tracking CO₂ emissions along the entire production chain.

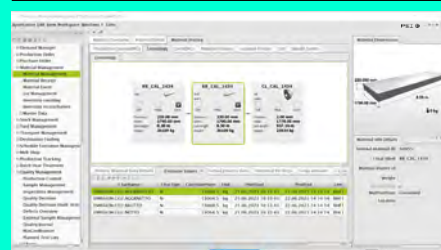
The market is increasingly demanding reliable carbon footprint calculations and related certificates for various

metals products. The PSImetals Product Carbon Footprint Tracking approach provides transparent calculations based on configurable Quality Process Snapshots and the tracking of energy consumptions and CO₂ emissions at piece and product levels along the entire production chain. It tracks all emission-relevant process data and calculates scope 1, scope 2, and upstream scope 3 CO₂ emissions in real-time.



PRODUCT CARBON FOOTPRINT TRACKING:

PRODUCT ID: CL CAL 1434



EMISSION VALUES:

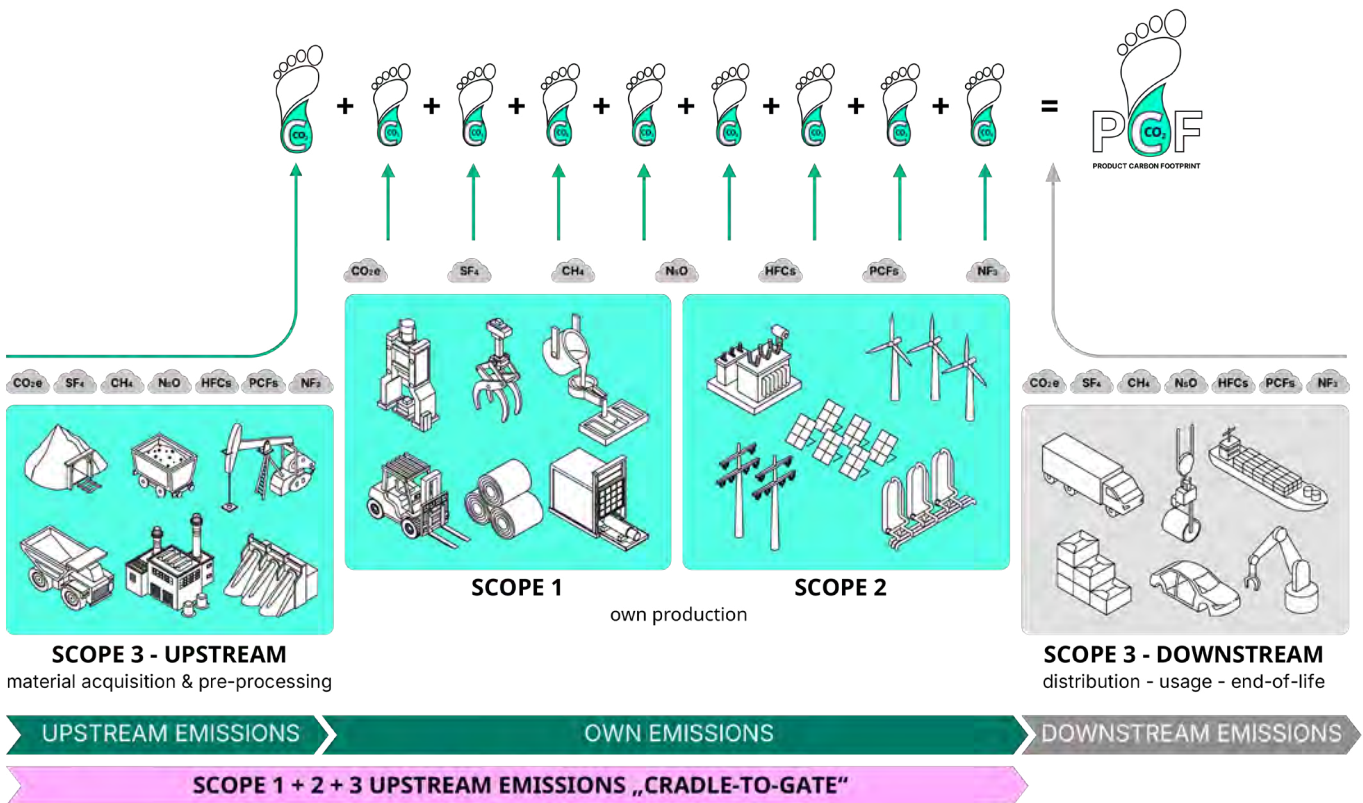


Material: Slab
220 mm x 1790 mm x 8.50 m, 26109 kg

Aggregated Gross CO₂e Emissions: 13069.5 kg

Aggregated Net CO₂e Emissions: 13064.5 kg

Step into your decarbonization journey



FROM “CRADLE-TO-GATE”: PCF tracks all emission-relevant process data in real-time along the material's entire production chain, calculating Scope 1, 2, and upstream Scope 3 emissions for each individual product.

Key facts & benefits of PSImetals Carbon Footprint Tracking:

- ✓ Reliable PCF-calculations and certificates for various metals products
- ✓ Real time PCF-Tracking from “Cradle-to-Gate” along the Material Genealogy
- ✓ Transparent calculation and tracking of emissions on piece and product level
- ✓ CO_2 emissions and Energy Demands as Green KPIs for Optimized Planning, Scheduling and Execution
- ✓ PCF data like today's quality data – easy to implement & easy to use
- ✓ Business and Intelligence readiness – statistical evaluations and hence transparency on decarbonization progress

From data to decisions: hybrid intelligence for smarter steelmaking

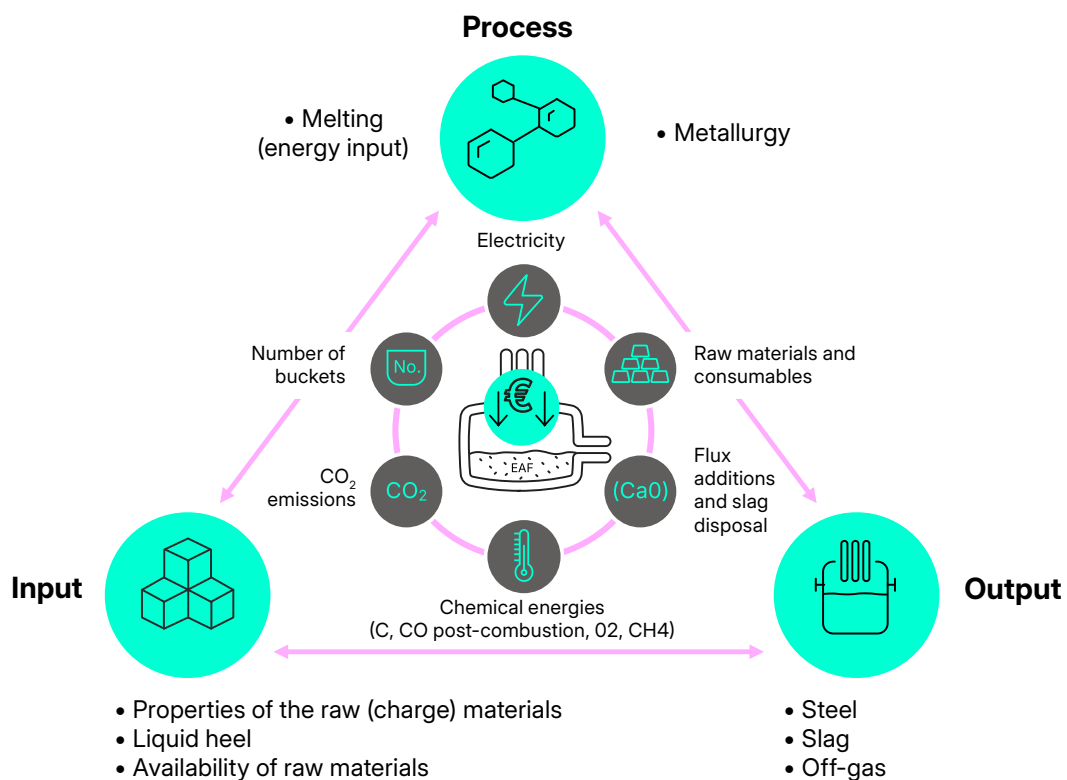
A comprehensive hybrid charge and alloy optimization model developed by PSI's partner, qoncept technology, has been integrated into PSImetals as a third party service

on PSI's service platform (SP). The hybrid model (qontrol maps) goes beyond the capabilities of the conventional approach.

Components of the hybrid model:

- ✓ **qontrol materials - Scrap Characterization Model**
This component uses AI techniques to continuously evaluate and update the expected chemical composition, metallic yield, and melting energy requirements of each scrap type based on observed melting results.

- ✓ **qontrol maps - Optimization Model**
A decision algorithm uses these dynamic scrap properties to calculate the most cost-, energy-, and emission-efficient charge mix, while respecting production constraints such as grade limits, material availability, and real-time pricing.
- ✓ **qontrol maps - Metallurgical Process Model**
This thermodynamic module ensures that the calculated charge mixes remain metallurgically valid by modeling key reactions such as decarburization, oxidation, reduction, and slag formation.

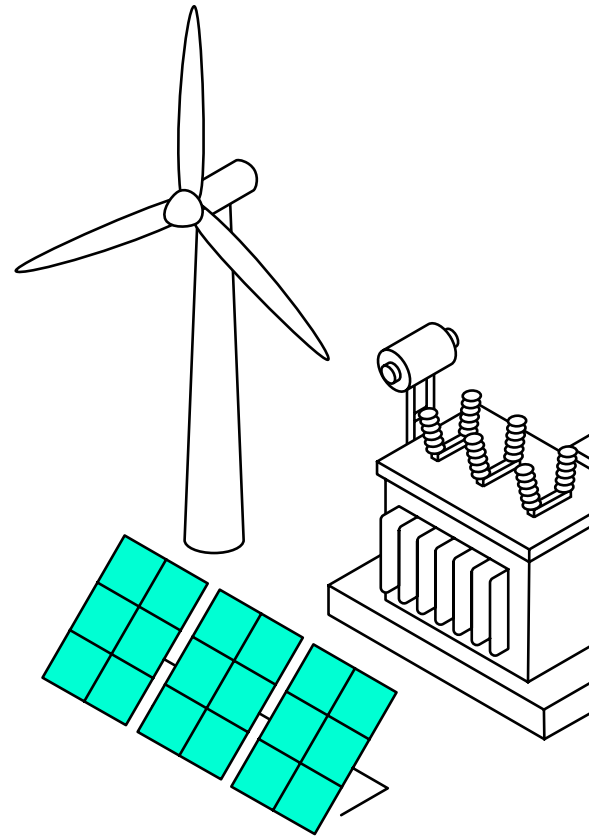


Material input, process conditions and output data of metallurgical model for EAF treatment with considered cost drivers for charge and alloy optimization.

Hybrid Charge and Alloy Optimization model

Key facts & benefits of hybrid Charge & Alloy Optimization model:

- ✓ Automatic adaptation of scrap properties
- ✓ Optimization of material inputs across the entire production chain and meltshop
- ✓ Consideration of energy consumption and CO₂ emissions
- ✓ Improvement of heat campaign planning



Met

Step/Process

25F Blending

EAF Tapping

VOD

Reduction and Alloying

	C	Si	Mn	P	S	Cr	Ni	Mo	Al	Cu	V	Sn	Ca	N	B	Co	As	Pb	W	Nb	Mg	Zr	Zn	Fe
SPECMIN	0.04	0.25	0.85			16.25	4.55	0.44	0.024	0.005	0.024	0.007	0.0005	0.0005	0.0005	0.004	0.0005	0.0005	0.002	0.0005	0.0005	0.0005	76.94	
CALC	0.04	0.25	0.85	0.025	0.0025	16.25	4.55	0.44	0.024	0.005	0.024	0.007	0.0005	0.0005	0.0005	0.004	0.0005	0.0005	0.002	0.0005	0.0005	0.0005	76.94	
SPECMAX	0.04	0.45	1.05	0.025	0.0025	16.25	4.55	0.44	0.024	0.005	0.024	0.007	0.0005	0.0005	0.0005	0.004	0.0005	0.0005	0.002	0.0005	0.0005	0.0005	76.94	
MIN		0.25	0.85			16.25	4.55			0.005														
MAX	0.04	0.45	1.05	0.025					0.024															

Materials

Expand

Material	T	Active	Stock kg	Comments
Al Block			47.201	ADD Comment
Al Block (low Si)			28.101	ADD Comment
Al Granules			99.701	ADD Comment
Al Wire			28.634	ADD Comment
Cr Wire			14.782	ADD Comment
CrB Wire			7.211	ADD Comment
Cr A			14.225	ADD Comment
Cr B			14.410	ADD Comment
Cr Melt			72.380	ADD Comment
Cr Melt			49.245	ADD Comment
FeB			12.791	ADD Comment
FeB A			12.781	ADD Comment
FeB B			12.401	ADD Comment
FeB C			14.287	ADD Comment
FeB D			79.239	ADD Comment
FeB E			24.273	ADD Comment
FeB F			12.001	ADD Comment
FeB G			91.175	ADD Comment
FeB H			14.810	ADD Comment
FeB I			84.634	ADD Comment
FeB J			78.221	ADD Comment
FeB K			25.242	ADD Comment
FeB L			14.339	ADD Comment
FeB M			12.489	ADD Comment
FeB N			14.787	ADD Comment
FeB O			78.221	ADD Comment
FeB P			84.634	ADD Comment
FeB Q			14.339	ADD Comment
FeB R			12.489	ADD Comment
FeB S			14.787	ADD Comment
FeB T			78.221	ADD Comment

Chemistry

Energy

Met

Slag

Other

Reaction

Active

25.001 + 20 + 40 + 1000

Step Results

General

Heat No. 12345

Step No. 123

Material 1

Electrode 1000

Cr Block 1000

55.143

2.563

2.678

2.678

2.678

54.000

Chemical 1000

Cr Block 1000

Energy 1000

Cr Block 1000

4.808

Material

Material

Calculated kg

Al Block

332

Al Block (low Si)

202

Al Granules

99

Al Wire

142

Cr Wire

14

GUI example of hybrid Charge and Alloy optimization along all production steps, from EAF melting to reduction and alloying in VOD line.

Optimized Scrap Management across the production chain

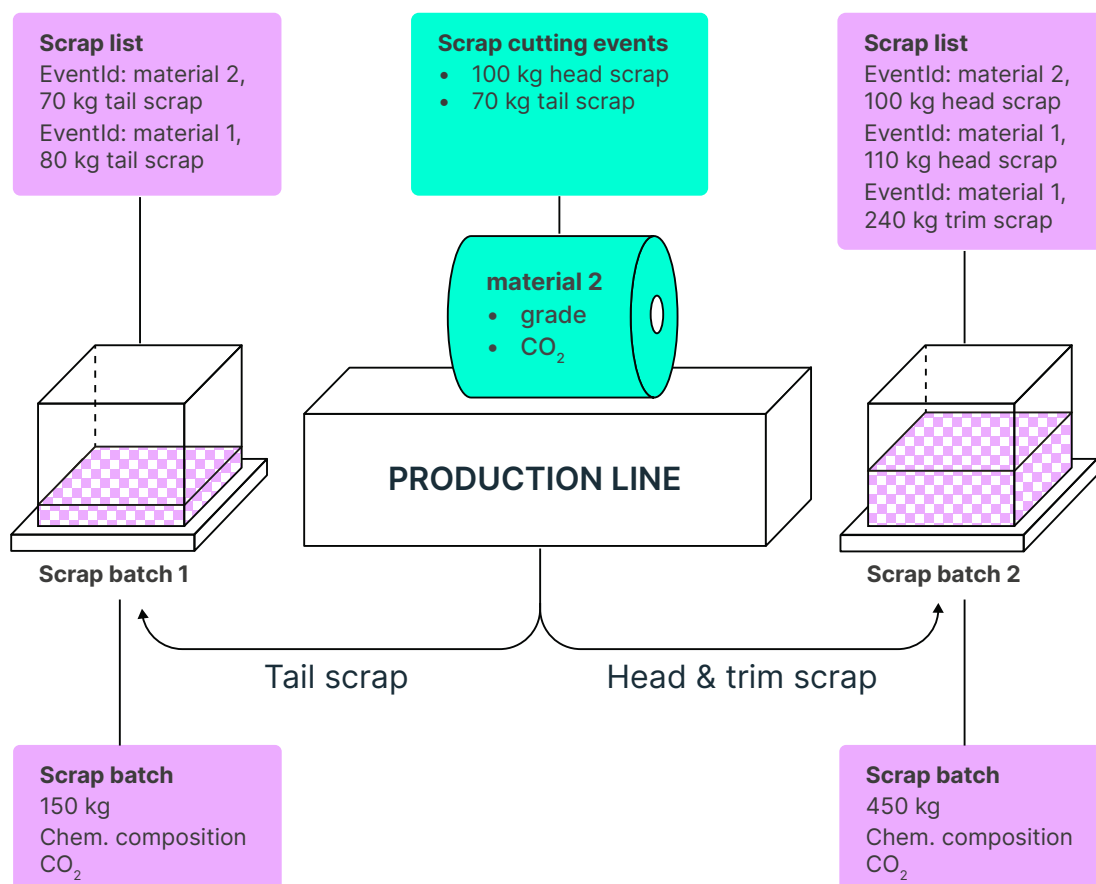
PSImetals efficiently manages internal scrap generated during downstream production processes by treating it as batch material and automatically capturing essential production data. Scrap from on-site operations—such as trimming or cutting head and tail scrap—is a valuable resource that can be recycled in-house in the meltshop or sold externally.

To facilitate this, scrap is collected in dedicated containers placed at strategic collection points along the production lines. Since containers often contain scrap from multiple campaigns, their contents can be heterogeneous. PSImetals ensures high-grade recycling by automatically tracking total weight and average chemical composition for every batch.

A detailed scrap list per container provides a comprehensive overview of its composition, including individual cut parts and information about their

respective mother materials. Additionally, the carbon footprint of each scrap piece is recorded, enabling calculation of the product carbon footprint (PCF) for the entire scrap batch.

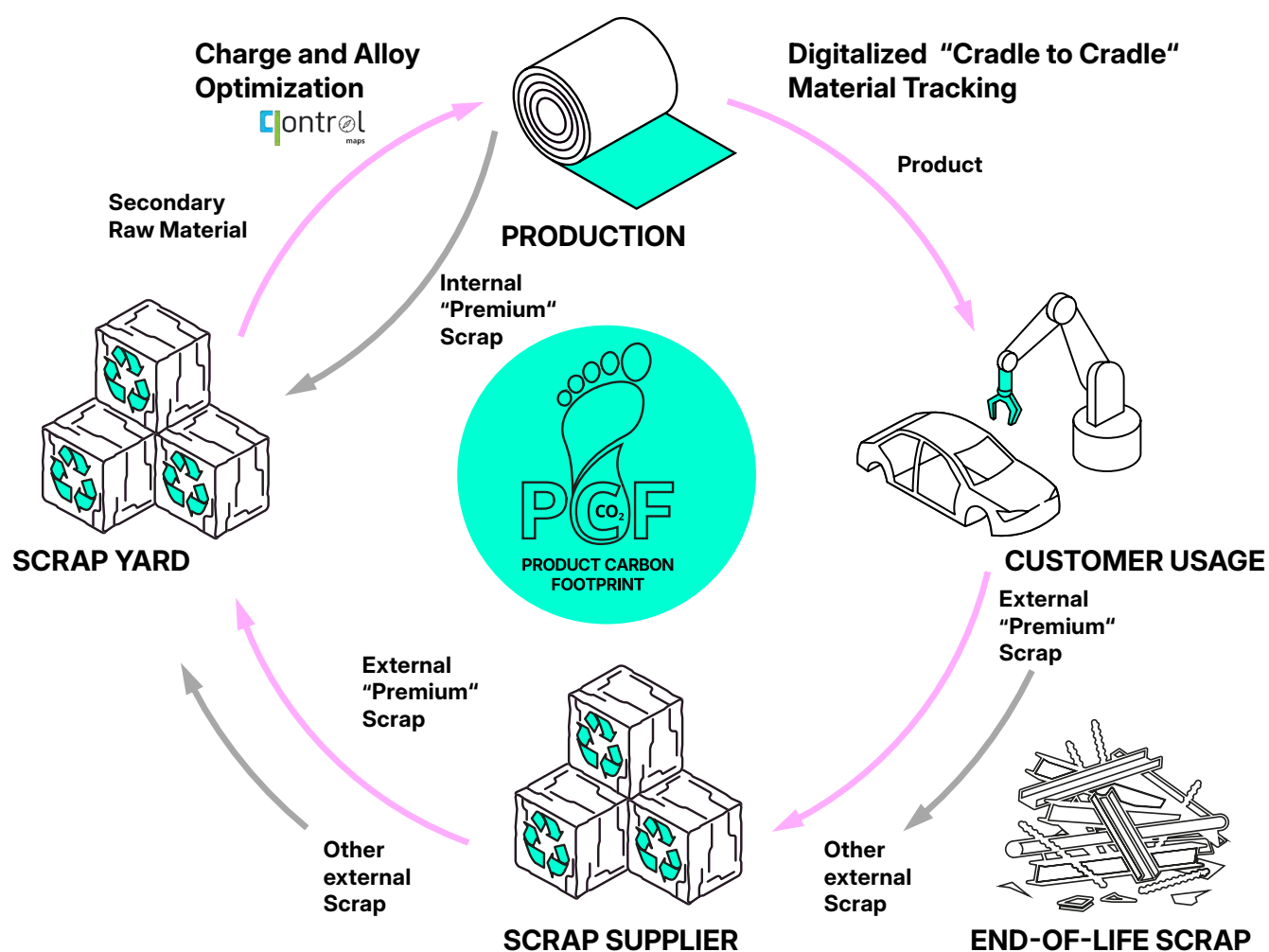
With this holistic approach, you can plan scrap demands, optimize scrap mix and alloy charging, manage internal and external scrap yards, and track scrap consumption across the entire steel production chain, reducing energy use and lowering the product's carbon footprint.



Automatic scrap tracking based on the standard production and scrap cutting events.

Benefits of holistic Scrap Management for circular economy:

- ✓ Enhanced scrap sorting and tracking (composition, CO₂ footprint) for more reliable charge and alloy calculations
- ✓ Collaboration with customers to monitor and improve scrap quality
- ✓ Dedicated suppliers process and return scrap with tracked composition and properties
- ✓ Material characteristics shared via Material Genealogy



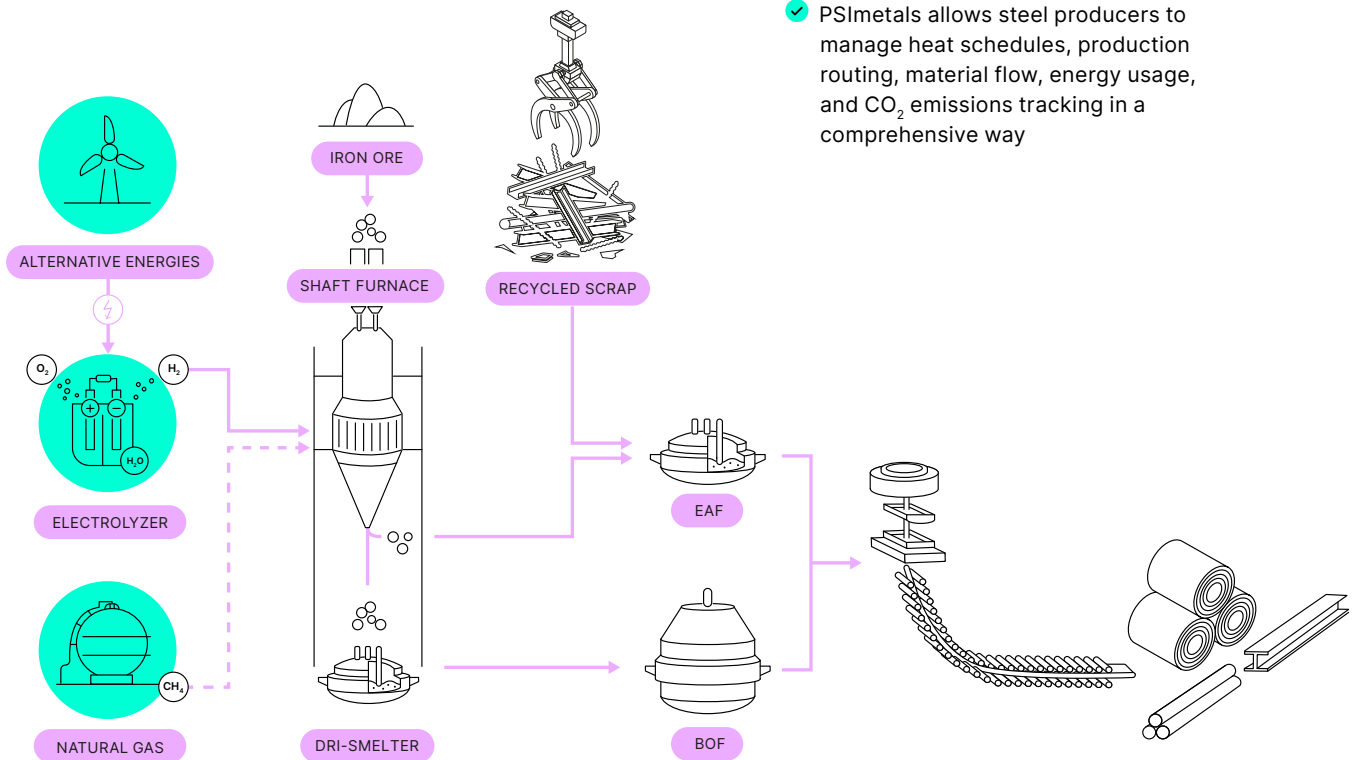
PSImetals supports holistic Scrap Management for circular economy.

It's time for a radical transformation

✓ The steel industry faces the historic task of decarbonizing production to net-zero by latest 2050

✓ To produce carbon neutral steel in the future, we need huge amounts of climate neutral DRI based on green hydrogen and renewable electricity

✓ PSImetals allows steel producers to manage heat schedules, production routing, material flow, energy usage, and CO₂ emissions tracking in a comprehensive way



Decarbonization - facts and challenges of today & tomorrow:

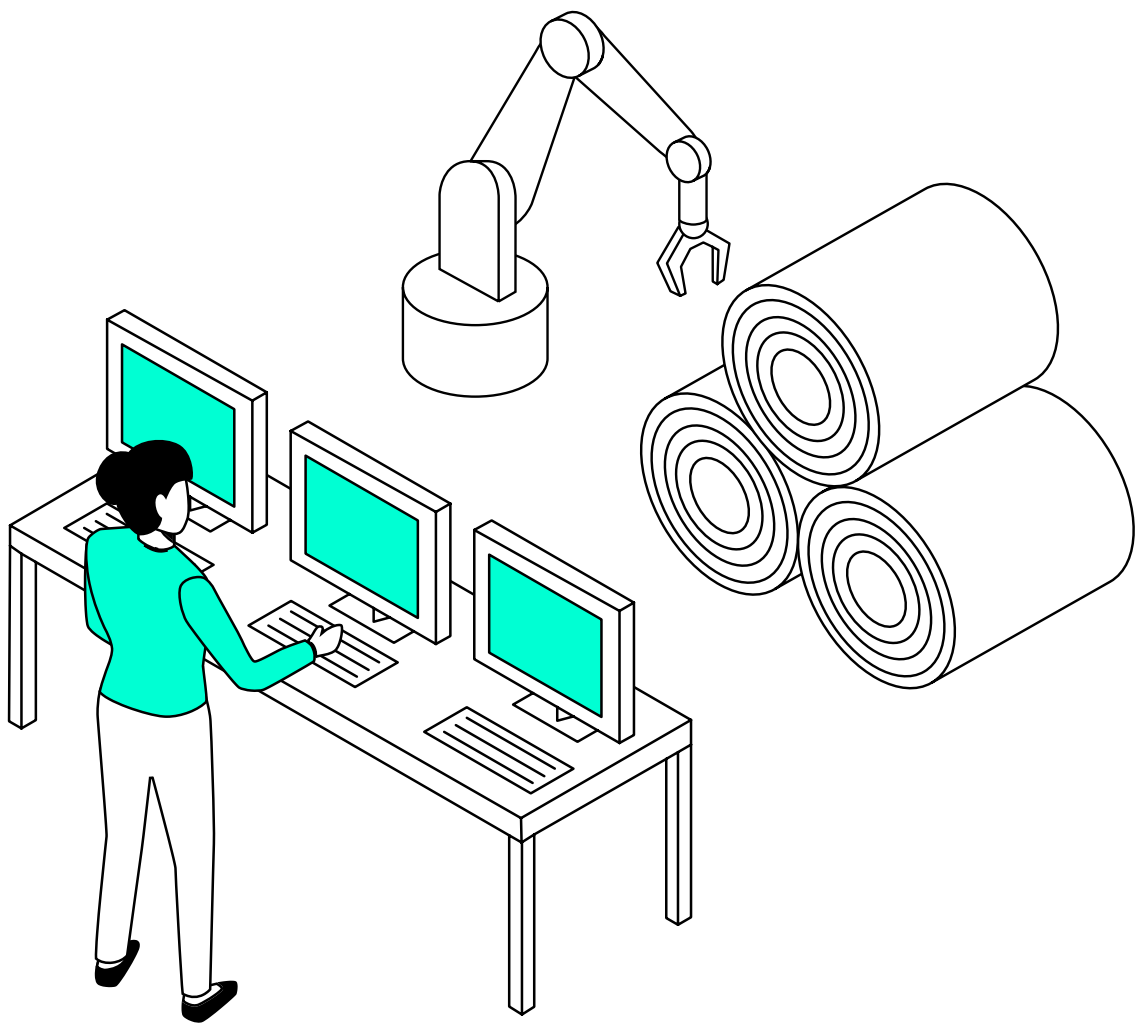
- ✓ "The future is electric" and we have to deal with high and fluctuating energy prices as well as availability of green energy.
- ✓ More than ever, energy availability and price impacts on production have to be managed.
- ✓ Customers and government regulations are increasingly demanding CO₂-reduced products.
- ✓ Classical BF/BOF steelmaking will be replaced by processes using green hydrogen and DRI, smelters and EAF.
- ✓ Enormous demand for green hydrogen and renewable electric energy will drive the transformation.
- ✓ Hybrid steel plants combining classical and new production routes will be inevitable.

Production management solutions today for generations to come

Our goal is to drive decarbonization — with our production management solutions, you can:

- ✓ Integrate renewable energy into your existing system
- ✓ Support decarbonization of industrial processes
- ✓ Contribute to the reduction of emissions in transport and logistics within your plant

Step on your decarbonization journey with PSImetals



PSI Software
Process Industries & Metals

Dircksenstraße 42-44
10178 Berlin (Mitte)
Germany

T +49 30 2801-0
M process-industries@psi.de
W www.psi.de

Other Offices:

Düsseldorf, Aachen (Germany)
Brussels (Belgium)
Graz, Traun (Austria)
Kolkata, Pune (India)
Pittsburgh (USA)
Poznan (Poland)
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