



# METSTA Standardibrunssi Future **Steelmaking**





www.eurofer.eu

## Crude steel production per region: World

All qualities • in '000,000 metric tonnes

### REGIONS IN DESCENDING ORDER OF CRUDE STEEL PRODUCTION

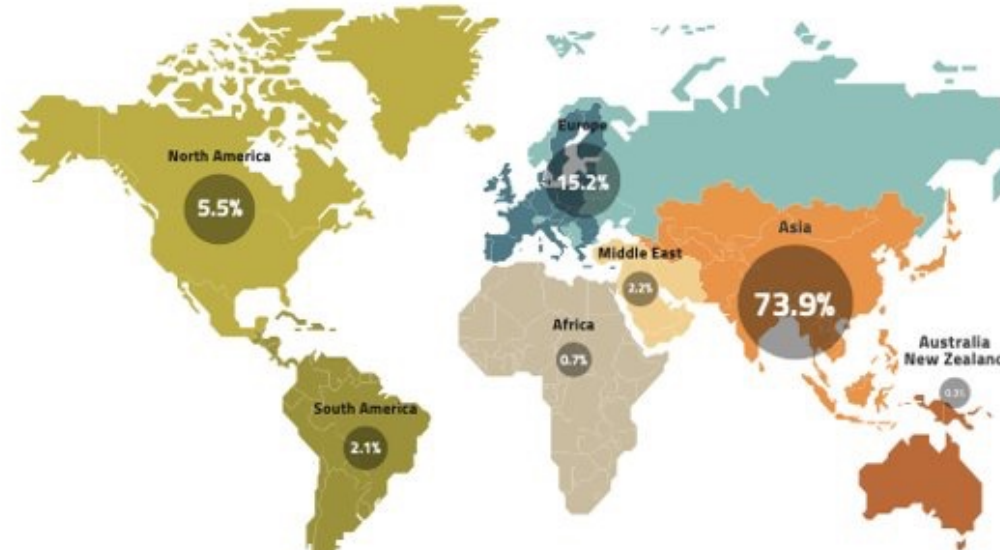
TABLE • 2020  
SOURCE: EUROFER

		% shares
	2020	2020
<b>Asia</b>	<b>1,351.3</b>	<b>73.9%</b>
▶ of which China	1,054.7	57.7%
▶ of which India	100.3	5.5%
▶ of which Japan	83.2	4.6%
<b>Europe</b>	<b>278.1</b>	<b>15.2%</b>
▶ of which European Union	139.3	7.6%
▶ of which CIS	100	5.5%
<b>North America</b>	<b>101</b>	<b>5.5%</b>
of which United States	72.7	4.0%
<b>South America</b>	<b>38.2</b>	<b>2.1%</b>
<b>Middle East</b>	<b>40.7</b>	<b>2.2%</b>
<b>Africa</b>	<b>12.6</b>	<b>0.7%</b>
<b>Australia/New Zealand</b>	<b>6.1</b>	<b>0.3%</b>
<b>WORLD</b>	<b>1,828.2</b>	<b>100%</b>

### MAP OF STEEL PRODUCTION BY REGION

MAP • 2020

SOURCE: EUROFER



Steel is part of green transition

1 000 kg steel



~ 2 000 kg CO<sub>2</sub>

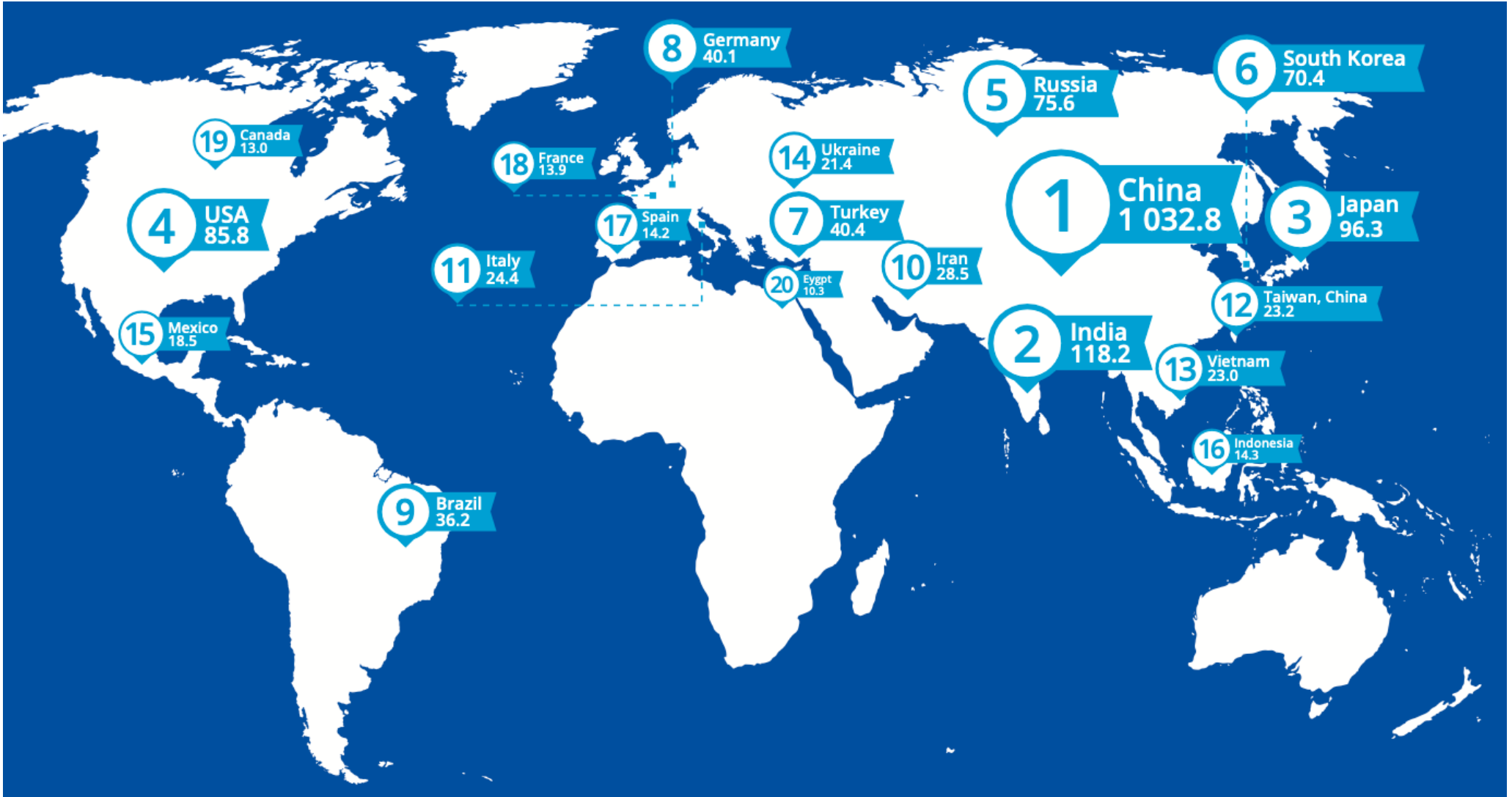
Steel production equals CO<sub>2</sub>  
7-8% total CO<sub>2</sub> emissions

This means:

- 200 kg / person (and growing equal to total Finnish production, annually)
- in western countries: 300 kg / person (stabilized),
- in Finland 800 kg / person (one of the world's steel countries)



# Top 20 steel-producing countries 2021 (million tonnes)







# Quo Vadis Steel





# Steel markets and grades

- There is about 70 000 commercial steel grades
- New generations of steel continue to be developed that make it possible for manufacturers and builders to implement durable, lightweight designs.
- Going forward, steels will be ever stronger and meet higher environmental standards will be needed.



## Automotive:

- On average, 900 kg of steel is used per vehicle.
- Focus on AHSS and green thinking

## Building and Infrastructure

- More than 50% of world steel demand.
- More or less standard steels

## Steel and energy

- Steel is and will be critical for supplying the world with energy, whether based on fossil fuels, nuclear technology, or renewable sources like wind, solar or geothermal
- Steels in hydrogen society are ?
- More or less standard steels but will change (e.g. H<sub>2</sub>)

## Steel in transport

- Steel provides strong, safe and sustainable transport solutions
- Focus on UHSS/AHSS and green thinking

## Steel in tools and machinery

- Special steels and limited markets

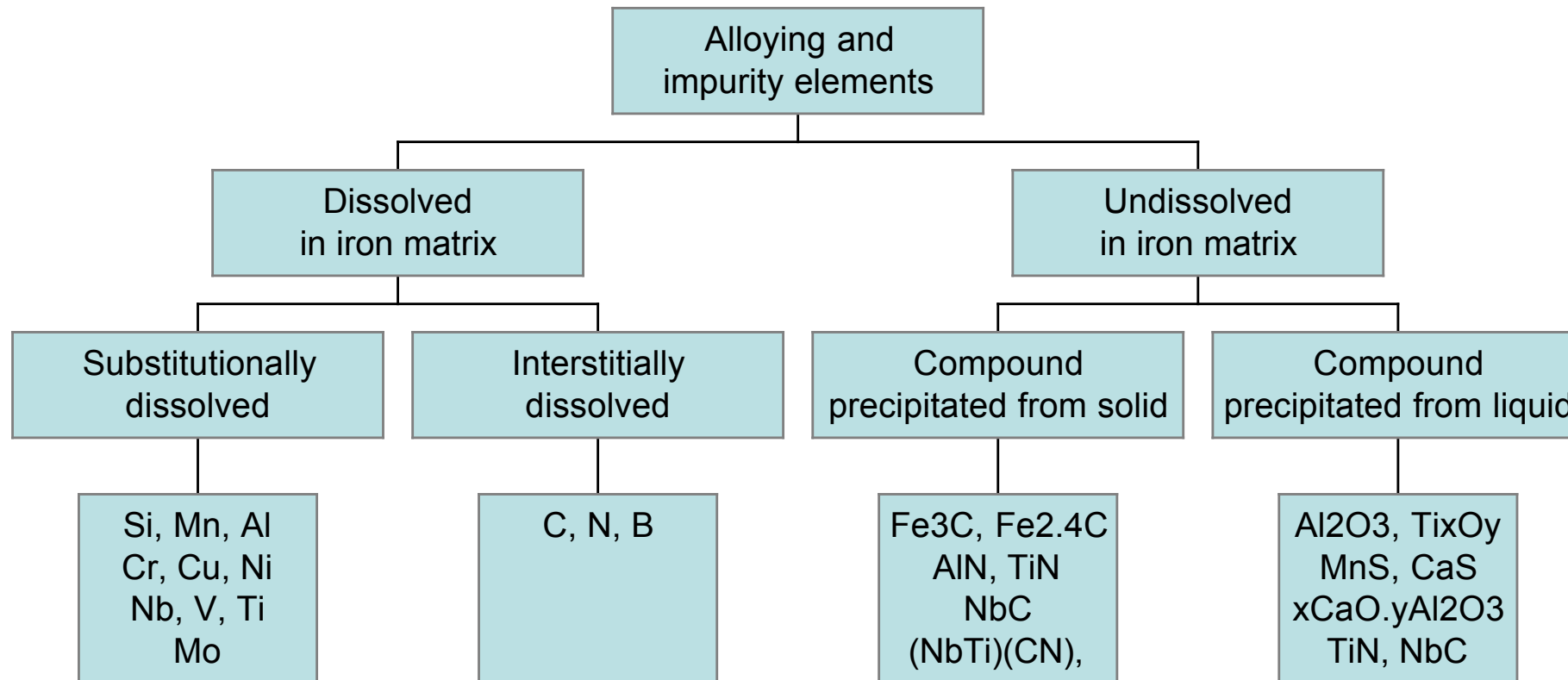
## Others

- Lot of everything



# Steel alloying

- typically, steel contains about 20-25 necessary alloying elements
- carbon and low alloying steel consist 95-99.8 % iron
- alloying + steelmaking = 100-2000 MPa strength variations



# Global challenge to reduce emissions

## Emission sources

- Steel production accounts for 7–8% of global CO<sub>2</sub> emissions.
- The main source of CO<sub>2</sub> emissions is the use of carbon-based reductants.
- Also the use of fossil fuels (e.g. natural gas) causes significant CO<sub>2</sub> emissions.
- Rule of thumb for iron ore-based steelmaking  
1 ton of steel ≈ 2 tons of CO<sub>2</sub>
  
- **Hydrogen has been envisaged as a substitute for the carbon-containing reductants and fuels.**

## Challenge

Climate-neutral Finland by 2035

Climate-neutral EU by 2050

## Aims of SSAB, (Blastr & H2 Green Steel)

Fossil-free steel in the market < 2035

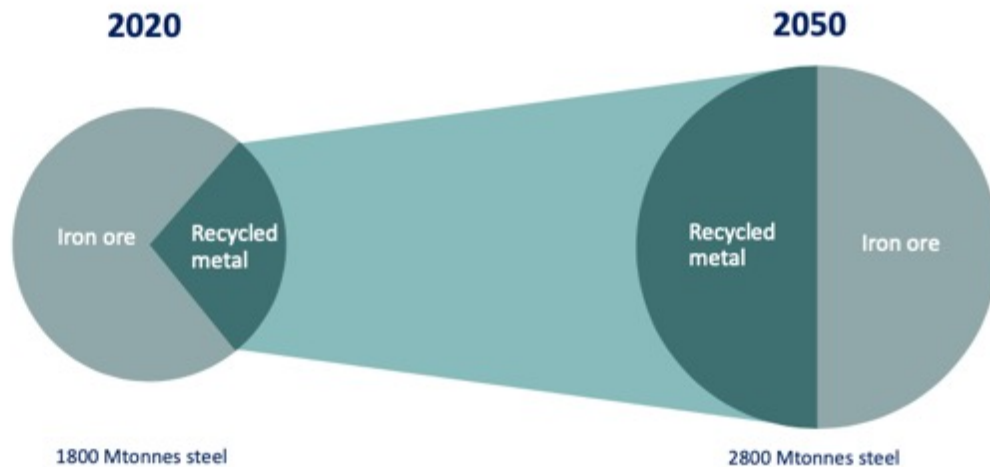
Fossil-free operation by 2045



# Global challenge to reduce emissions

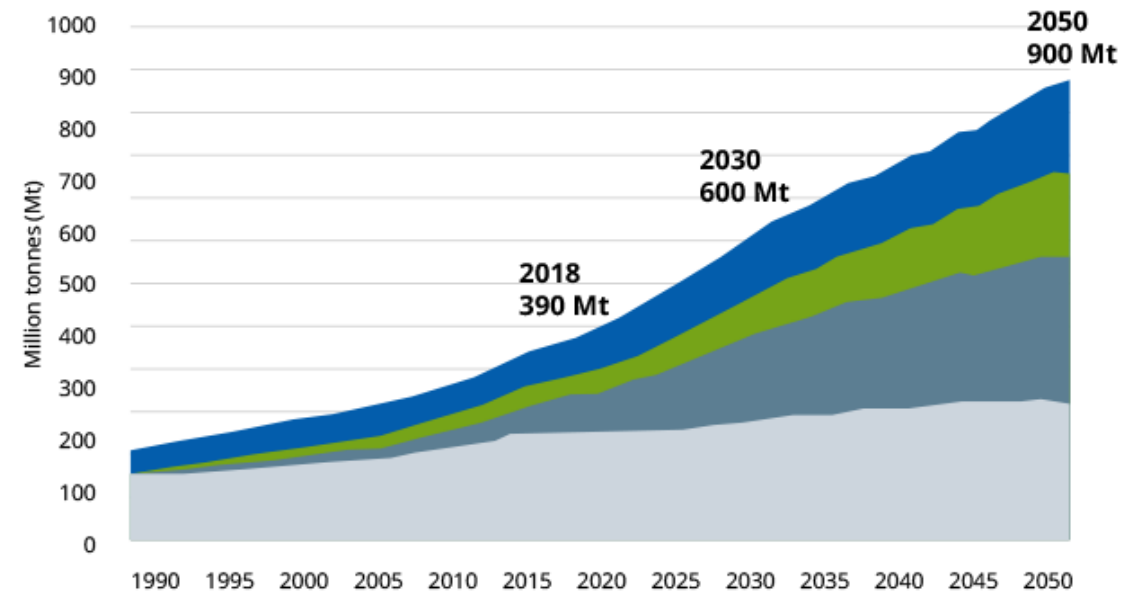
## Recycling will not be enough

– 50% iron ore-based steel will still be needed by 2050



## End-of-life scrap availability<sup>5</sup>

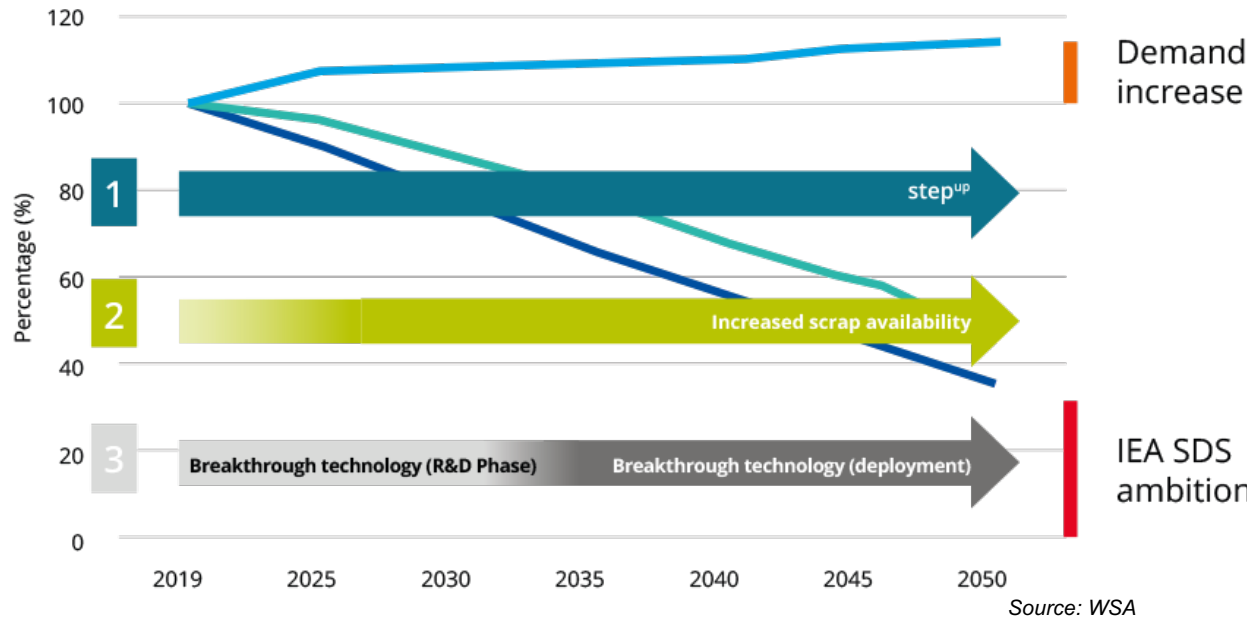
■ Rest of the world ■ Other Asia ■ China ■ EU + North America + Japan







# Steel production, total CO<sub>2</sub> emissions and CO<sub>2</sub> intensity, 2019 – 2050 under the International Energy Agency (IEA) Sustainable Development Scenario (SDS)



— Steel production  
— CO<sub>2</sub> emissions  
— CO<sub>2</sub> intensity

Based on data provided in the IEA's Iron and Steel Technology Roadmap, October 2020

	Technology readiness	Years until plateau of productivity	Development costs <sup>1</sup>	CAPEX requirements <sup>2</sup>	Operating costs <sup>3</sup>	Public acceptance	Possibility to transform brownfield plant
CCUS	Carbon capture, use and/or storage	5-10	High	High	High	Low	High
	Carbon capture, use and/or storage with biomass	5-10	High	High	High	Low	High
Alternative reductant agent	H <sub>2</sub> -based direct reduced iron – Shaft furnace	0-3	High	High	High	High	High
	H <sub>2</sub> -based direct reduced iron – Fluidized bed	5-15	High	High	High	High	High
	Suspension ironmaking technology	17-22	High	High	High	High	High
	Plasma direct steel production	20-25	High	High	High	High	High
	Electrolytic processes	20-30	High	High	High	High	High

<sup>1</sup> Compared to the other presented carbon neutral technologies <sup>2</sup> Compared to CAPEX of BF-BOF greenfield plant in 2040-2050 <sup>3</sup> Compared to BF-BOF plant in 2040-2050 (incl. carbon tax)

● High ○ Low  
Source: Roland Berger



: [ArcelorMittal Northern Lights](#) | [BAO-CCU](#) | [Aço Verde do Brasil](#) | [Carbon 2 Chem](#) | [Emirates CCS](#) | [Hisarna](#) | [Steelanol](#)

: [COURSE50](#) | [HBIS & Tenova](#) | [HYBRIT](#) | [Novel flash oxide smelting](#) | [Salcos](#) | [SuSteel](#)

: [Boston Metals](#) | [Siderwin](#)

: [GrinHy](#) | [H2FUTURE](#)



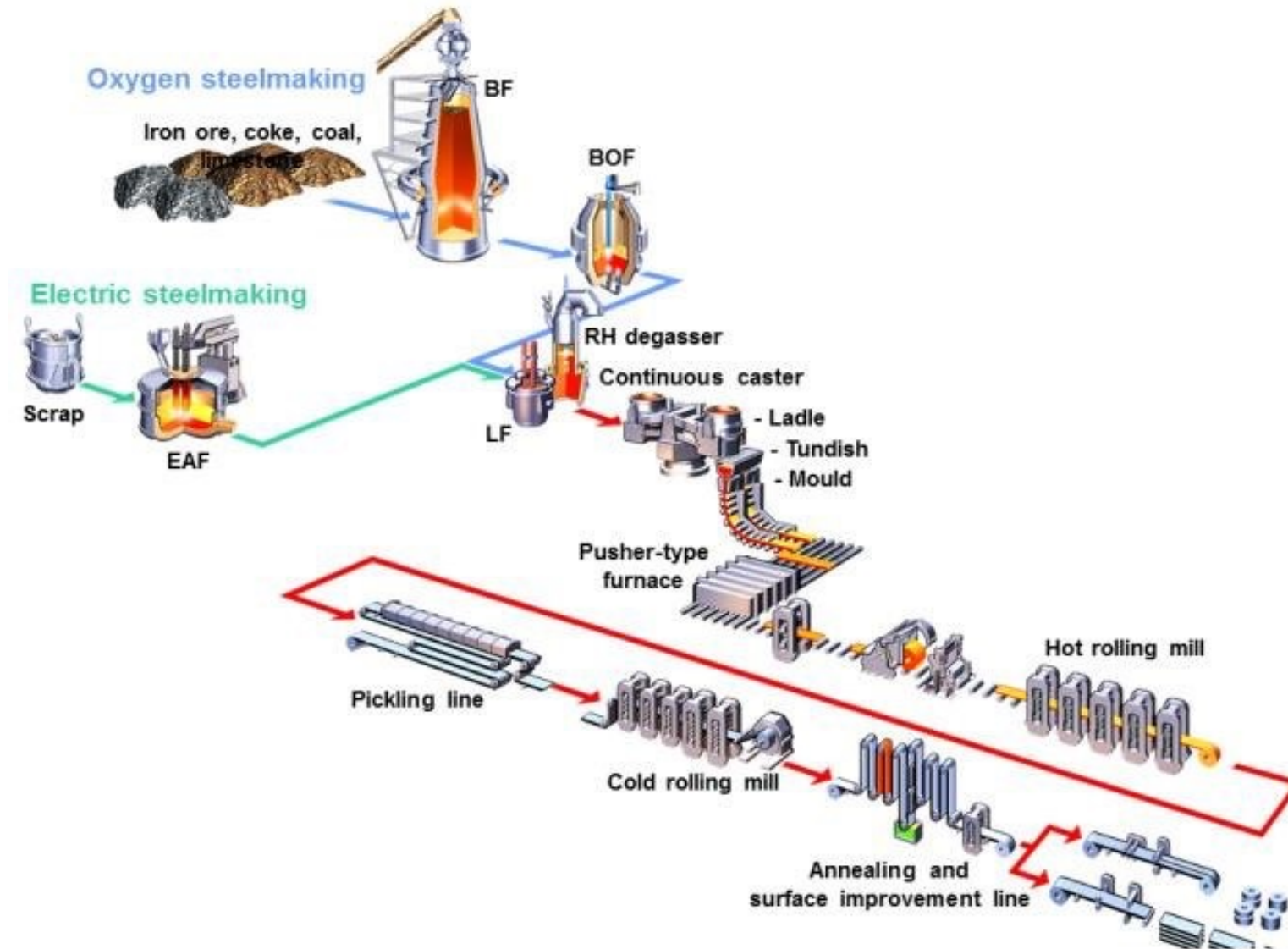


# Future Steelmaking – Some Aspects





# The most typical steel production routes today

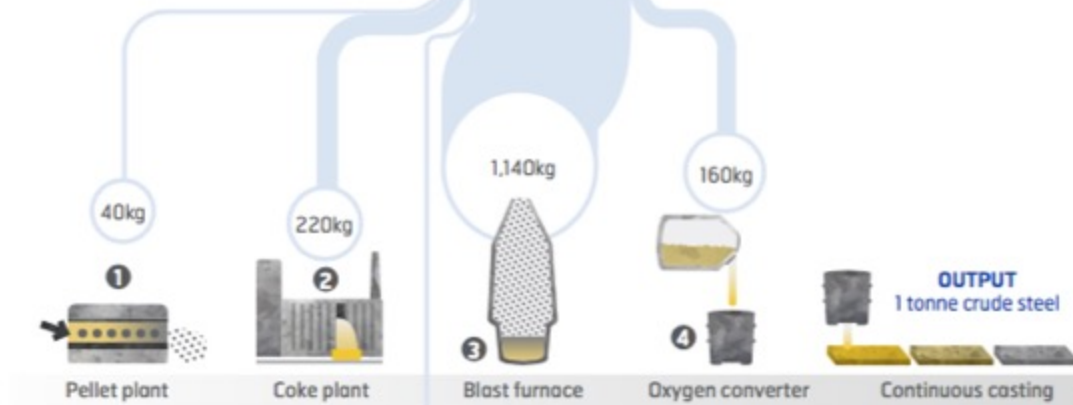




## SWEDISH REFERENCE

FOSSIL EMISSIONS

CO<sub>2</sub> 1,600kg



ENERGY CARRIERS

OIL 81kWh

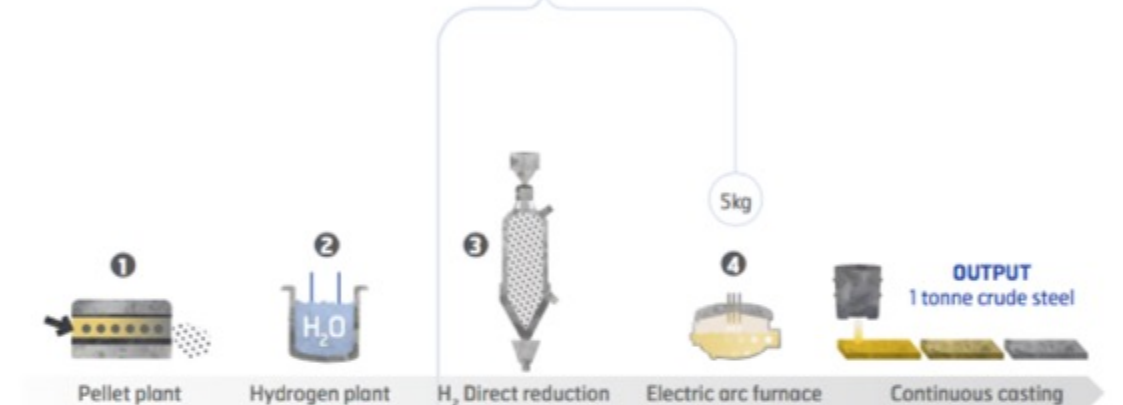
COAL 5,150kWh

ELECTRICITY 235kWh

## HYBRIT

FOSSIL EMISSIONS

CO<sub>2</sub> 25kg



ENERGY CARRIERS

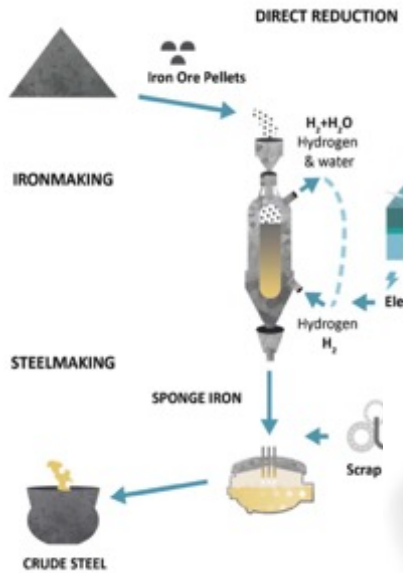
BIO 560kWh

COAL 42kWh

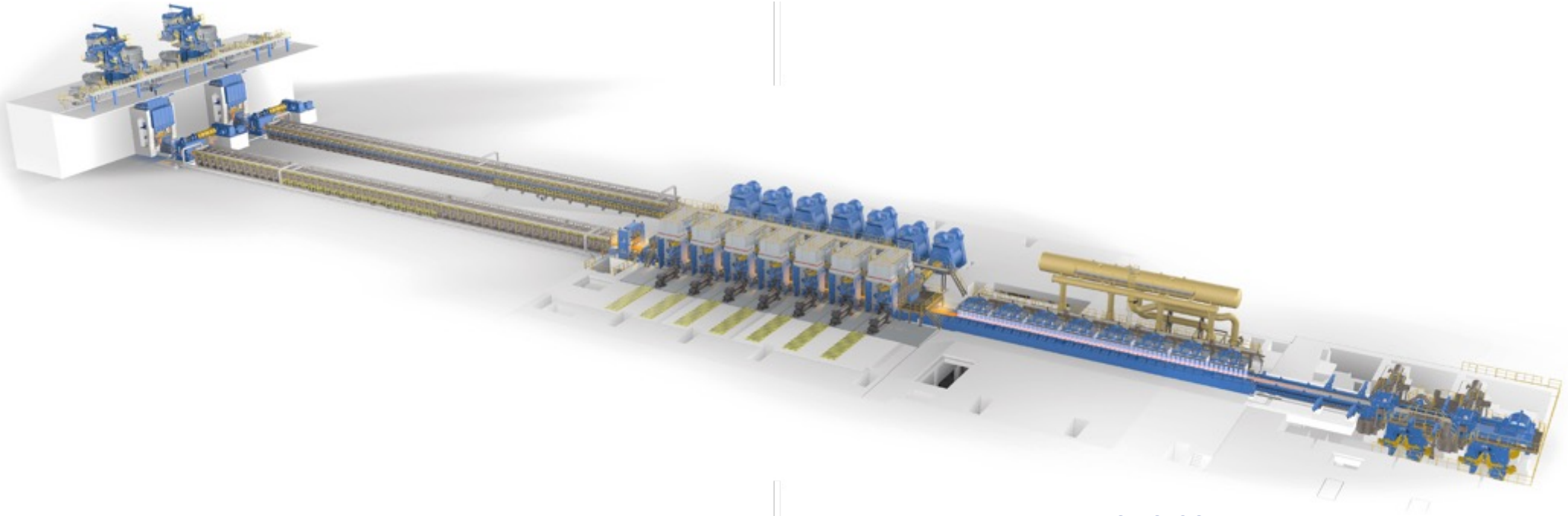
ELECTRICITY 3,488kWh



# Direct reduction and mini-mill type steelmaking routes

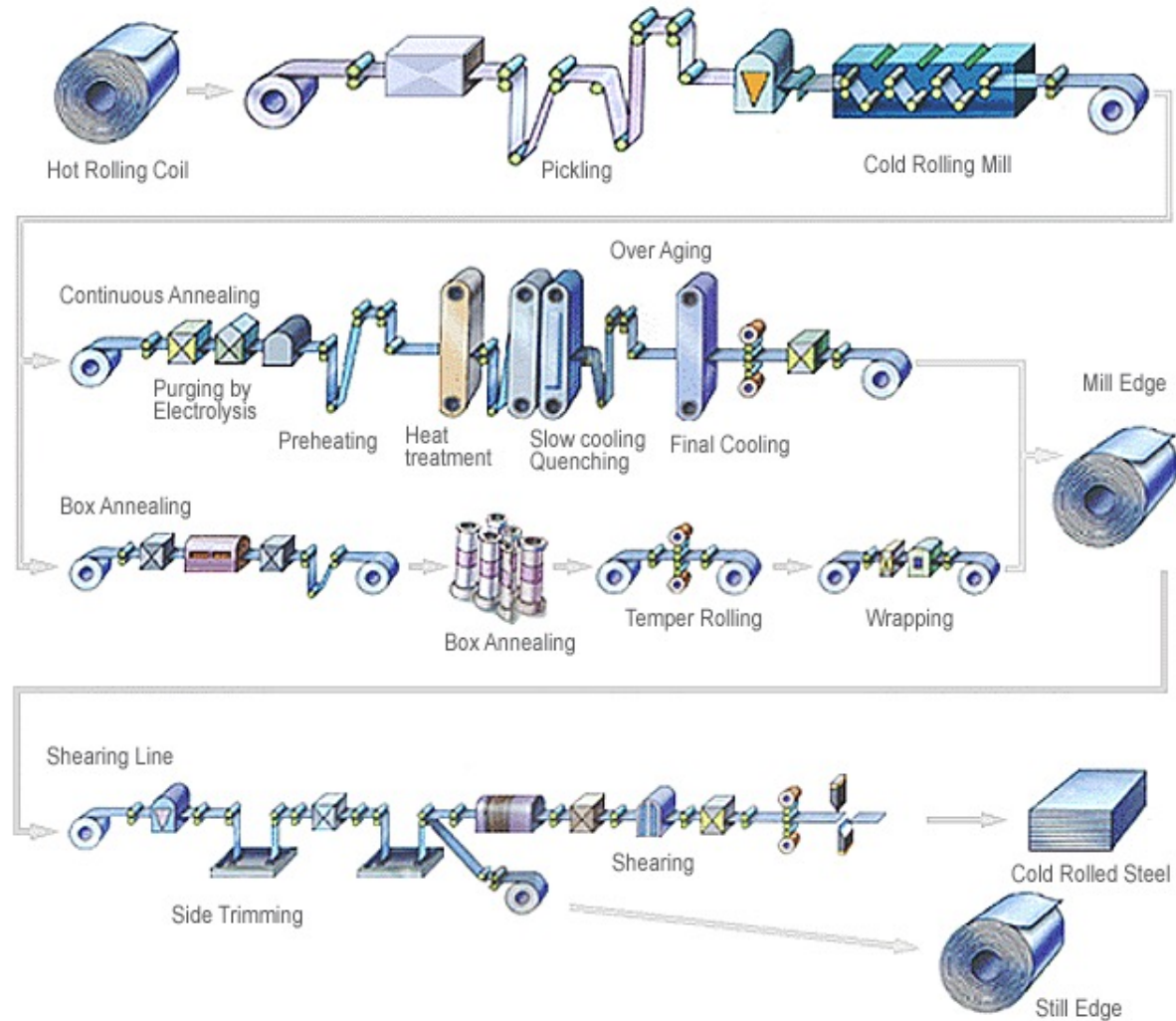
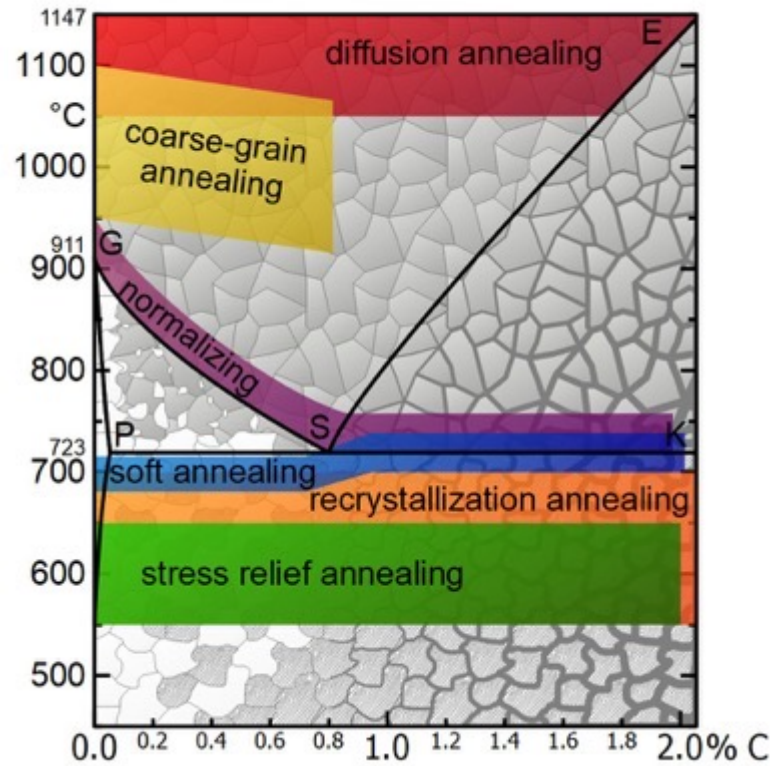


*different temperature history than the most used hot rolling mill concept and thus novel metallurgy is needed*





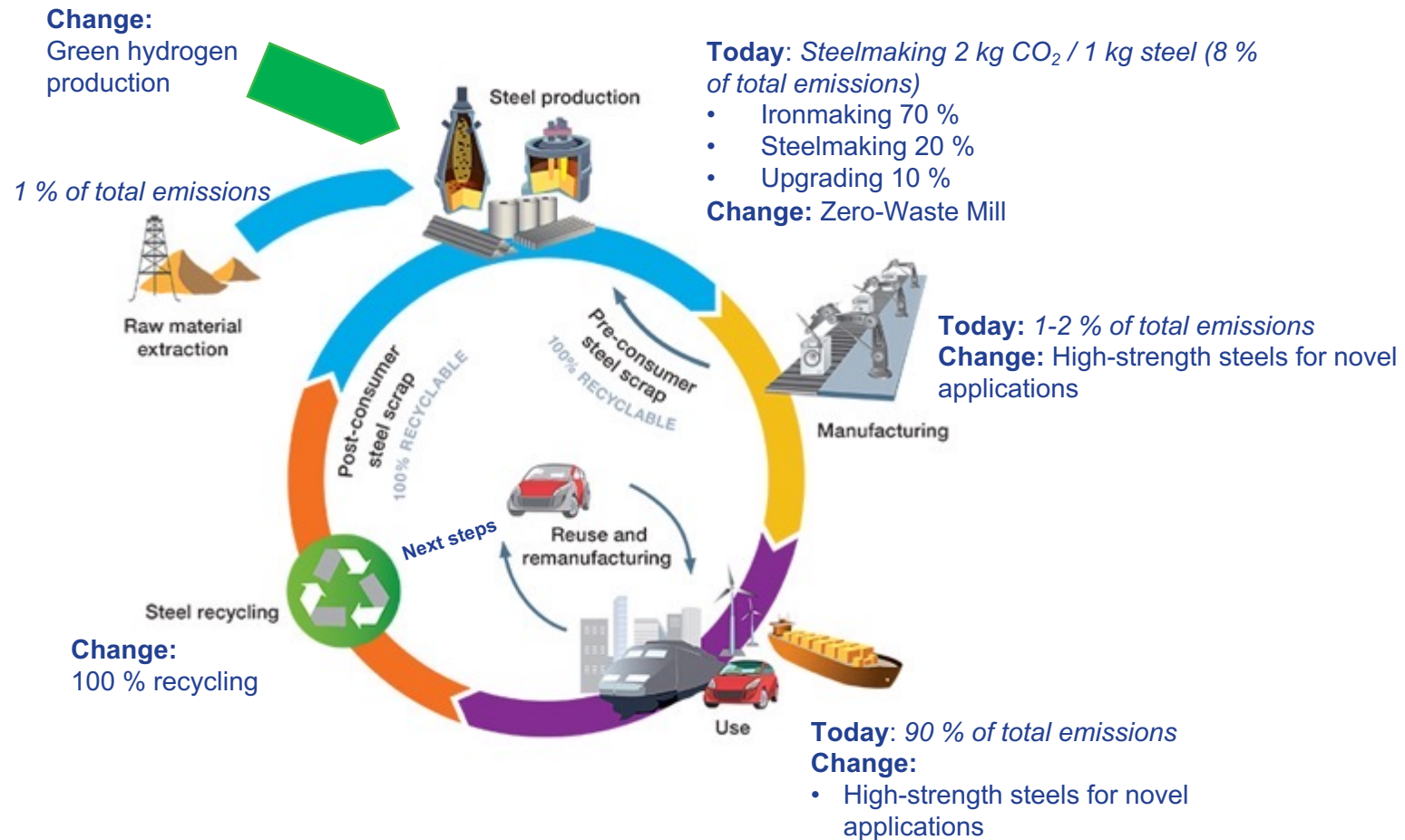
# Heat treatment and cold rolling





# Summary: Zero-Waste Mill and Sustainable Use of the Steels are the Future

Steels' life cycle – affects even 60% of world's GDP







Next big steps is green

**Thank you!**

