2024 AIST Leadership Conference

North American Steel Update

Ron Ashburn

Executive Director, AIST

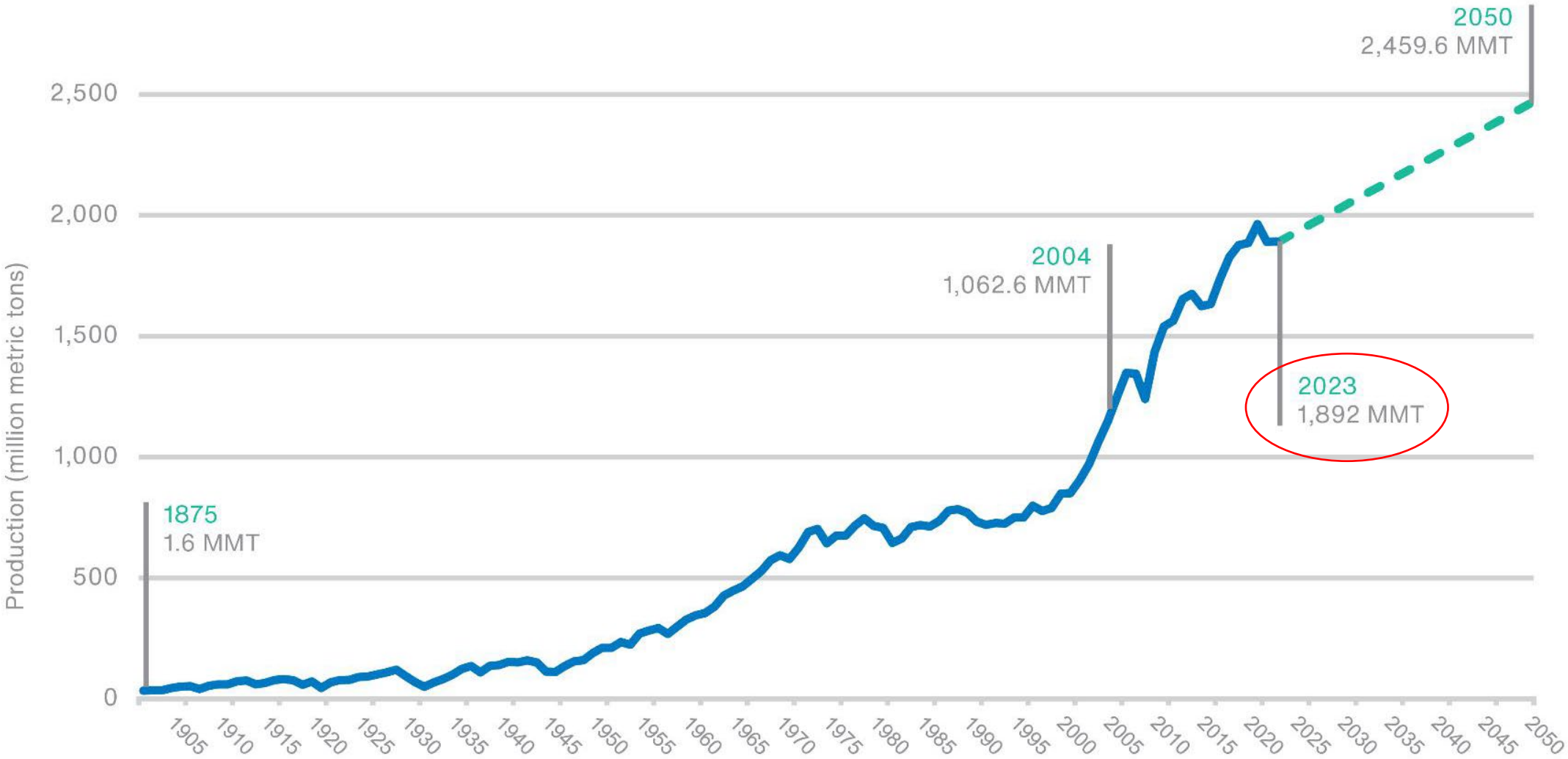
19 Nov 2024

NIST
National Institute of Standards and Technology

Multi-year effort: 2022 – 2024; published in **Q1 2025**

- Define **baseline** for U.S. steel sector relative to global technical processes
- Identify **technical pathways** and timeline to ensure long-term competitiveness
- Create **workforce initiatives** to foster innovation and recruitment

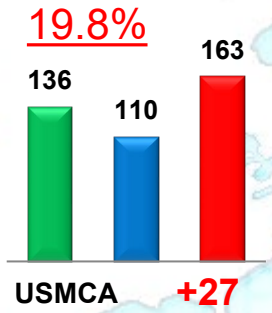
Global Steel: Production

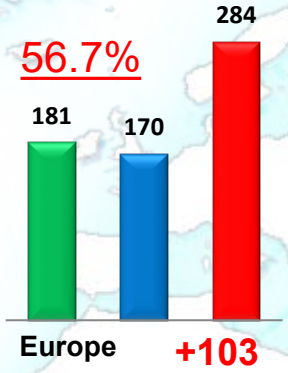


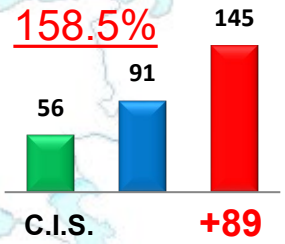
Source: Worldsteel Association, World Economic Forum

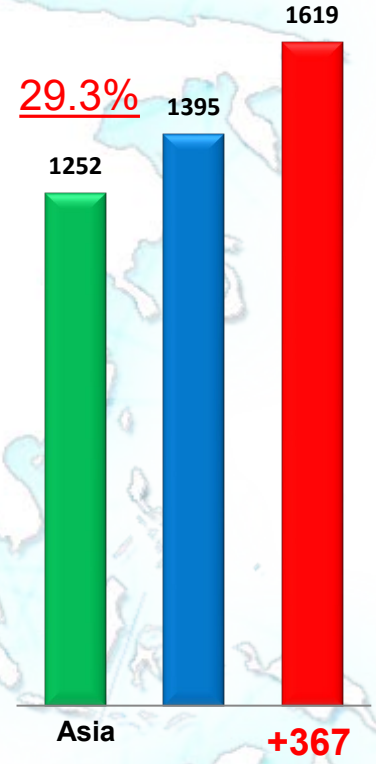
Global Steel: 2023

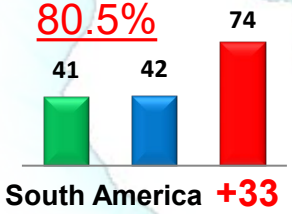
Demand / Production / Capacity

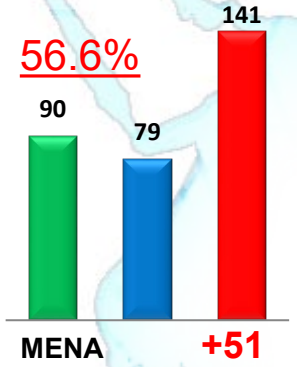


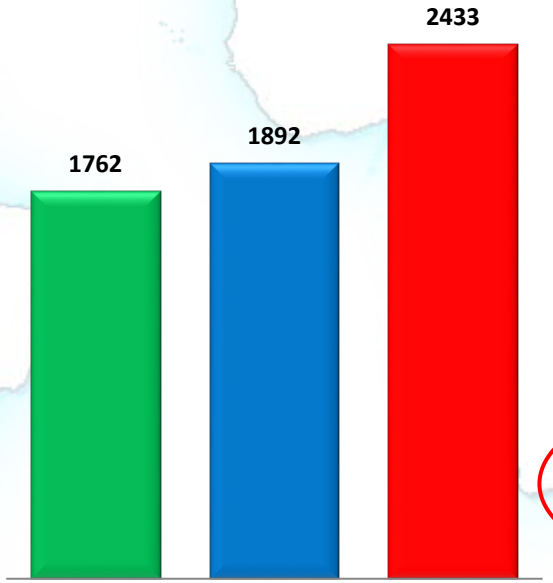












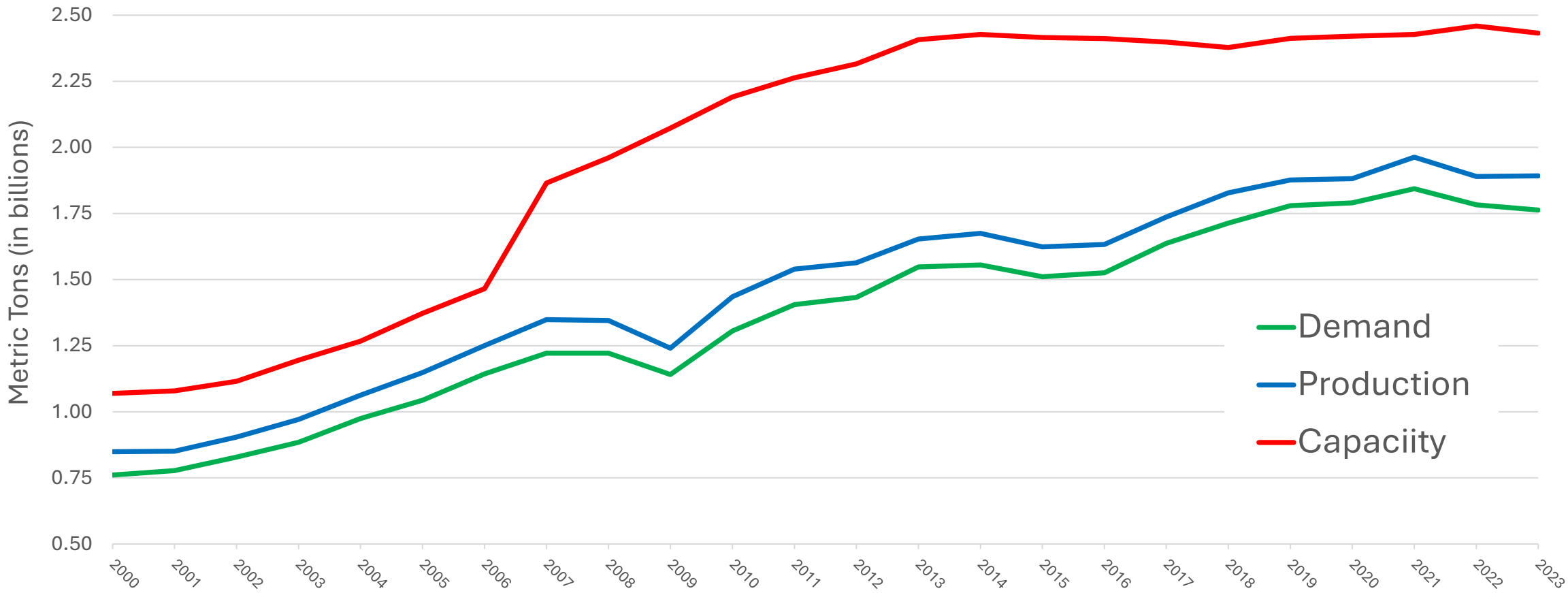
38.0%
+670

Steel Demand
Steel Production
Steel Capacity

Million Metric Tons
Not Scaled Between Regions

Sources: World Steel, OECD, AIST

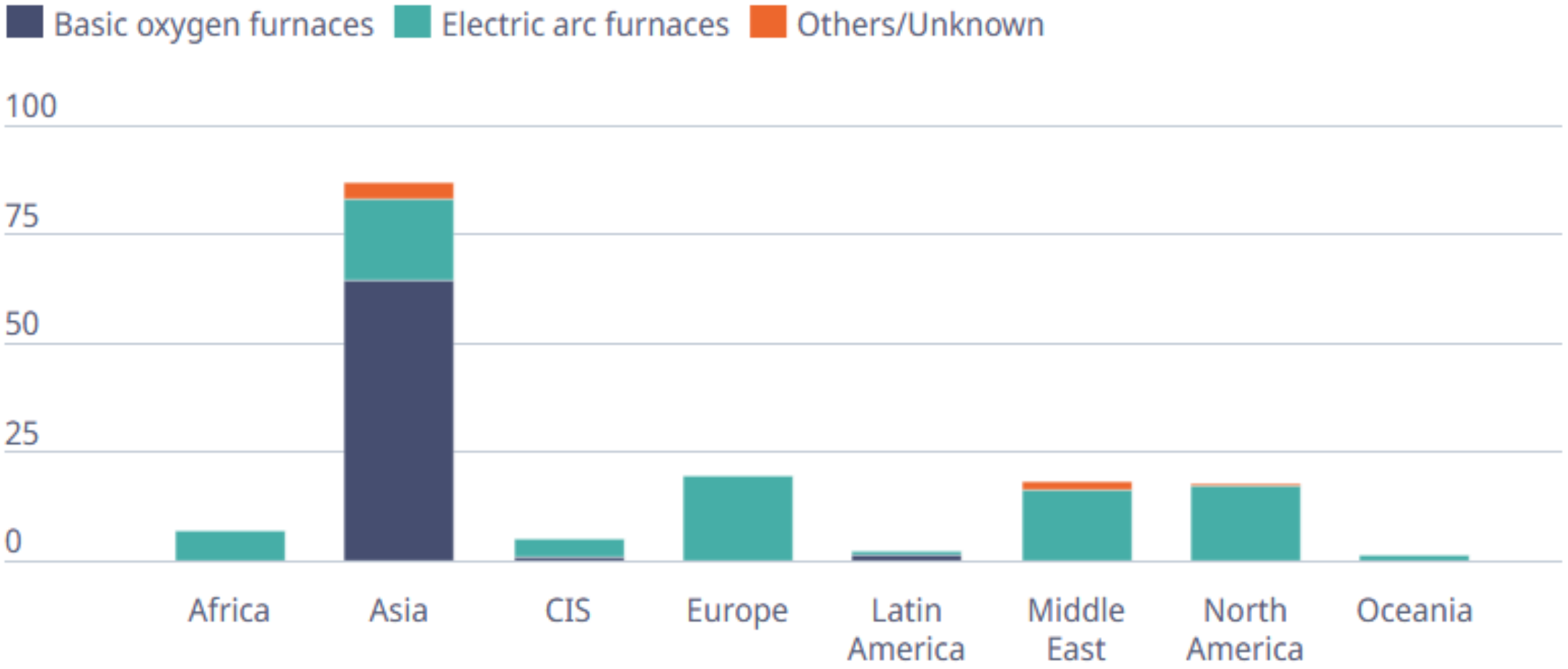
Global Steel: Demand, Production & Capacity



Source: OECD, World Steel Association

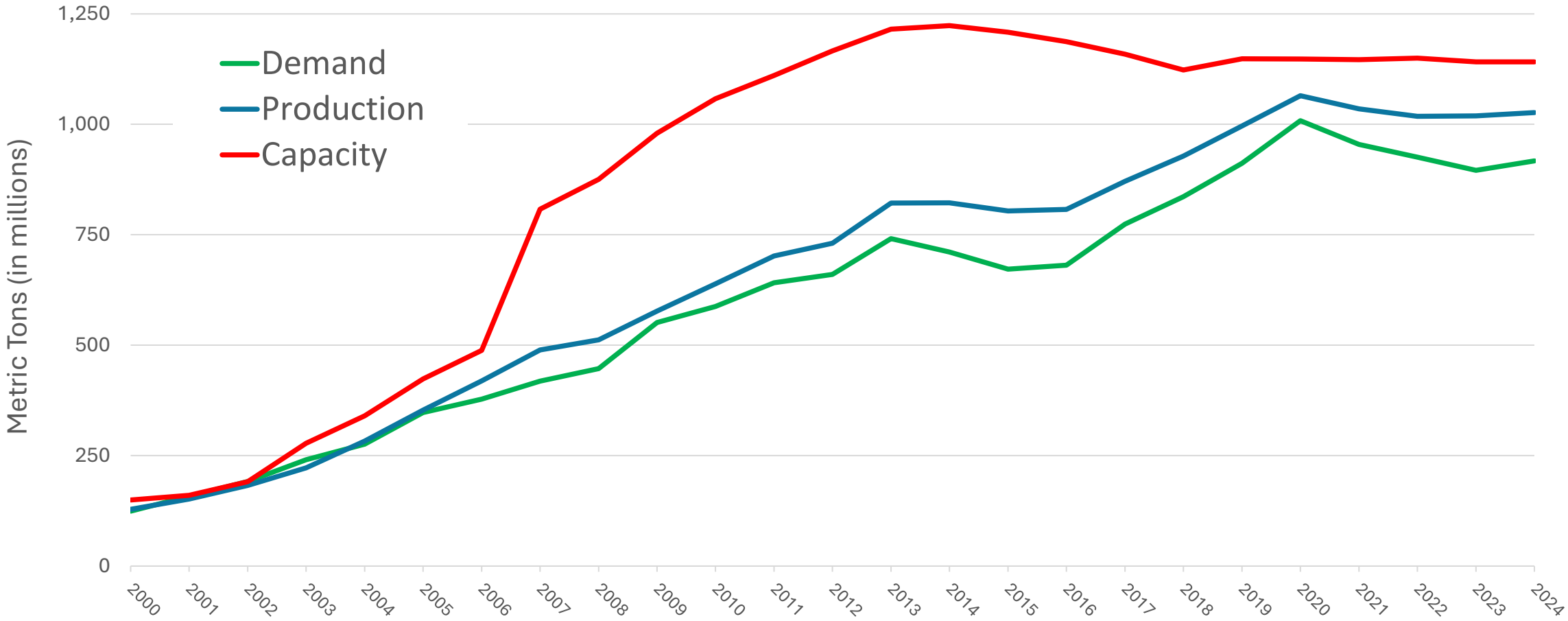
Global Steel: Projected Capacity Additions 2024-2026

Million Metric Tons



Source: OECD Steel Committee, Nov 2024

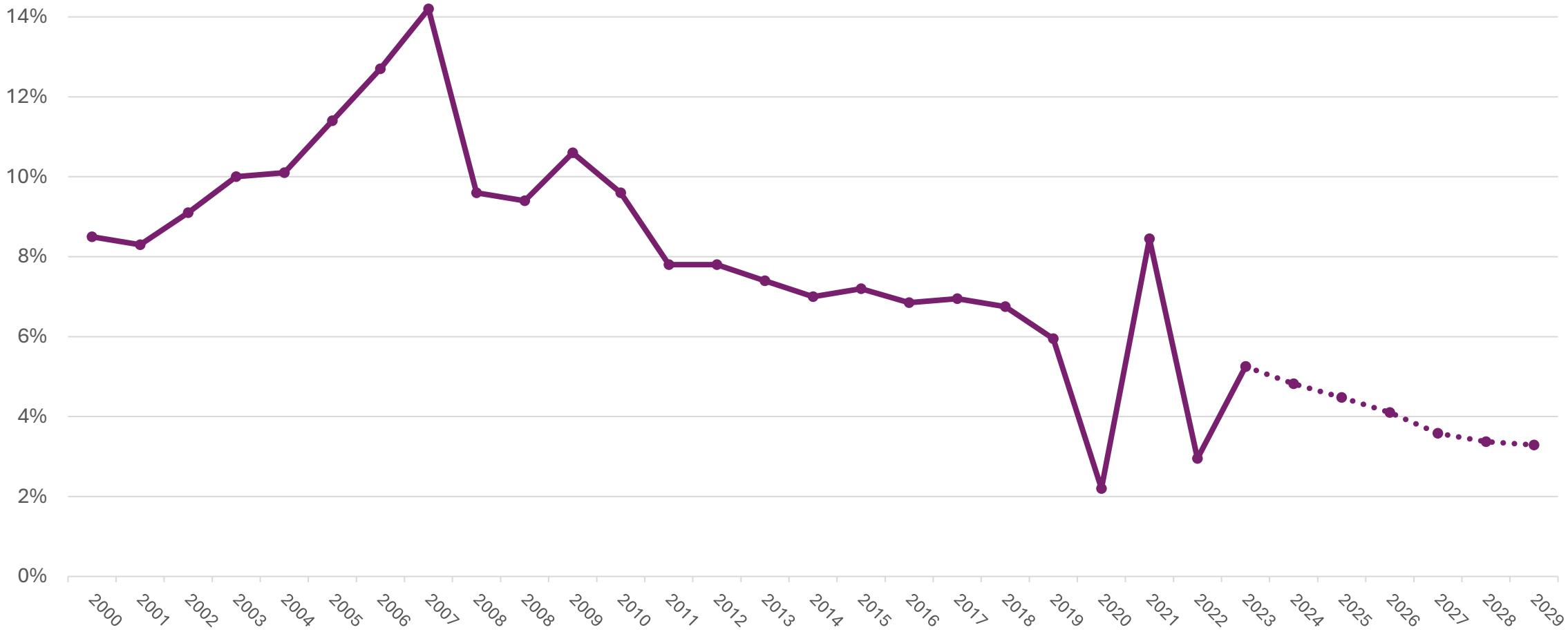
China Steel: Demand, Production & Capacity



Source: World Steel Association

China GDP Growth Rate

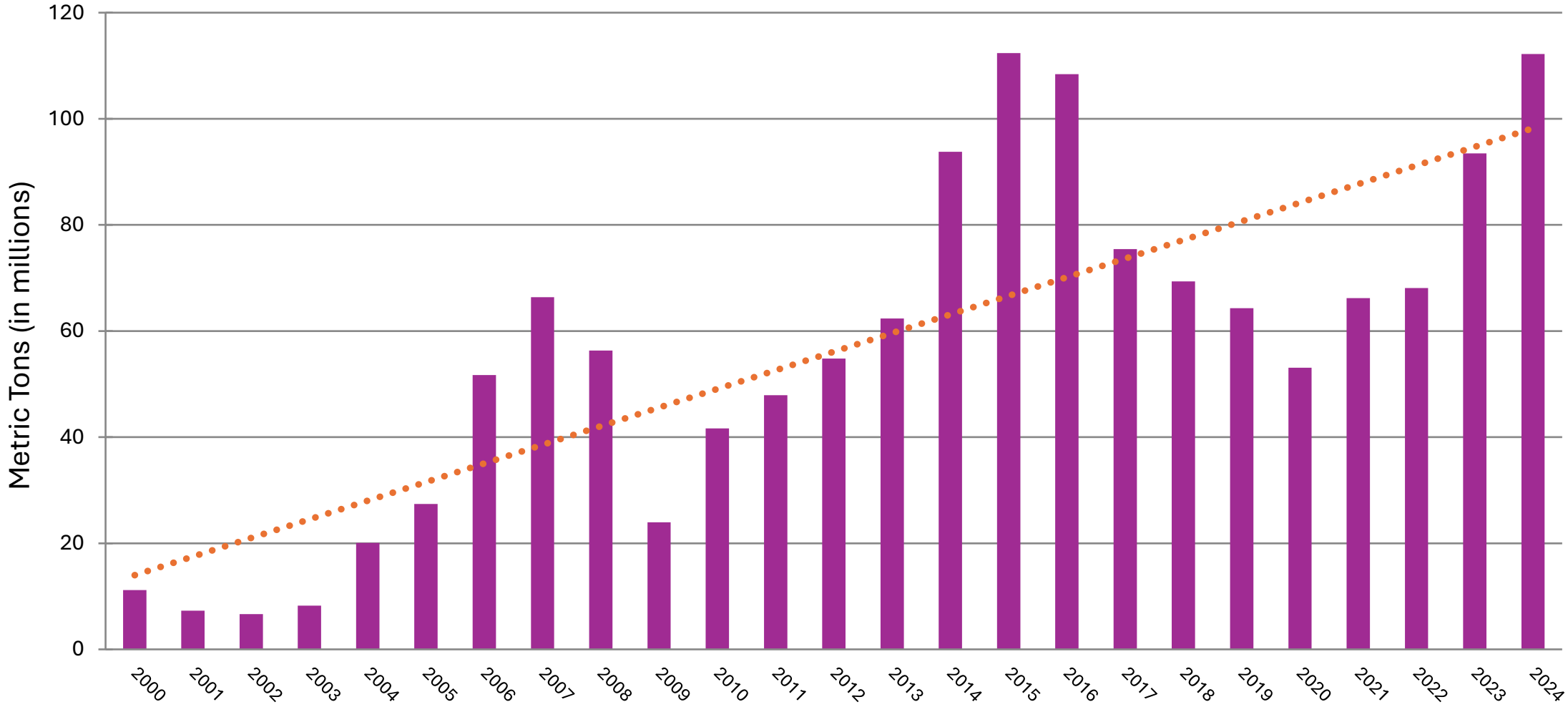
2000-2029(e)



Source: International Monetary Fund

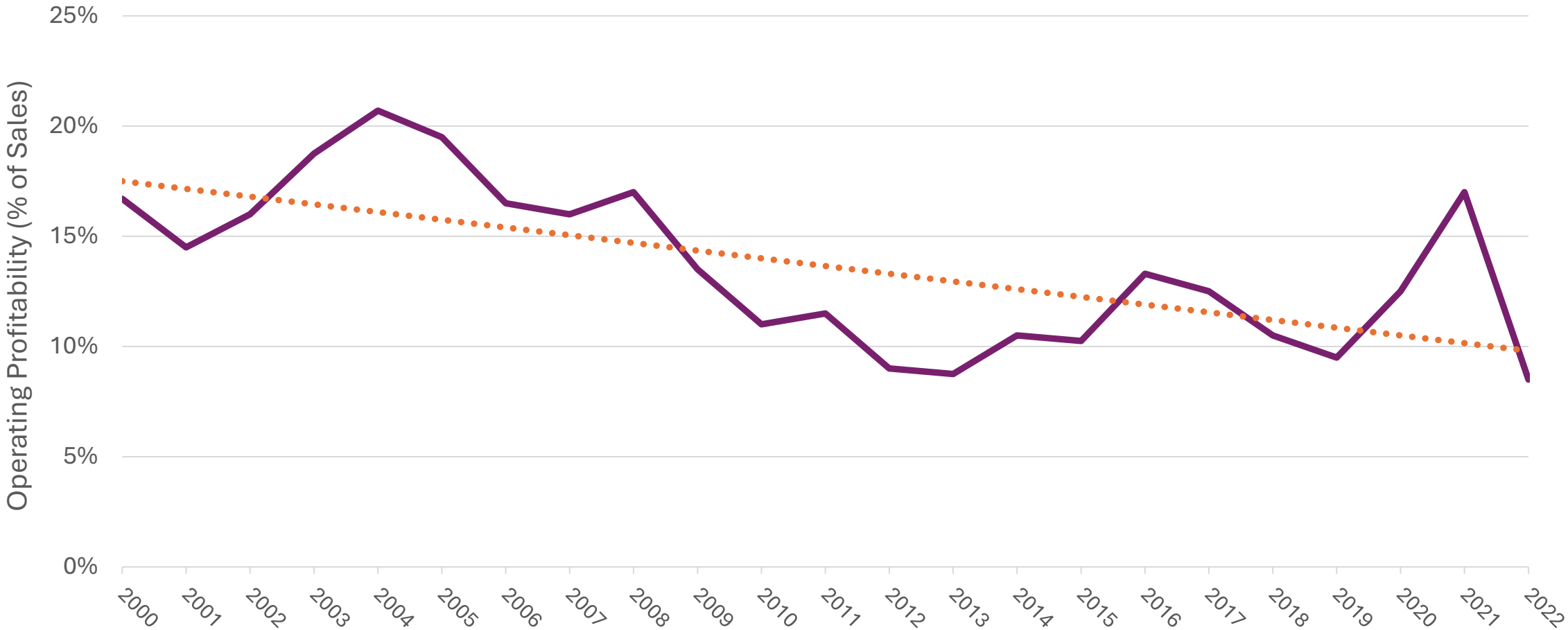
China Steel Exports

A Familiar Problem Re-Emerges



Source: World Steel Association

Global Steel: Average Operating Profitability



Source: OECD Steel Market Developments 2024

OECD Steel Committee

A Deteriorating Picture

- Previous **signals of crisis present** today: rising global excess capacity; falling steel prices; excessive volumes of unfairly traded steel and steel-intensive products.
- China's steel subsidies are more than five times higher than other non-OECD economies, and more than **10 times higher** than OECD countries.
- "The global steel demand outlook for 2025 might show moderate improvement on aggregate, but is surrounded by a number of **downside risks**…"

Source: OECD Steel Committee Ministerial Report, November 2024

Taking Measures

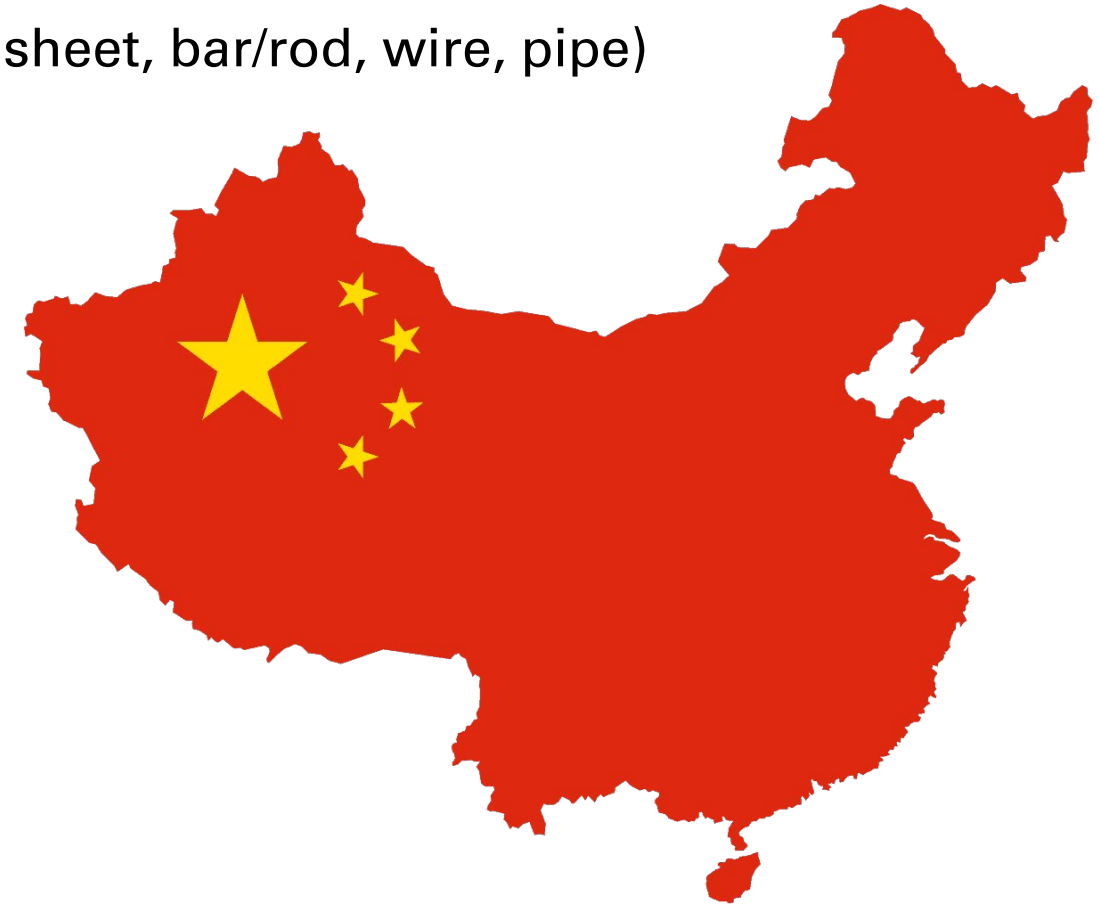
"We see a 'whac-a-mole' scenario: when one country starts to limit steel imports from China, **Chinese steel producers are likely to redirect them to another country** until that market, too, imposes new trade restrictions."

Chim Lee
Senior Analyst, Economist Intelligence Unit
24 October 2024

Taking Measures

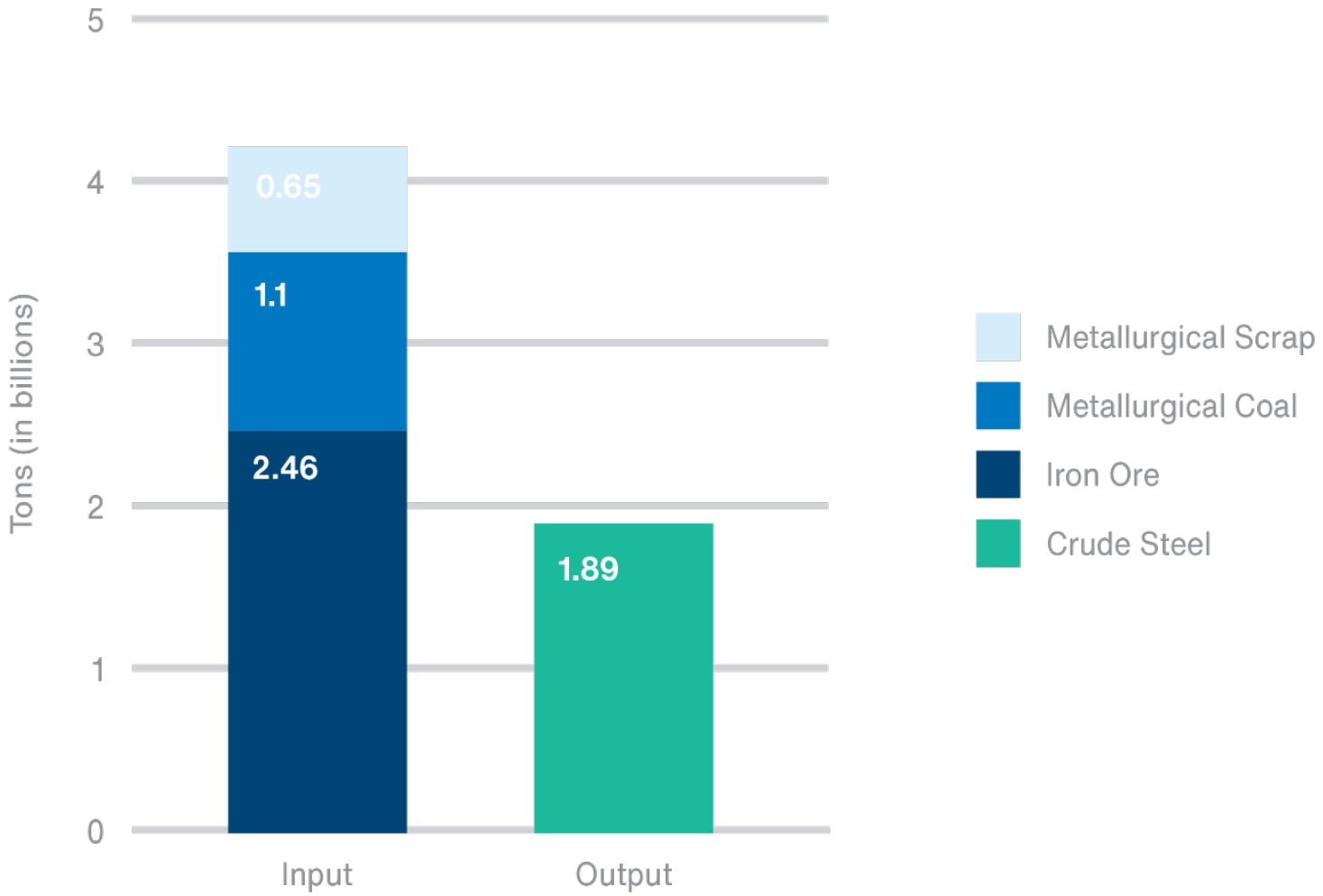
Recent Action on Chinese Imports: New Tariffs in 2024

- **Canada**: 25% on various shapes (ingot, plate, sheet, bar/rod, wire, pipe)
- **USA**: +17.5% on certain steel products
- **USA & Mexico**: 25% on trans-shipped steel
- **Brazil**: 25% on all steel products
- **Turkey**: 15% to 43% on HRC
- **India**: 12-30% on welded stainless pipe & tube
- **Thailand**: 31% on high-strength HRC



Global Input vs. Output

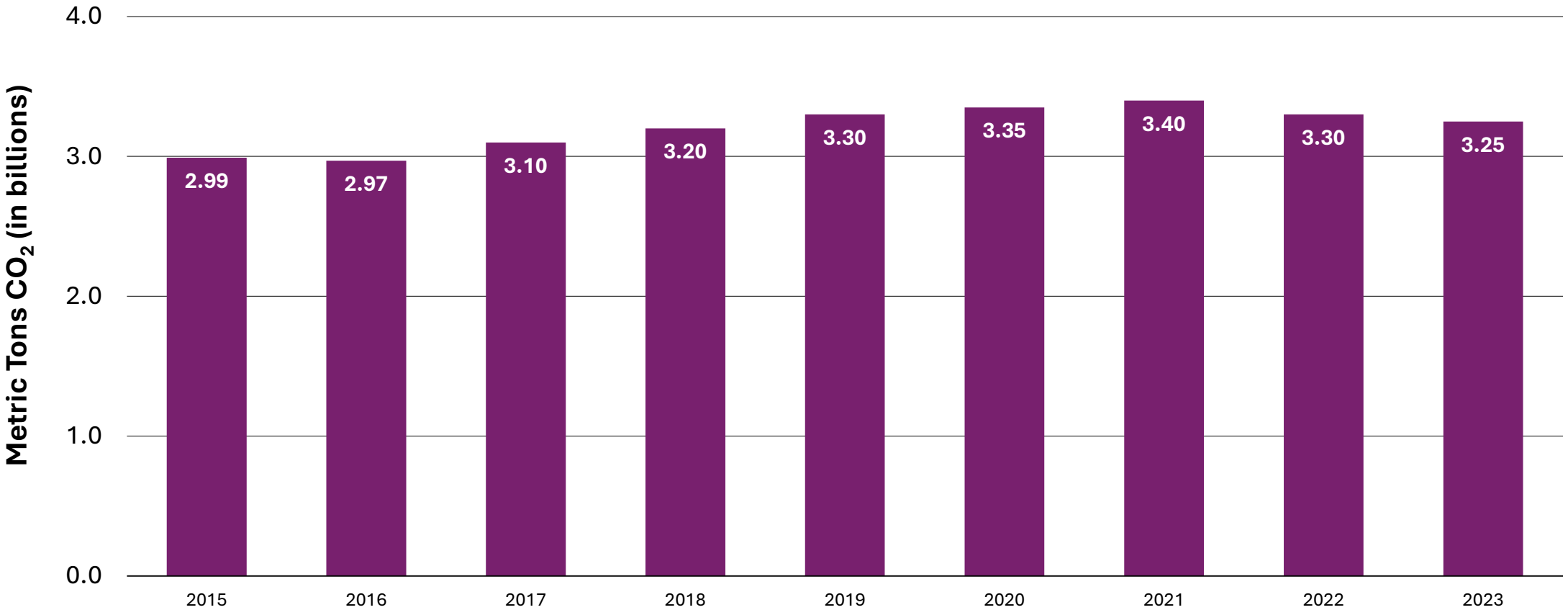
Crude Steel: 2023



Source: Worldsteel Association

Global Steel: Annual Emissions

Scope I & II

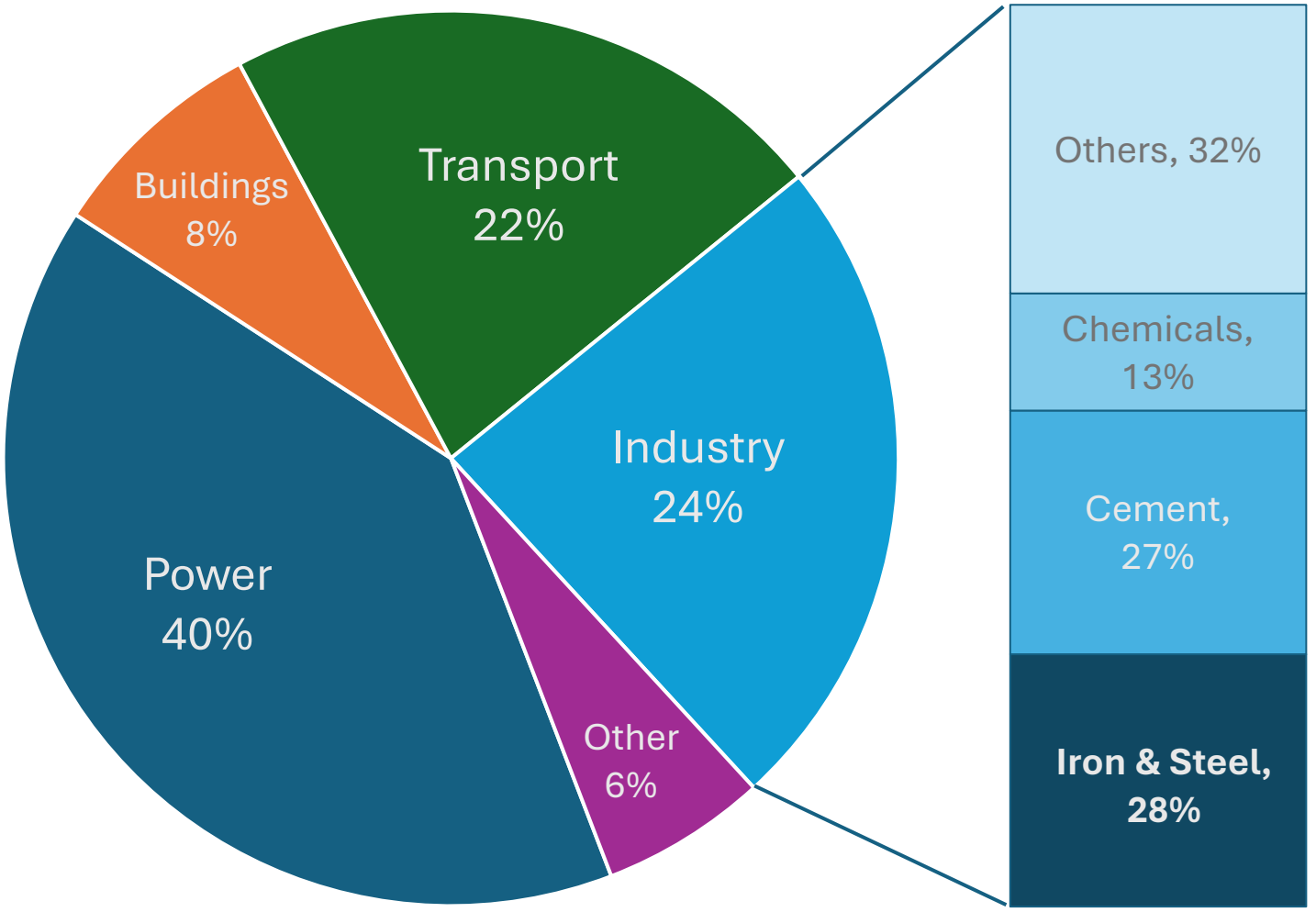


Source: ClimateTRACE

Global Challenge: Decarbonization

CO_2 Emissions

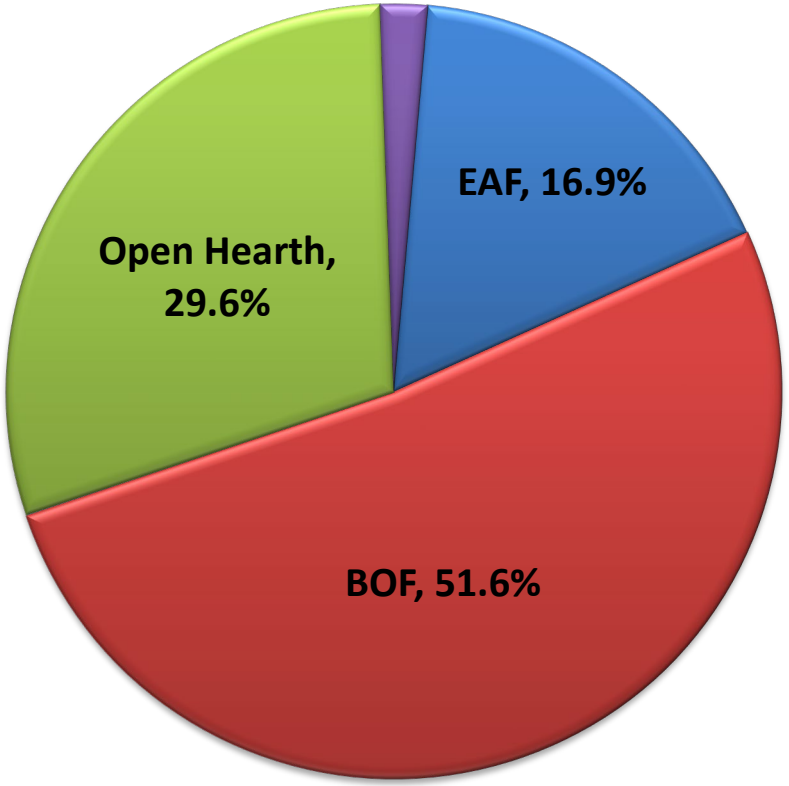
- Steel production contributes **~7%** of global CO2 emissions
- Mounting pressure for global decarbonization
- Global steel overcapacity hurting profitability



Diverging Process Adoption

Crude Steel Production

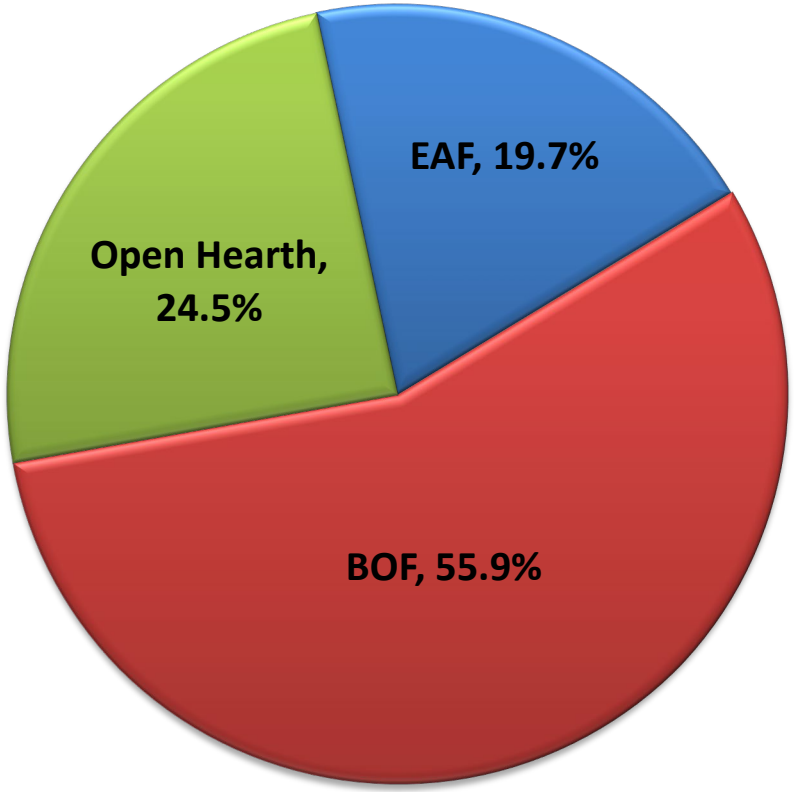
World



659.0 MMT

1974

North America (Can / US)



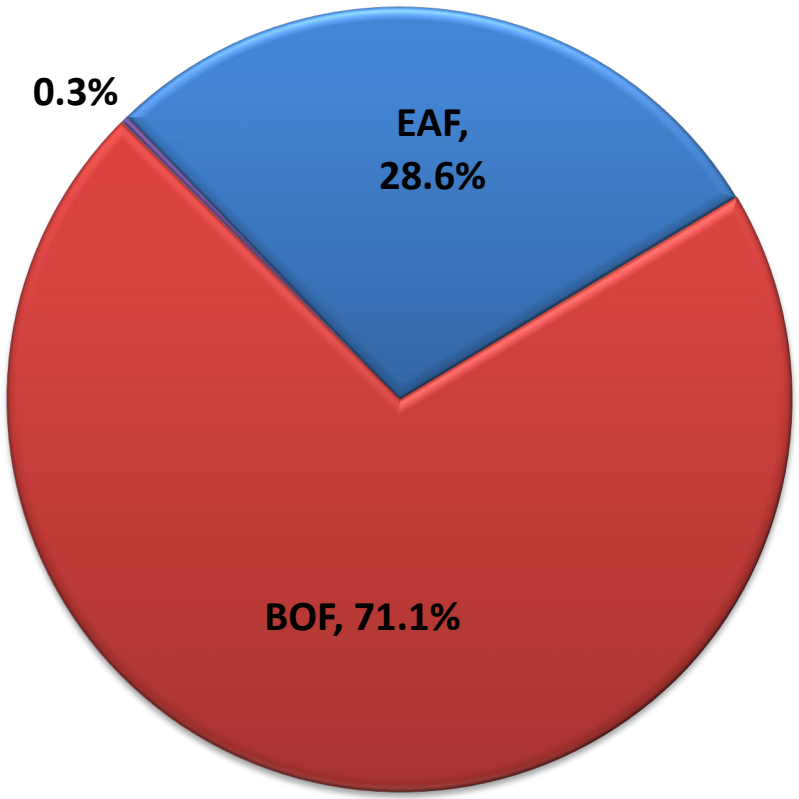
145.8 MMT; 22.1% of Global Production

Source: World Steel Association, AIST

Diverging Process Adoption

Crude Steel Production

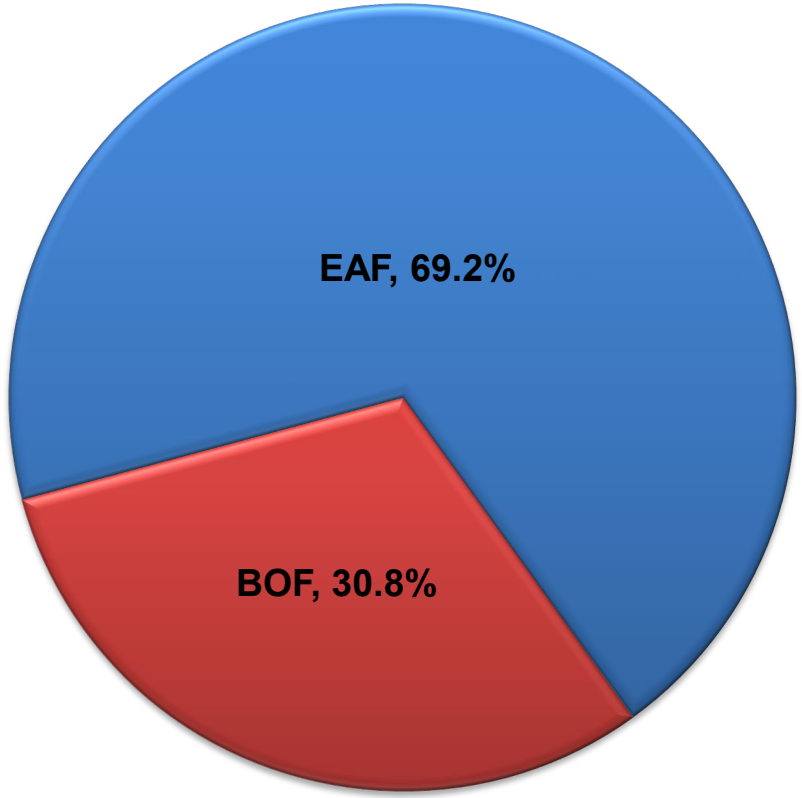
World



1,892.2 MMT

2023

North America

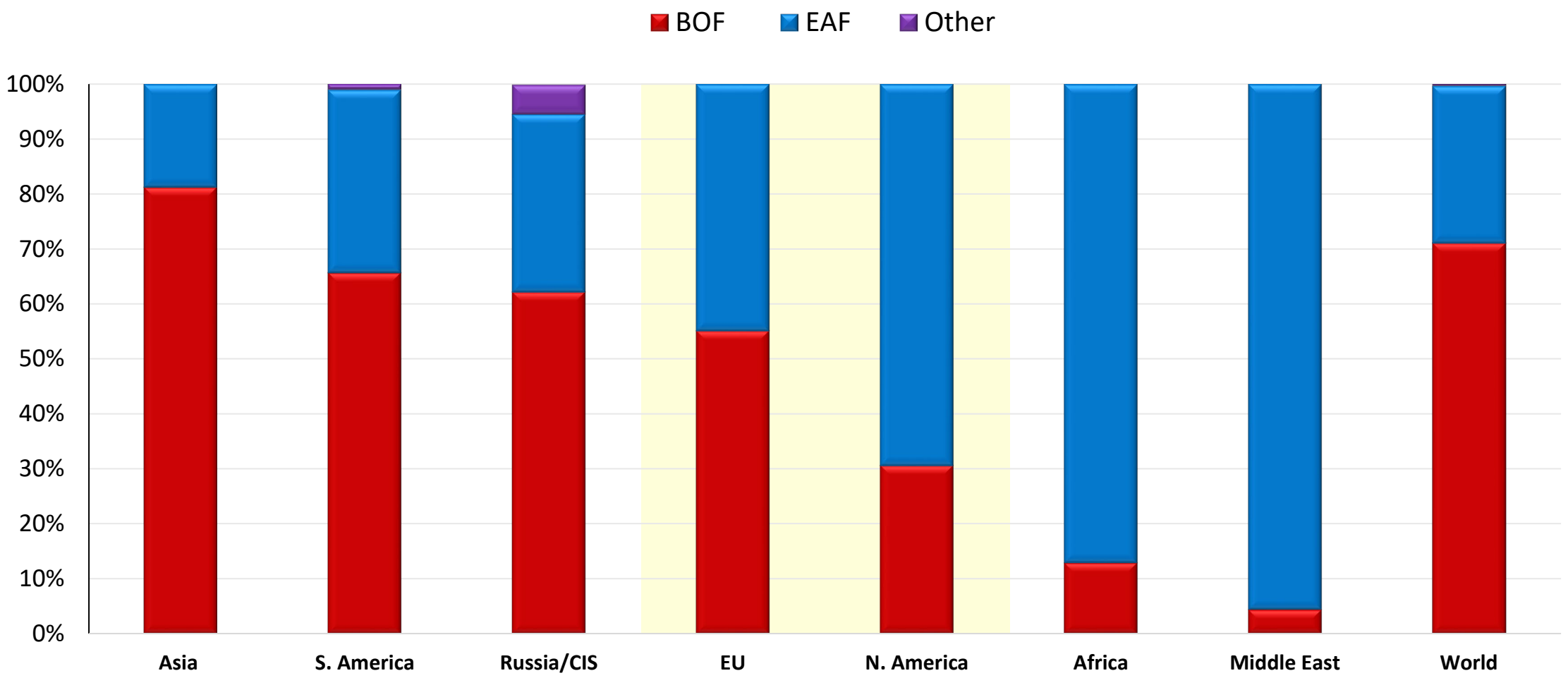


110.2 MMT; 5.8% of Global Production

Source: World Steel Association, AIST

Global Steel: Process Routes

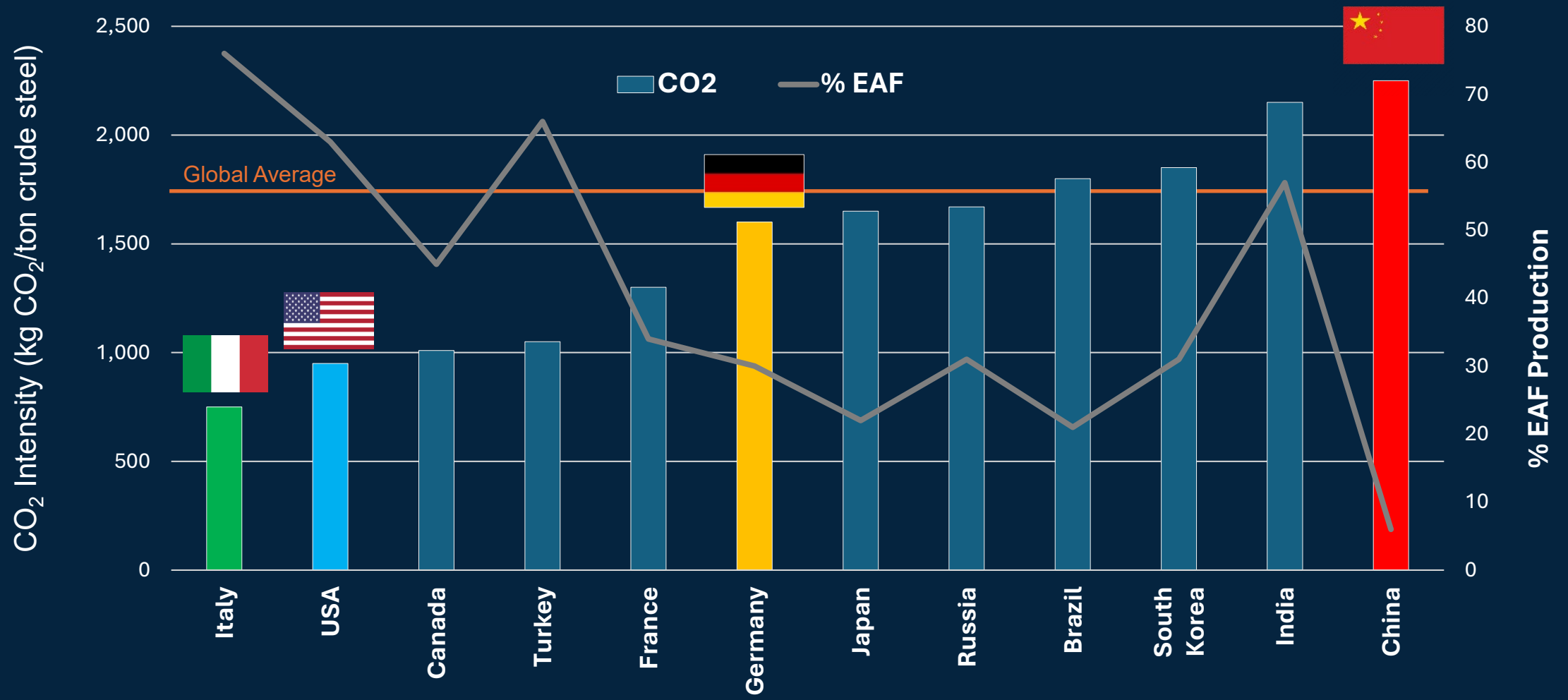
Percentage of Crude Steel Production



Source: 2024 World Steel In Figures

CO_2 Emissions Intensity

Scope I + II



Adapted from "How Clean is the Steel Industry," by Hasanbeigi & Springer – Global Efficiency Intelligence, 2022

Challenges for Steel

Global Capacity vs. Production Gap: While the gap between steel demand and capacity has slightly narrowed compared to the 2015 crisis, it remains significant at 670 million tonnes in 2023. However, operating profits are still at unsustainably low levels.

Trends in Decarbonization and Capacity Growth: Investments in lower-emitting steelmaking technologies are increasing, but the overall global capacity continues to grow faster than steel demand, creating risks of oversupply and threatening industry profitability.

Chinese Overseas Investment: Chinese steel companies dominate global cross-border investment in new steelmaking capacity, accounting for 62% of such investments, primarily in ASEAN (82% of Chinese overseas steel investments), Africa, and Asia, as they shift focus from weak domestic demand to regions with better growth prospects.

Source: OECD Steel Committee Ministerial Report, November 2024

Challenges for Steel

Future Capacity Outlook: Global steelmaking capacity is projected to rise by 68 million tonnes by 2026, with an additional 89 million tonnes planned, far exceeding demand growth of only 36 million tonnes per year, exacerbating oversupply concerns.

Strategic Industry Challenges: Steel profitability is under pressure due to energy costs, raw material expenses, decarbonization investments, and sluggish demand. Strategic measures, such as limiting net capacity growth, aligning with climate objectives, and managing trade impacts, are crucial to avoid repeating the challenges of the 2014/15 crisis.

Source: OECD Steel Committee Ministerial Report, November 2024

CO2 Emissions Reduction Targets

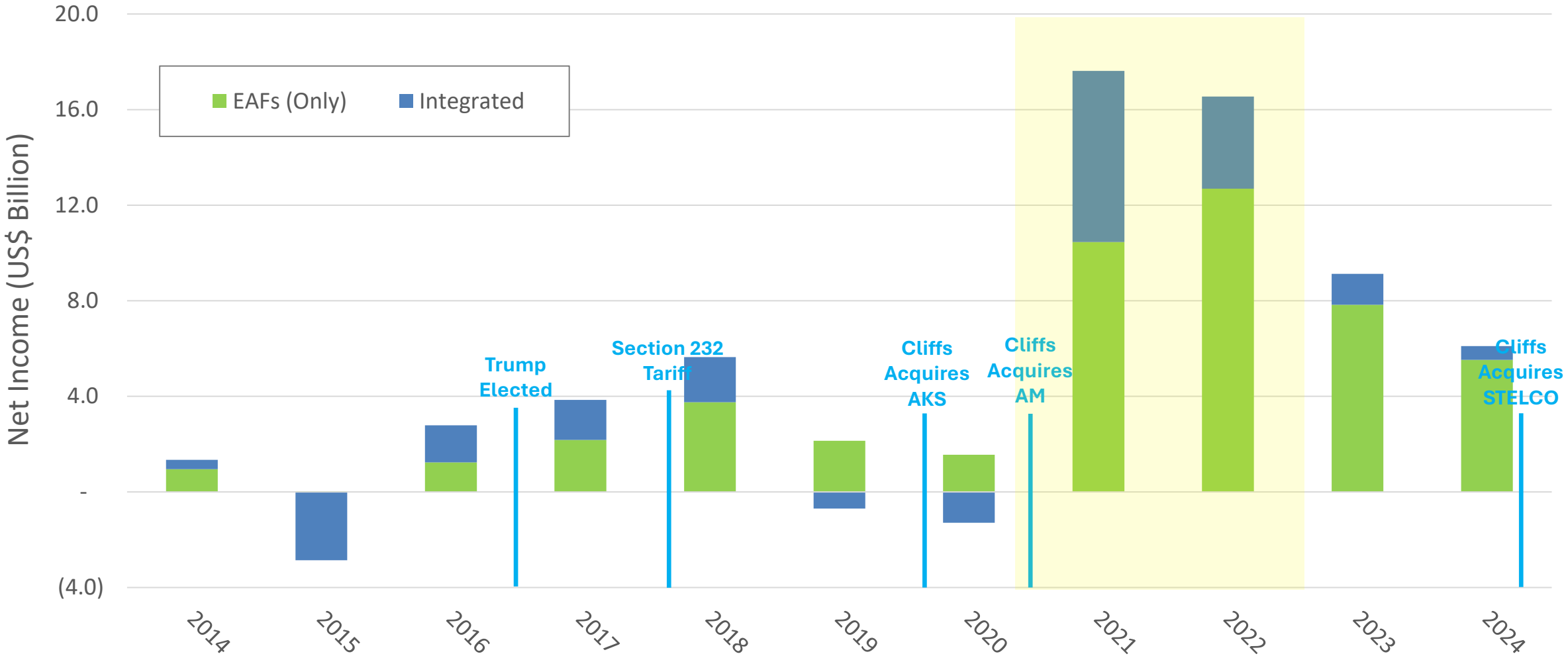
Scope I, II and III

Company	Announced	Goal	Baseline Year
Cleveland-Cliffs	Jan 2021 May 2024 (Revised)	30% reduction in combined Scope I & II by 2035 20% reduction in upstream Scope III by 2035 Near net-zero Scope I, II & III by 2050	2023
U. S. Steel	April 2021	20% reduction in Scope I & II by 2030; Net-zero by 2050	2018
Commercial Metals	June 2021	20% reduction in Scope I & II by 2030	2019
Steel Dynamics	July 2021	20% reduction in Scope I & II by 2025, 50% by 2030; Carbon neutral mills by 2050	2018
Nucor Corp.	July 2021 Nov 2023 (Revised)	35% reduction in Scope I & II by 2030; 9.2% reduction in Scope I, II, III by 2030; Net-zero in Scope I, II, III by 2050	2015

Source: Company announcements

Softening Market

Major U.S. Producers, Net Income

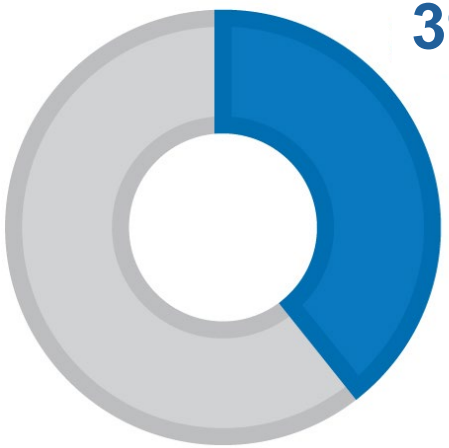


Source: Top 6/5 Producers Aggregated, Company Earnings Reports

North American Consolidation

Casting Capacity

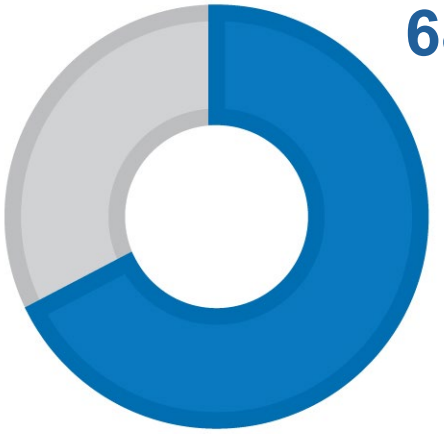
2003



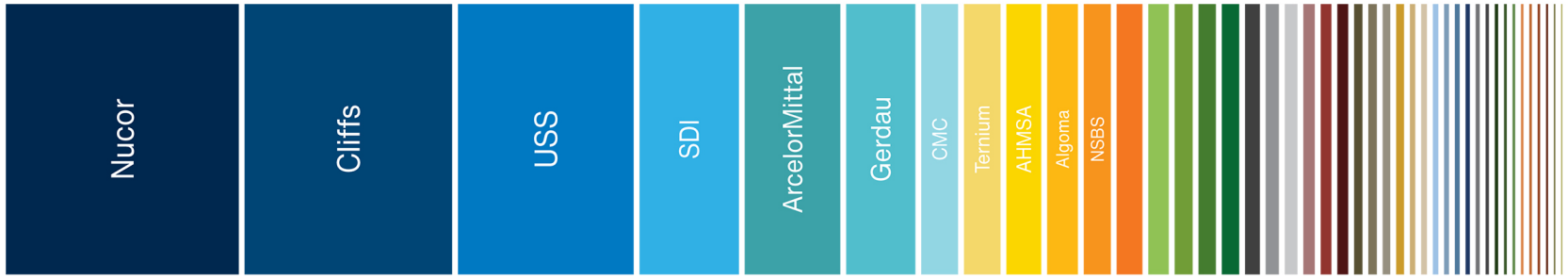
39%

Capacity Share of Top 6 Steel Producers

2024



68%



Source: AIST

Recent Investments, 2021- 2024

North American Steel Producers

DRI

~7.4 million tons

Melt

100% EAF

Flat Rolled / Processed Sheet

~26.3 million tons

Bar

~4.3 million tons

US$ 26,800,000,000

Source: Company announcements

North American Mill Developments

2024 Highlights

Nucor
US$3 billion W.Va. sheet mill on track; Kingman, Ariz., EAF & Lexington, N.C., bar mill to start in 1H ’25. Berkeley, S.C., auto-grade galv line in 2026.

SSAB Americas
Trialing hydrogen-reduced sponge iron in Montpelier, Iowa, electric arc furnace

Steel Dynamics Inc.
Successful ramp of 1.1 million tons of galv/coating capacity (four lines); biocarbon production plant on track for Q1 ‘25 start; CO2 goals certified

Cleveland-Cliffs Inc.
Negotiations continuing with US DOE over US$1.3B Middleton DRI project; Stelco acquisition completed.

U.S. Steel
Big River 2 rolled first coil in October; optimism on close of Nippon Steel acquisition by year’s end; US $1.3 billion investment in two BFs planned

ArcelorMittal
Dofasco transformation in progress. AM/NS Calvert meltshop installation on track for 2025 start; planning in progress for Texas HBI expansion.

North American Mill Developments

2024 Highlights

CMC
Civil work on W.Va. rebar mill complete. Equipment being installed now; on track for late ‘25 start. Ramp-up of Arizona rebar/merchant bar mill progressing.

Algoma
Progressing on EAF installation, on track for Q1 ‘25 start; plate mill improvements completed

Hybar
Arkansas mill progressing, with ‘25 start anticipated. New equity partner added; energy contract secured with adjacent solar field

Pacific Steel Group
Local permitting secured for first new meltshop in 50+ years. Solar-powered micromill to begin in late summer of ‘26.

North Star BlueScope
Directors approved US$130 million debottlenecking project at hot strip mil. Work includes improved cooling setup and a downcoiler upgrade.

Ternium
Civil work on slab plant underway. Three of five new finishing lines ramping up, with remaining two to start in next two months. Work continuing on cold mill.

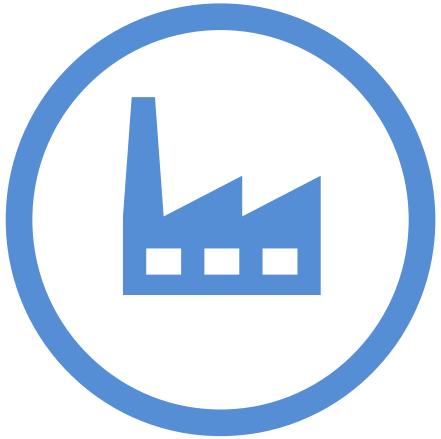
Favorable Policy

Landmark Bills offer Future Growth

U$ 1,874,000,000,000

Infrastructure Investment and Jobs Act

US$1.2 Trillion
Roads, bridges, electric grid, electric vehicle charging, H2 infrastructure



CHIPS and Science Act

US$280 Billion
Domestic semiconductor manufacturing, R&D, workforce development

Inflation Reduction Act

US$394 Billion
Clean electricity generation and transmission, electric vehicle incentives

Green Opportunity?

Construction Drives Steel Demand

Every **US$ 20 Billion**
in New Infrastructure Spending
=
1 Million Tons of New Steel Demand

Source: AISI, AIST

Hydrogen Hubs

Fostering a Clean Energy Industry

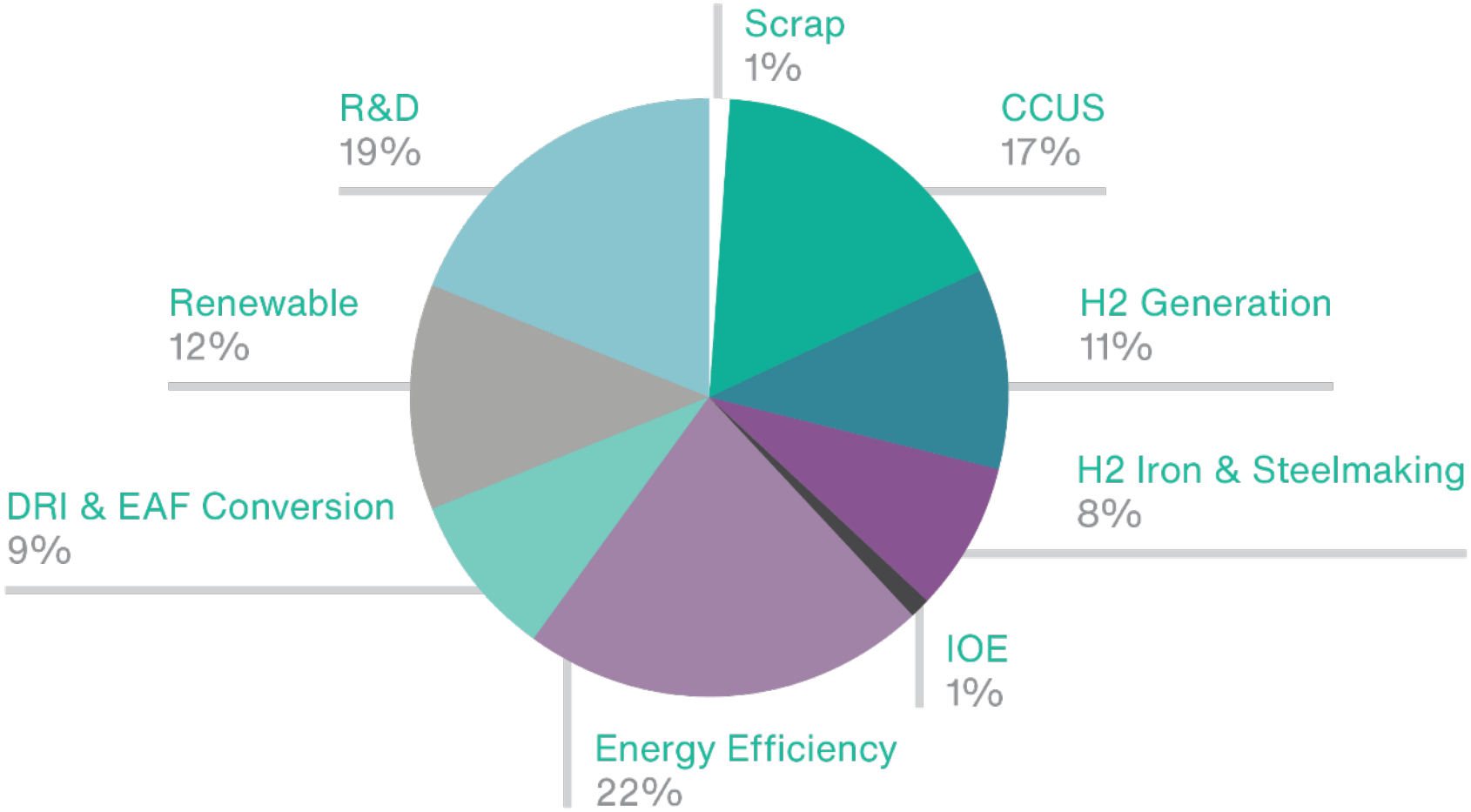
- Infrastructure Act provides US$8 billion in funding for regional hub development
- Projects for production, processing, delivery, storage, and end-use of hydrogen
- Cleveland-Cliffs, U.S. Steel, Nucor and other steel producers participating

Source: U.S. Department of Energy

Process Adaptation

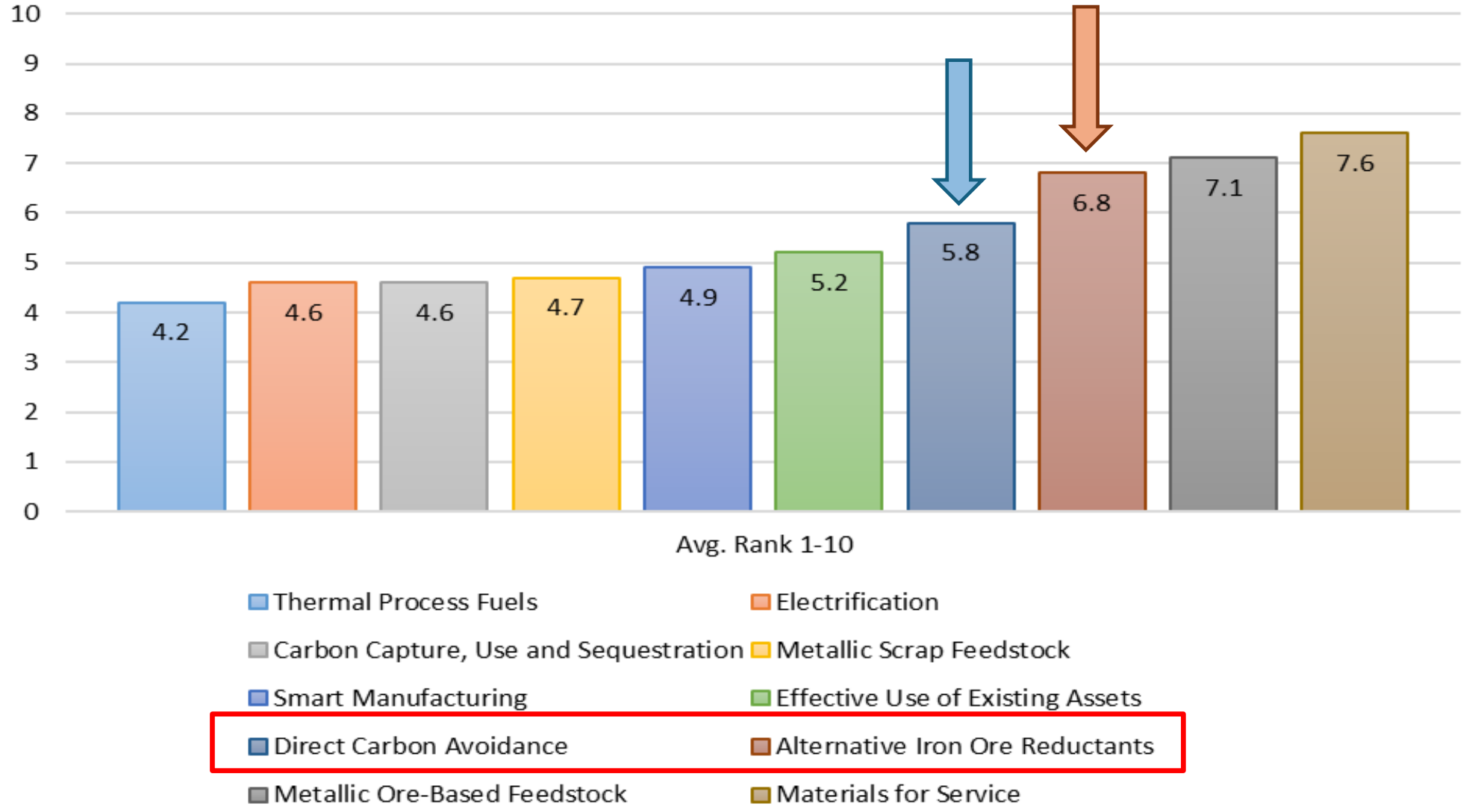
Multiple Pathways to Decarbonize Steel

Technology Profiles
Recent Iron & Steel
Decarbonization Projects (240)

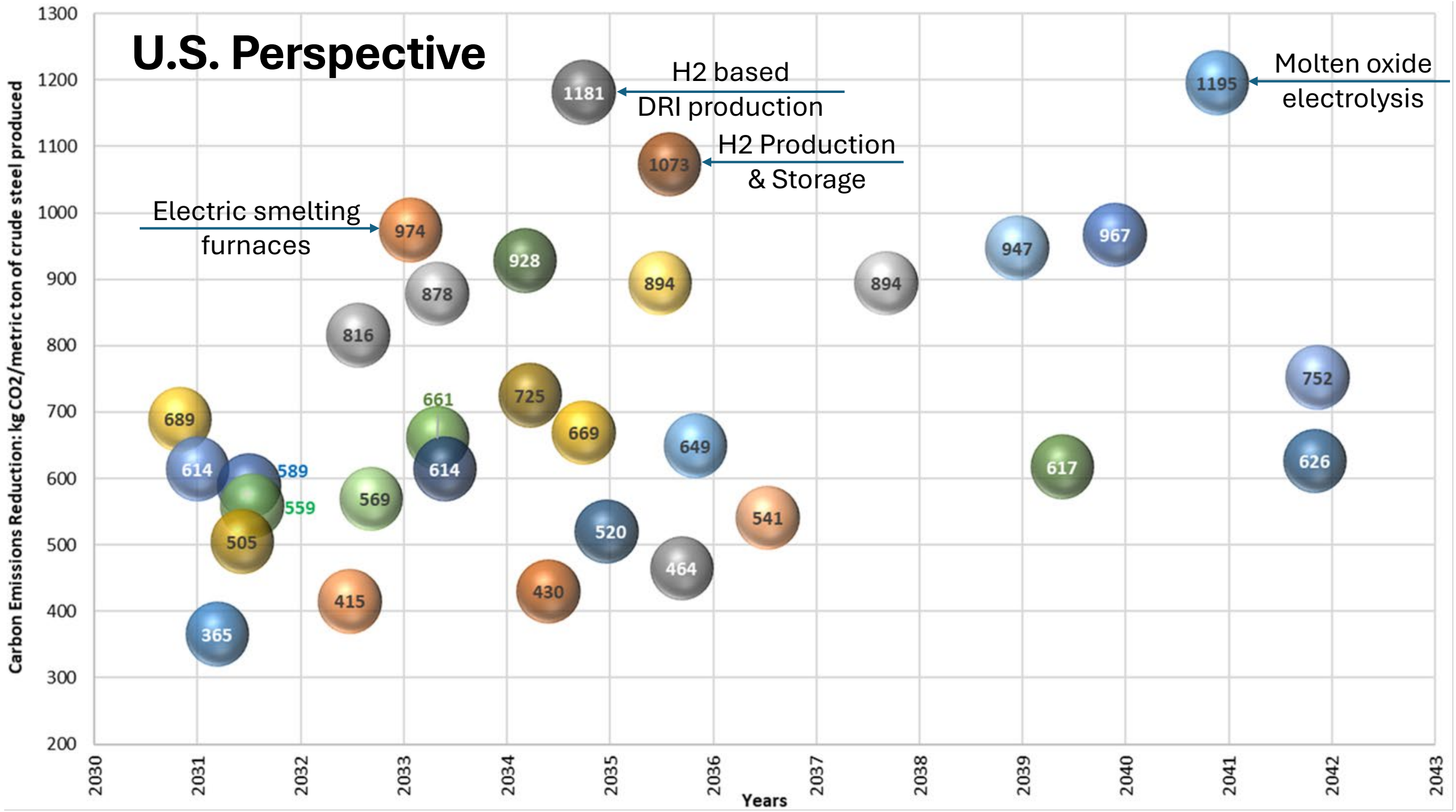


Source: OECD Steel Committee Presentation, March 2024

Industry Priority – Decarbonization Technologies



Source: AIST

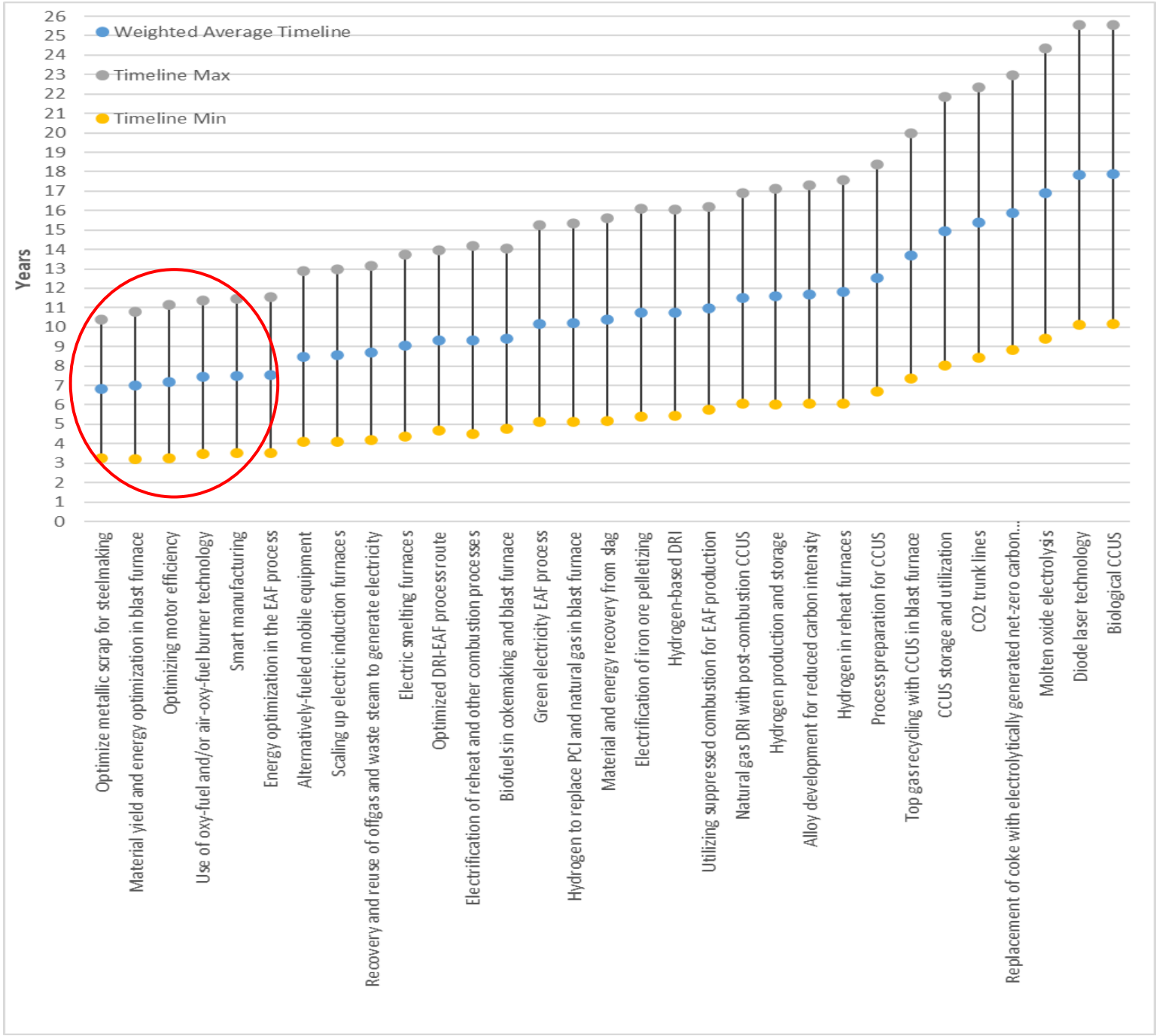

U.S. Perspective
H2 based DRI production
H2 Production & Storage
Molten oxide electrolysis
Electric smelting furnaces
1181
1073
1195
974
928
878
894
894
947
967
816
752
661
725
689
669
649
614
589
614
617
626
559
569
541
505
520
464
415
430
365
Carbon Emissions Reduction: kg CO2/metric ton of crude steel produced
Years
1300
1200
1100
1000
900
800
700
600
500
400
300
200
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
2040
2041
2042
2043

Shorter Term

Commercial Implementation

6-8 years

- Optimize Metallic Scrap
- Material Yield and Energy Optimization in BF and EAF
- Optimize Motor Efficiency
- Use of Oxy-Fuel and/or Air-Oxy-Fuel Burner Technology
- Expand Smart Manufacturing

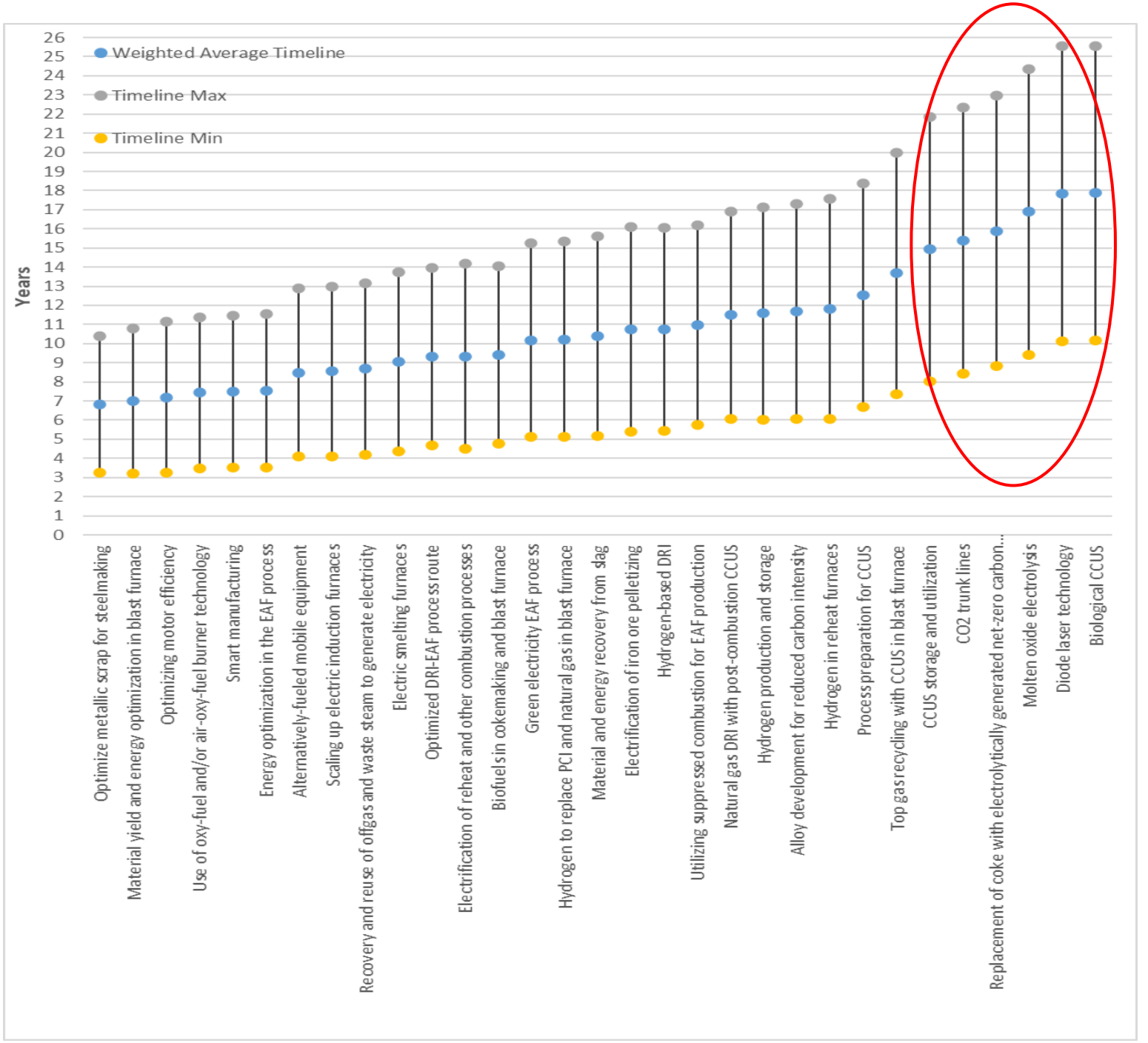


Longer Term

Commercial Implementation

15-18 years

- Biological CCUS
- Diode Laser Technology
- Molten Oxide Electrolysis
- Replacement of Coke With Net–Zero Carbon Syngas
- CO2 Trunk Lines
- CCUS Storage and Utilization



Decarbonization Strategy:

Theme 1 – Material and energy efficiency optimization

Maximizing available raw materials such as scrap and lower grade iron for steel production will become paramount as demand increases.

Market pressure will require smart technologies and innovations to optimize the metallization of those raw materials, as well as energy applications and overall manufacturing processes..

Decarbonization Strategy:

Theme 2 – Electrification of processes

Electrification will be necessary to replace fossil-fuel driven combustion processes and equipment.

Green electricity from nuclear and renewable sources such as wind, hydro and solar, etc. will need to be sufficiently available and cost effective for baseline and intermittent needs.

There’s also the potential for iron reduction via electrolysis.

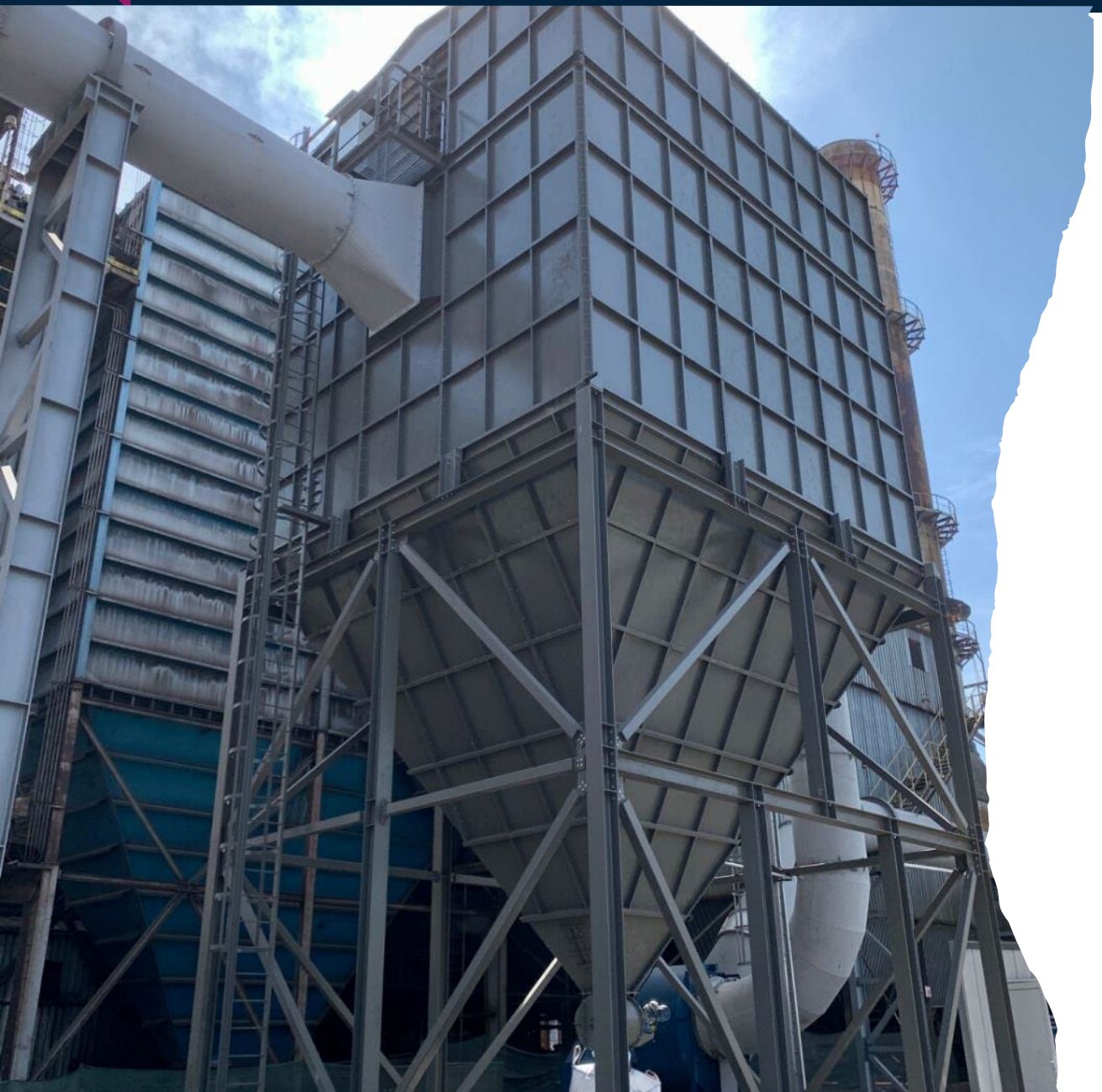
Decarbonization Strategy:

Theme 3 – Alternative energy sources and low carbon fuels

The most considered alternative has been H2 based on its potential to be produced at scale.

Hydrogen, as a replacement for carbon, can act as a reducing agent as well as an energy source for reheating.

To compete, green steel will need vast amounts of Hydrogen at a competitive cost.

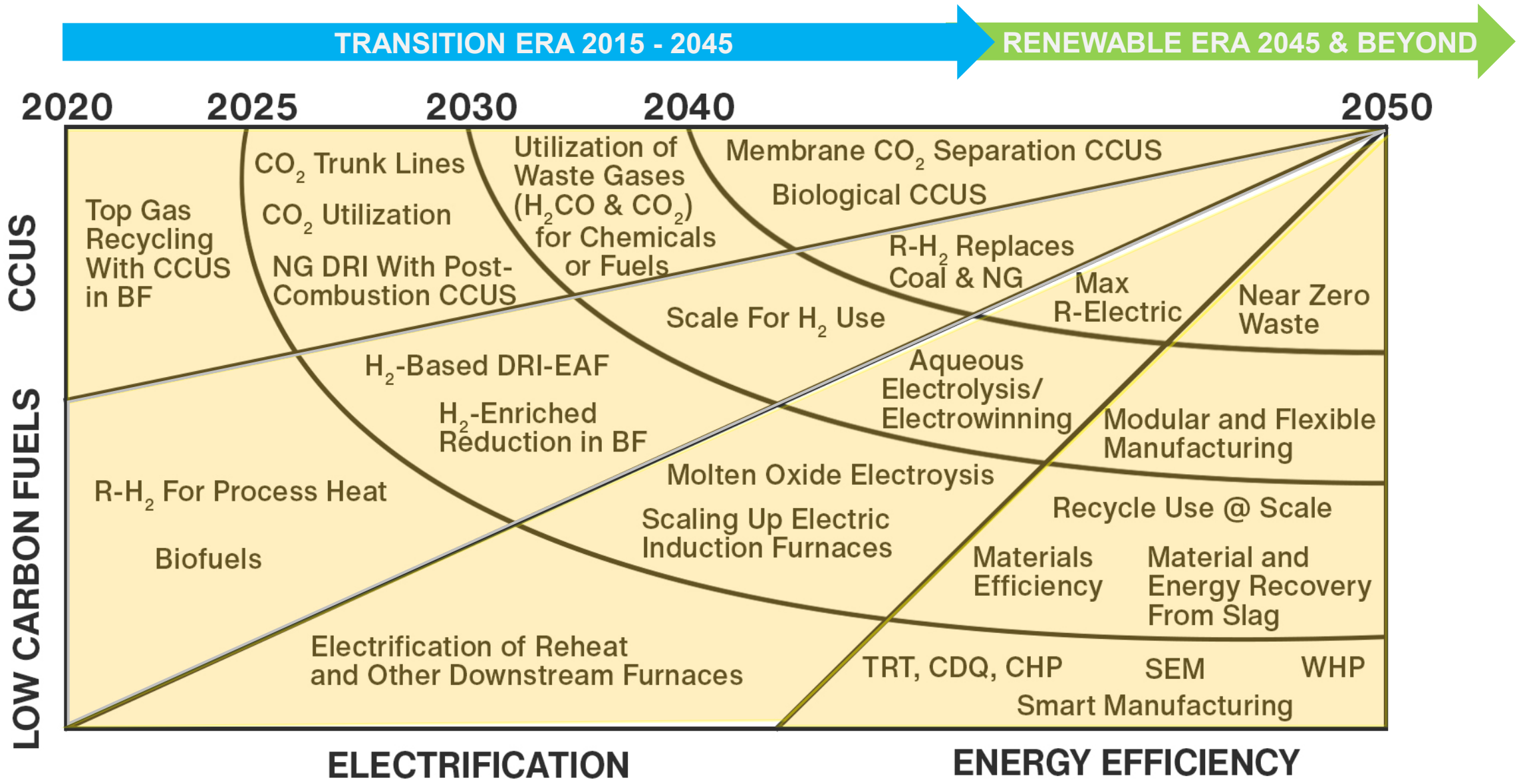


Decarbonization Strategy:

Theme 4 – Carbon capture, utilization and storage (CCUS)

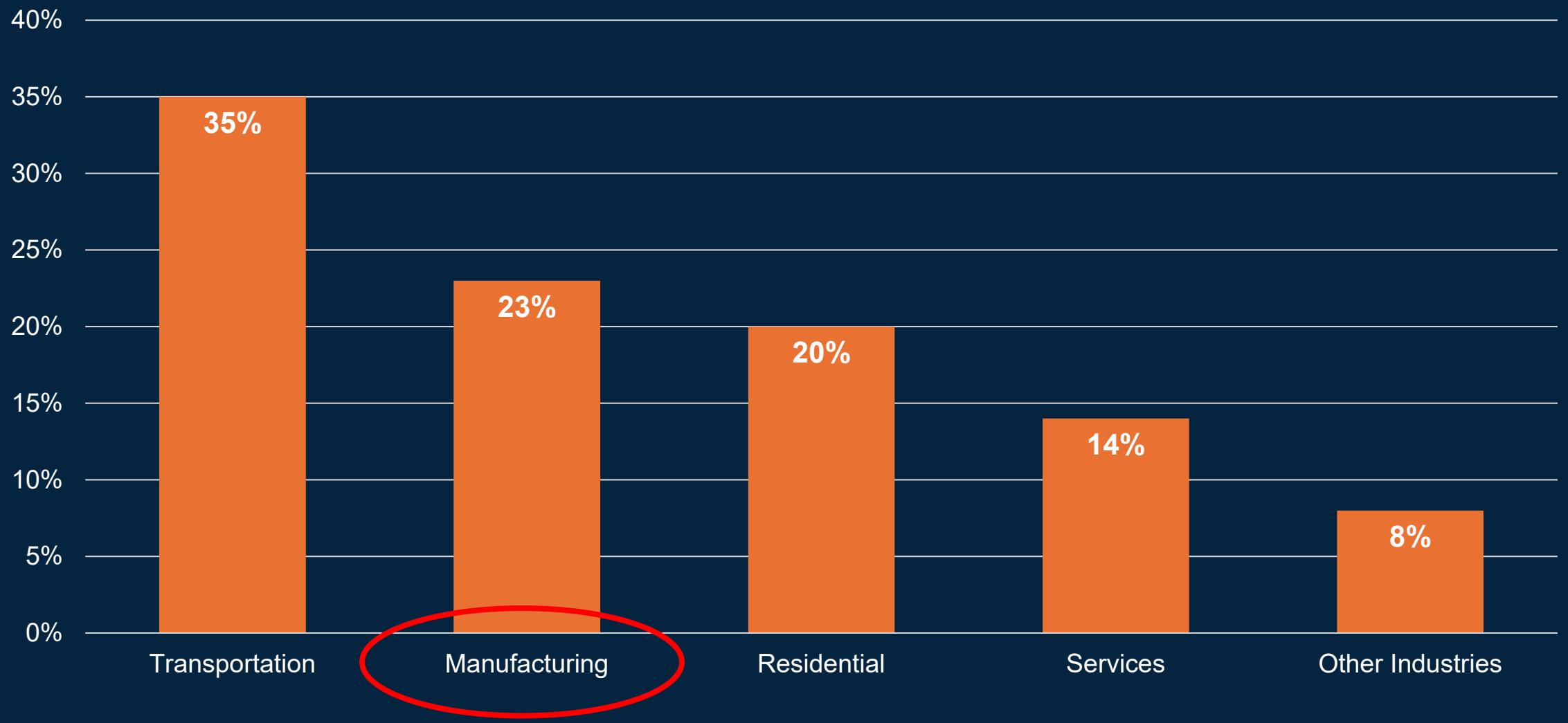
Recovery and re-use of off-gas waste heat in the steel industry provides significant energy and cost savings.

On average, approximately one-third of the energy input into an EAF is lost via off-gas waste heat.



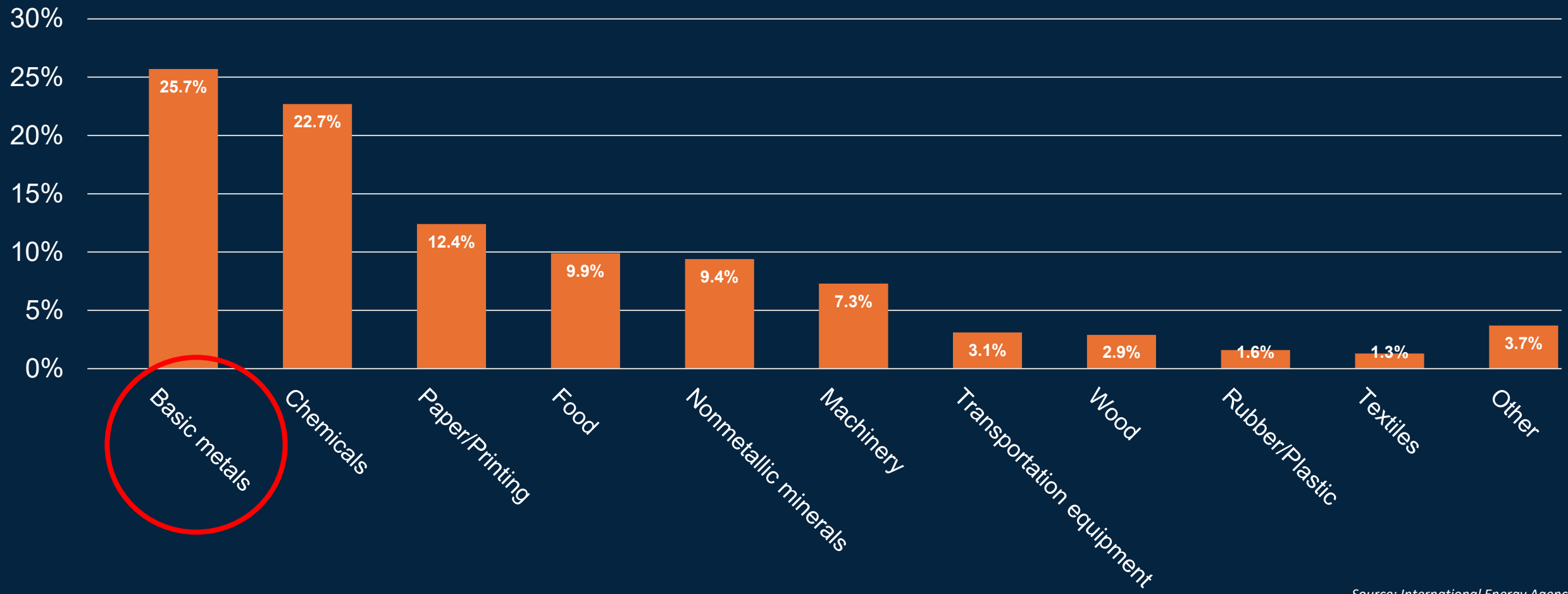
Source: AIST, U.S. Dept. of Energy

Global Energy Consumption: 2023



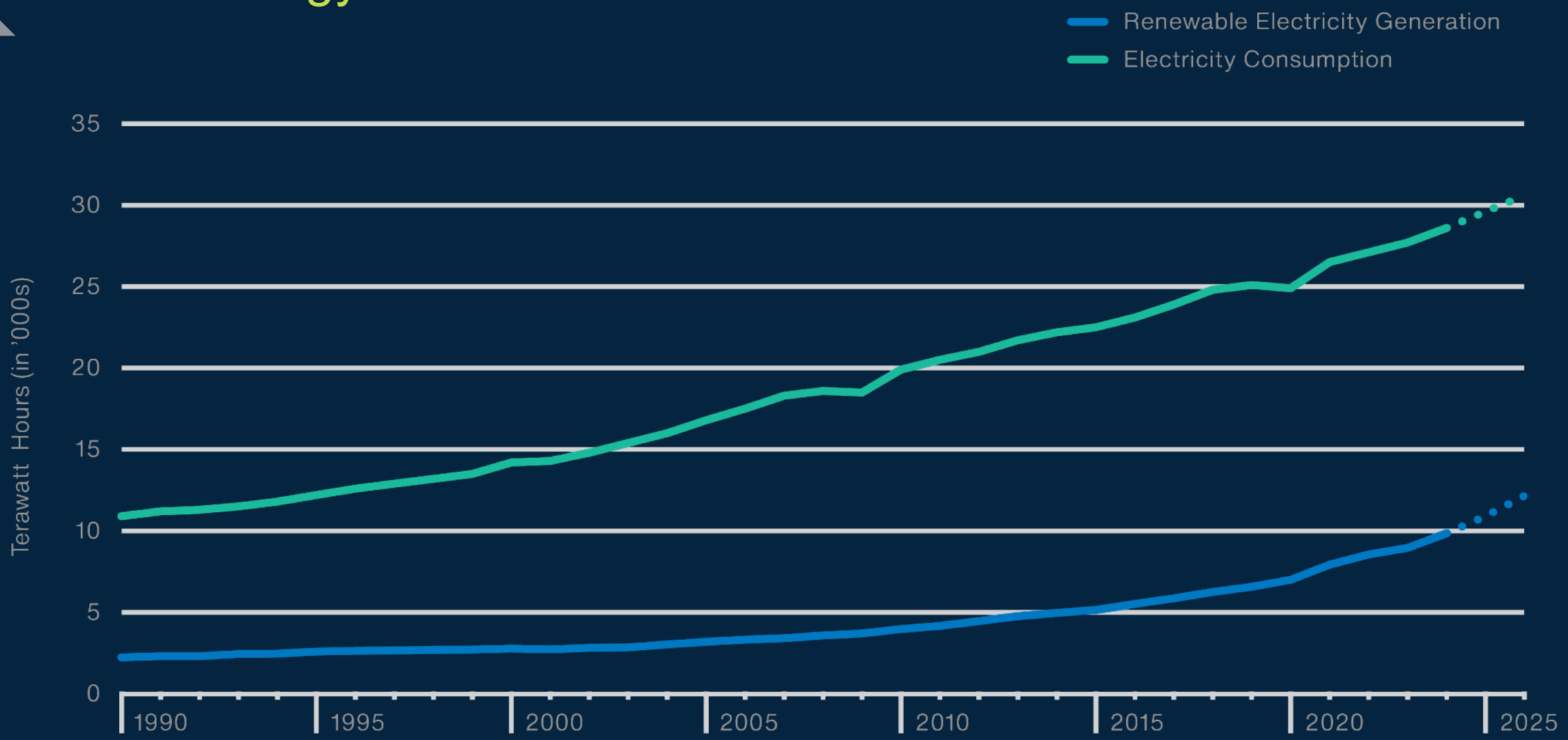
Source: International Energy Agency

Manufacturing Energy Consumption: 2023



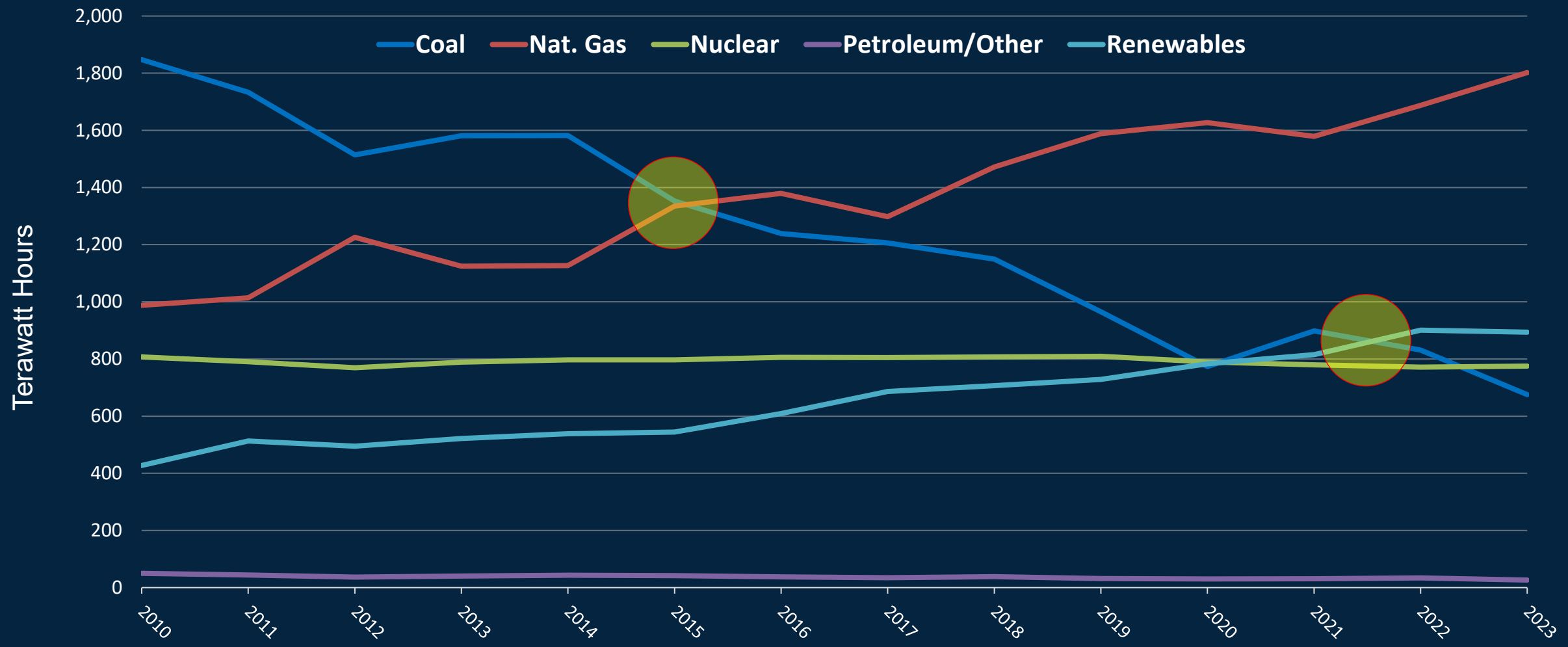
Source: International Energy Agency

It's an Energy Problem



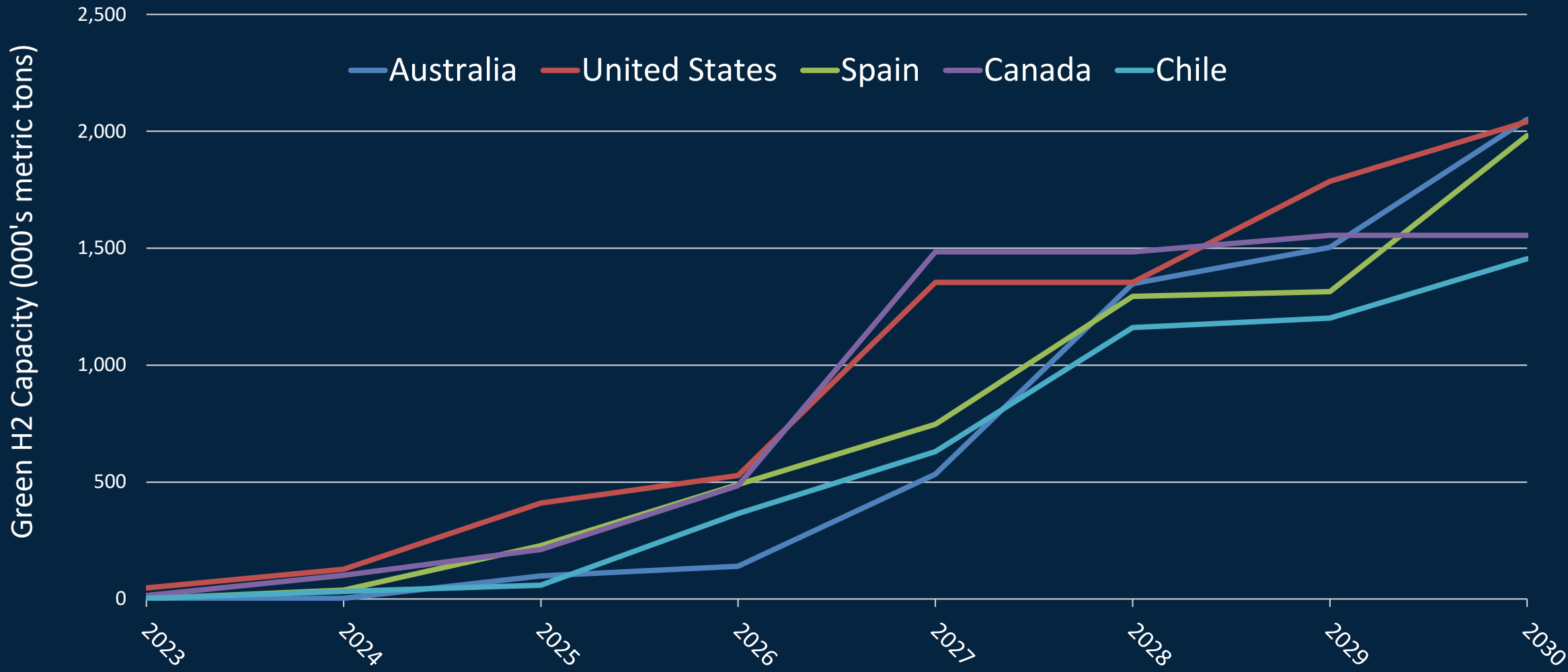
Source: IEA Electricity 2024

U.S. Electricity Generation



Source: U.S. Energy Information Agency

Green H_2 Production Capacity



Source: Rystad Energy, Hydrogen Insight

"The EU's industrial policy on renewable hydrogen needs a reality check. The EU should decide on the strategic way forward towards decarbonization without impairing the competitive situation of key EU industries or creating new strategic dependencies."

Stef Blok
European Court of Auditors Member
July 2024

A Heavy Lift for Hydrogen

- Targets for renewable H2 production/imports overly ambitious.
- No clear overview of needs or of available public funding for massive build-up of H2 industry.
- Further work needed: How to calibrate market incentives for renewable hydrogen? How to prioritize scarce EU funding? Which parts of the value chain to focus on?

Source: European Court of Auditors Special Report, Oct 2024

Clean Hydrogen Development

Projects Shelved

- Shell **paused** the Akura low-carbon hydrogen project in **Norway**, citing lack of blue hydrogen demand. Was to have a capacity of 2.5 GW, producing 1,200 metric tons of hydrogen per day by 2030

- Repsol **shelved** three green hydrogen projects in **Spain**, citing an "unfavorable regulatory environment and potential windfall tax on energy companies."

- Fortescue **formally halted** a giant green hydrogen project in British Columbia, **Canada**, telling regulators that it is exiting the permitting process on account of a lack of cheap power.

Markets: Steel is Essential to Green Energy

TONS OF STEEL USED PER MW OF NEW GENERATING CAPACITY

~15 tons

Natural Gas

40-70 tons

Solar Array

~100 tons

Onshore Wind

~250 tons

Offshore Wind

TONS OF STEEL USED PER MILE

~65 tons

Energy Transmission

Source: Nucor

Green Energy NEEDS Steel

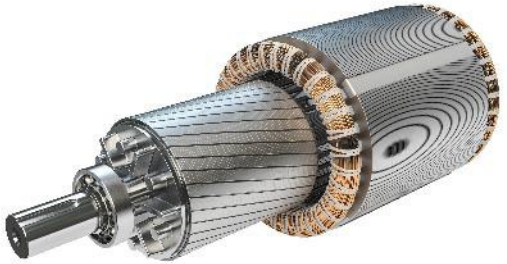
Steel NEEDS Green Energy

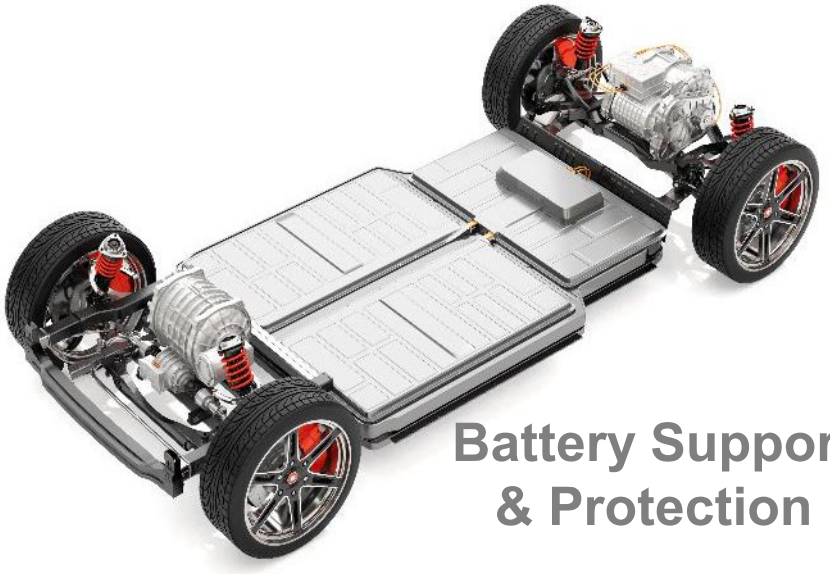
Driving New Demand

Electric Vehicles

Lightweight Bodies: AHSS

Electric Motors: NGOES

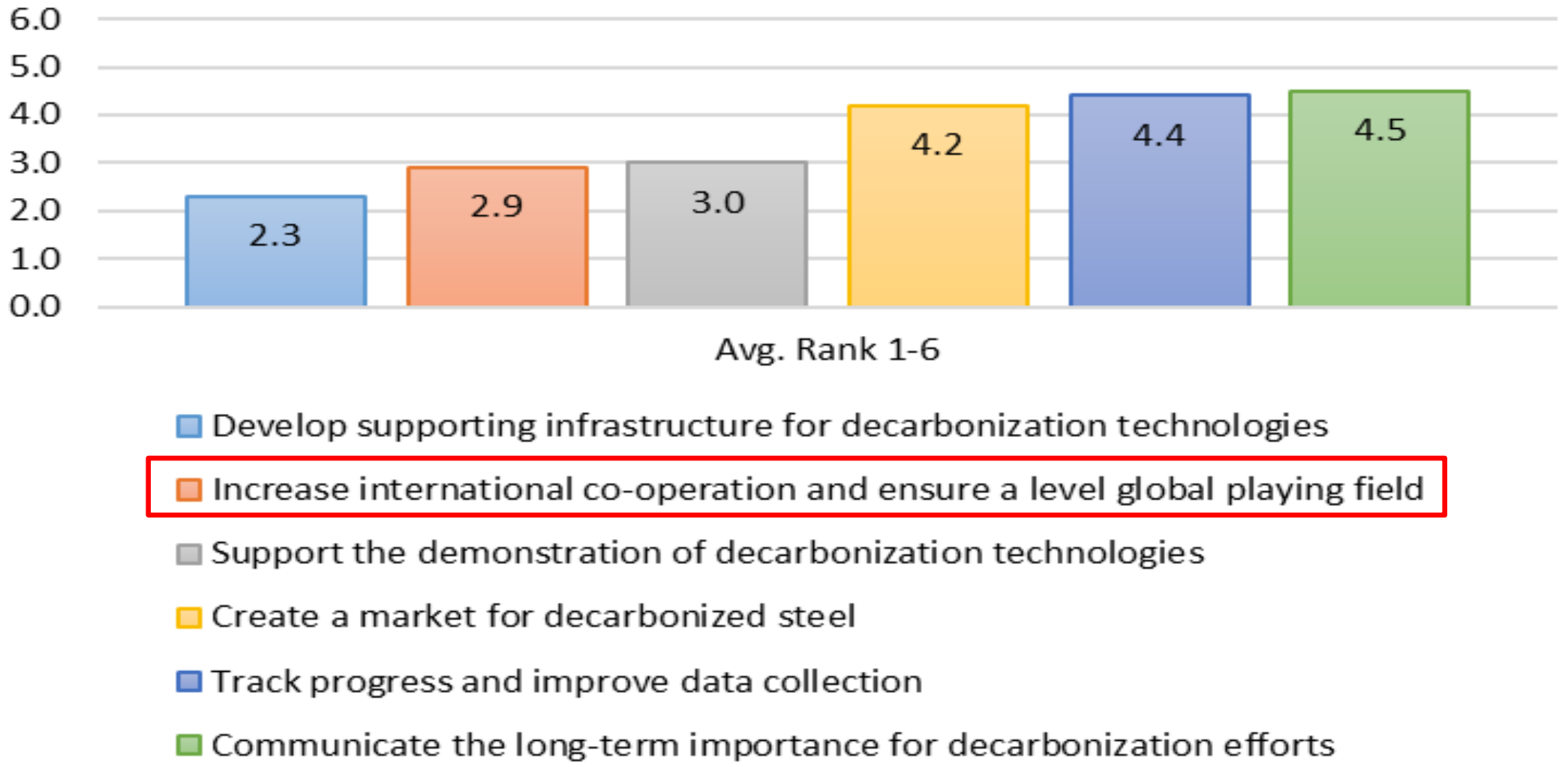




Battery Support & Protection

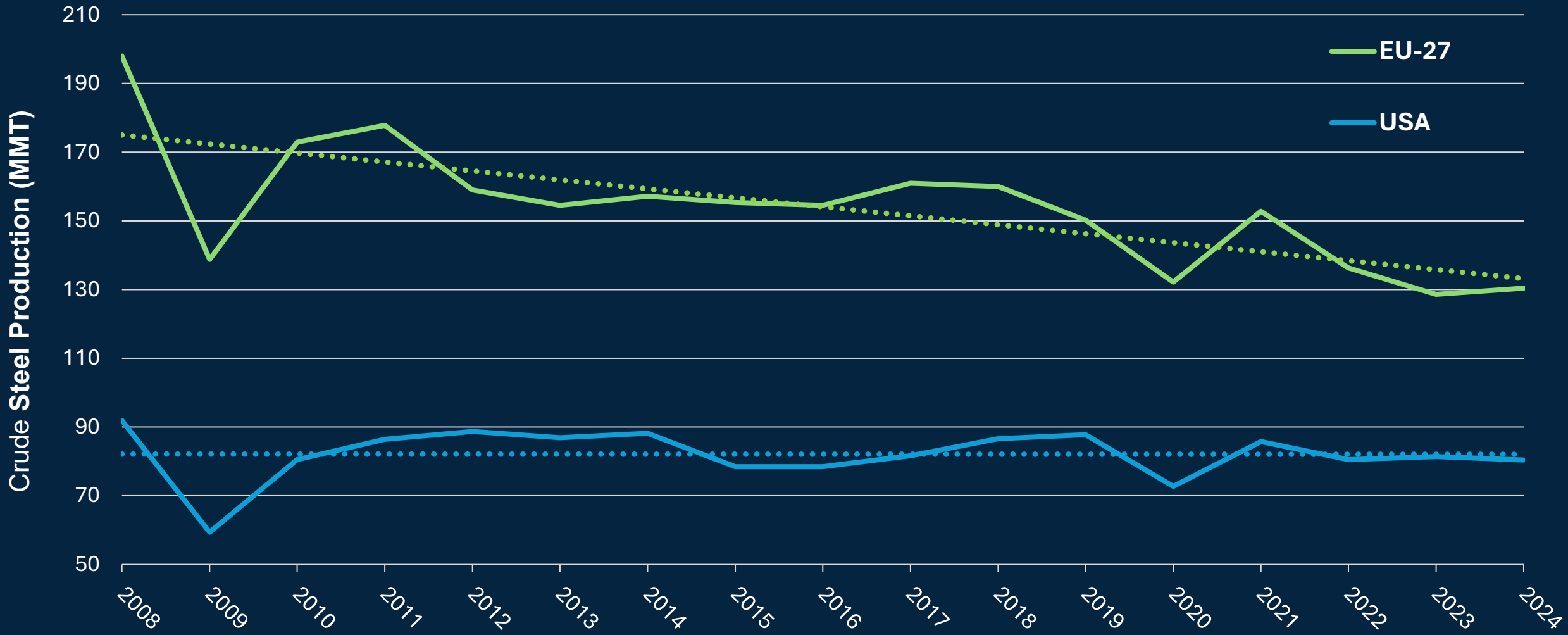
Charging Infrastructure: GOES

Industry Priority – Government Engagement for Decarbonization



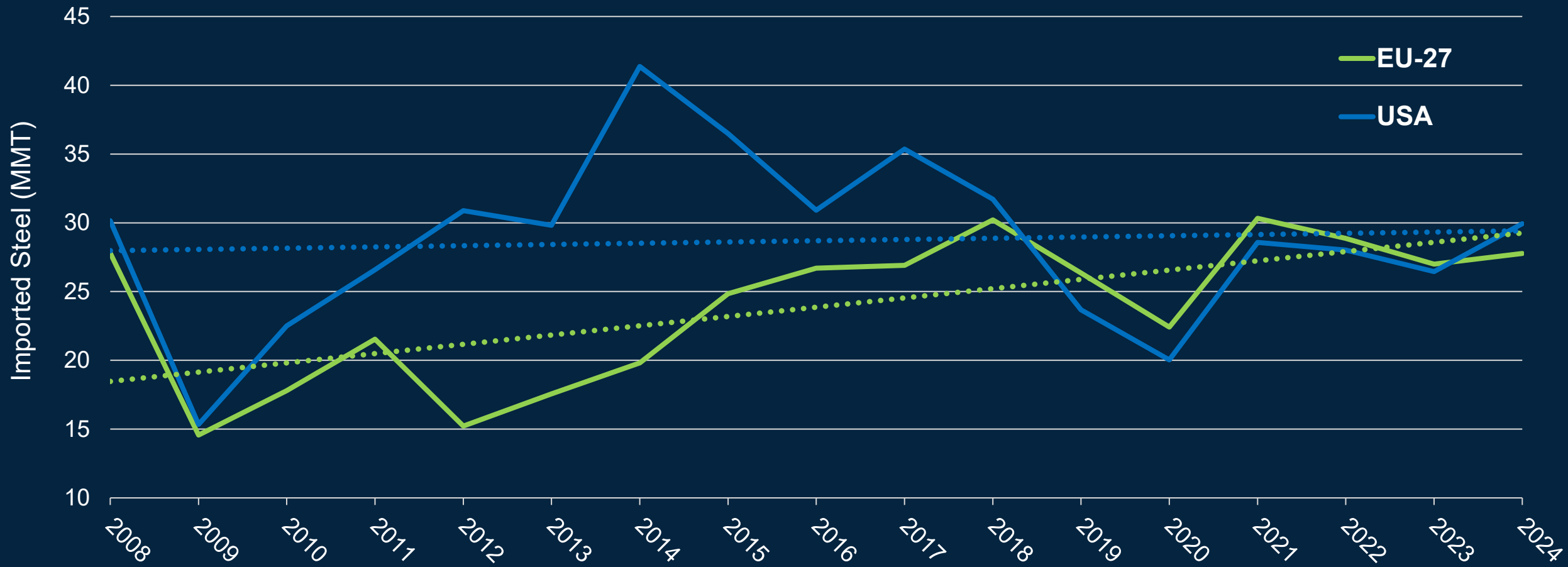

GLASGOW BREAKTHROUGHS
CLIMATE GROUP STEELZERO
G7 GERMANY
Leadit
LEADERSHIP GROUP FOR INDUSTRY TRANSITION
UN environment
Transition Pathway Initiative
Net Zero Steel
Climate Bonds INITIATIVE
climate catalyst
HSBC
GREENHOUSE GAS PROTOCOL
CARES
ISO
WORLD GREEN BUILDING COUNCIL
OECD
ipcc
INTERGOVERNMENTAL PANEL ON climate change
ELLEN MACARTHUR FOUNDATION
ACT ASSESSING LOW CARBON TRANSITION
CDP
DISCLOSURE INSIGHT ACTION
International Resource Panel
Responsible Steel standards & certification
IPAC
International Programme for Action on Climate
UNFCCC
iea
wbcsd
CLEAN ENERGY MINISTERIAL
ENERGY TRANSITIONS COMMISSION
GSCC
Global Steel Climate Council
ICC
GPP FURNITURE
#CDPSupplyChain
SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION
CEBI
Clean Energy Buyers Institute
MISSION POSSIBLE PARTNERSHIP
Steel for Europe
Buying green!
A handbook on green public procurement
Center for Climate Aligned Finance
ROCKY MOUNTAIN INSTITUTE
UNIDO
WORLD ECONOMIC FORUM
TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES
THE CLIMATE GROUP
BCCA
Buy Clean California Act
COMET Coalition On Materials Emissions Transparency
MI
IFC International Finance Corporation WORLD BANK GROUP
Creating Markets, Creating Opportunities
worldsteel ASSOCIATION
CIRCULAR ECONOMY
Closing the loop
AN AMBITIOUS EU CIRCULAR ECONOMY PACKAGE
Net Zero Steel Pathway Methodology Project

Production



Source: World Steel Association

Import Penetration



Source: EUROFER, U.S. Census Bureau

U.S. and EU at the Vanguard

2023: Top 5 Importers

Rank	Country	Tons (MT)	CO_2 Intensity/Ton
1	EU-27	39.2	≤1.5
2	U.S.	26.4	≤1.0
3	Germany	18.7	≤1.5
4	Italy	18.7	≤1.0
5	Turkey	18.0	≤1.0

2023: Top 5 Exporters

Rank	Country	Tons (MT)	CO_2 Intensity/Ton
1	China	94.3	≥1.5
2	Japan	32.2	≥1.5
3	S. Korea	27.0	≥1.5
4	EU-27	26.0	≤1.5
5	Germany	22.5	≤1.5

Source: Global Efficiency Intelligence, Worldsteel Association

Decarbonization Strategy for Steel

Decarbonization represents a multi-generational opportunity for the steel industry to hasten the path to net-zero for all manufacturing.

Thank You!