How will the Decarbonization Programme Impact the Steel Industry and How should the Industry behave?

Showcase Vision for Krakatau Steel Carbon Neutrality by 2060

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BUMN UNTUK INDONESIA

KRAKATAU STEEL

The Outline

Introduction to Krakatau Steel

Overview of Decarbonization Efforts on Global Steel Demand Forecast

Evolution of Steel Industry towards Decarbonization with Potential Technology Options

Vision for Krakatau Steel Carbon Neutrality by 2060

Key Takeaways – Challenge & Moving Forward

Krakatau Steel has a rich legacy as Indonesia's leading steel manufacturer

Since launching **53 years** ago, we have become **Indonesia's largest** & **the 2nd largest ASEAN steel producer**

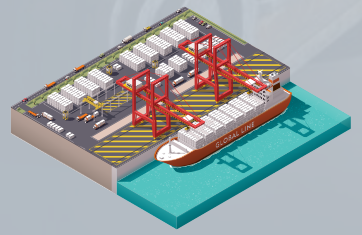
Today, KS is the **only state-owned enterprise steel player,** we are the best positioned to support national infrastructure projects e.g. New Capital City, Highway, High Speed Rail, Industrial / Refinery, Logistic, etc

In 2022, we have direct contribution of **US$1.7B** and **69,000** workers to our national economy

Over the years, we have built an integrated network of infrastructure and complementary businesses in Cilegon – Banten and across Indonesia

Java Railway Connection

Toll Road Access



Largest Bulk Port

Continuous Industrial Water Supply

Dual Source of Power Supply

Industrial and Commercial Estate Facilities

We are the **No 1 market leader** in Indonesia commanding **>30% total domestic market share**

We achieve **business excellence** by leveraging on our **steel industrial cluster** in Cilegon: steel downstream, infrastructure & JVs with Korea & Japan

Today, we boast over **6.9 Million Tons** of capacity **integrated** across the steel value chain

Examples of our product portfolio across Krakatau Steel Group

Hot rolled coil/plate

Wire rod

ERW pipe

Cold rolled coil/sheet

Slab

Bar & Section

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Amidst the pandemic & under the decarbonization trends, global steel demand will still be on a growing path, even though the growth rate moderates with declining in its steel intensity (1/3) *)

Steel intensity declines as automobile materials become lighter and stronger ➔▼ emission
4 ~ 7% weight reduction every 10 years

Slowing global trade and demand for containerships e.g. coal bulker & oil tanker
Eco-friendly natural gas & smart ships will lead the market

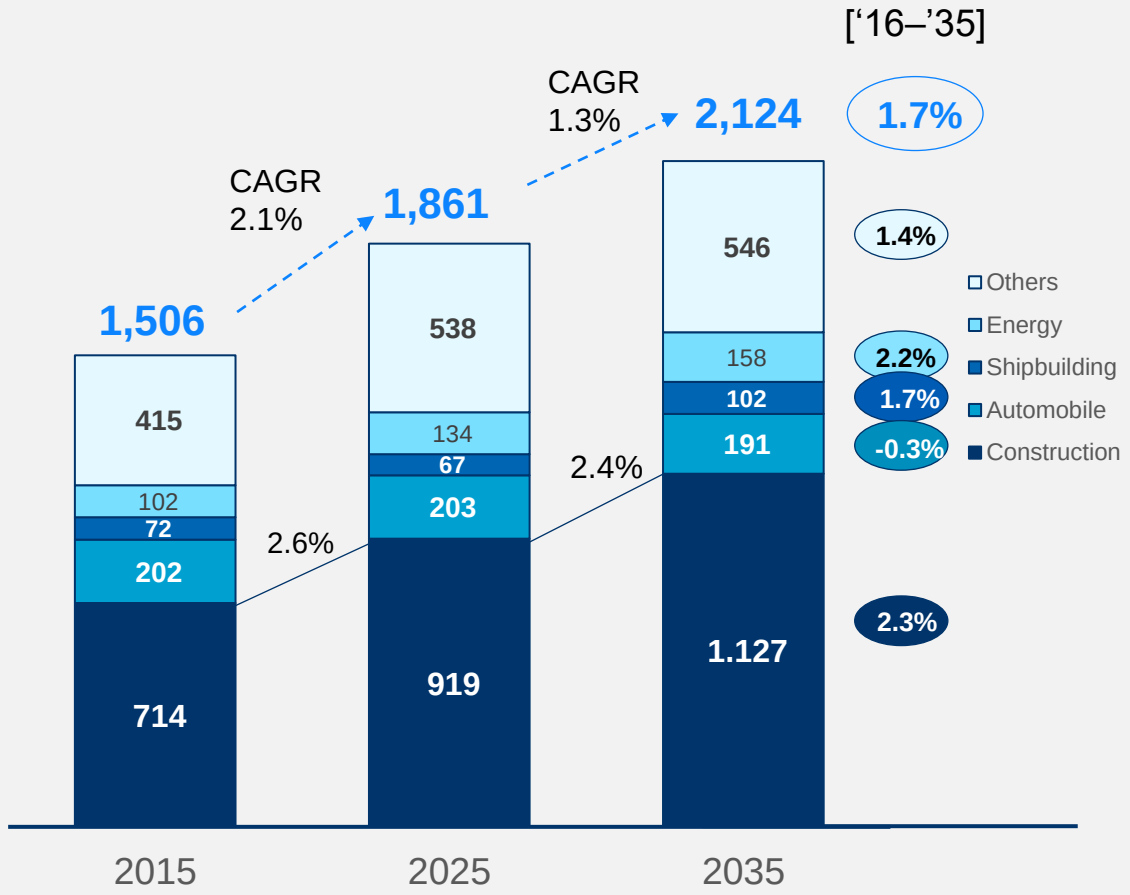
Increasing global steel demand due to construction investment (‘15-’35) CAGR 2.5%
Urbanization, Smart-Green & Mega Cities
➔ High-strength steel usage ▲ ,Steel demand ▼

Increasing energy investment (‘19-’40) USD 2,673 (Billion USD per annum)
The era of global transition toward renewable energy

**Steel intensity = steel demand / specific investment (tonne / k USD)*

Steel Demand Forecast

Million tonne



Note: *Shipbuilding sector includes other transportation*
Demand for other sectors is forecast using industrial production index

Source:

worldsteel ASSOCIATION POSCO RESEARCH INSTITUTE

The pressure for individual steel players to decarbonize is rising from multiple stakeholders (2/3)

1. Regulators are accelerating the shift to green economy

Regulators across the globe are **implementing** policies to incentive & accelerate **decarbonization** through emission quotas and carbon prices.

Over 50 countries have established or plan a form of carbon trading and/or tax.

2. Customers commitment to decarbonize is becoming steelmaker commitments

Steel customers such as **automotive OEMs have ambitious decarbonization targets**, not just for themselves but along the value chain **across their entire bill of material**.

"Green steel" demand is picking up with significant uplift expected **for the next generation of vehicles (2025+).**

3. Investors are backing sustainable companies

Capital accessibility is higher and easier **for sustainable companies**, leading to lower costs of capital.

Capital markets will increasingly scrutinize management actions **on ESG** e.g. BHP has proactively tied management compensation to sustainability outcomes.

4. Employees & Communities are looking for a purpose

The best talent is increasingly **focusing on company purpose**.

Companies with a clear sustainability purpose typically have a 25-50% reduction in employee turnover, 5% increase in employee productivity.

Source : McKinsey & Company

Customers' commitments to decarbonization become steel players' commitments (3/3)

Across iron & steel industry value chain

Key steel customer industries

Automotive OEMs are setting ambitious lifecycle decarb targets; Primary focus of resulting CO2 abatement strategies is on steel, aluminum, and batteries

TOYOTA HONDA BMW HYUNDAI

Public tenders require construction companies to use low carbon materials, including steel as national and local governments in developed countries support **green public procurement**

OBAYASHI DGS CALIFORNIA DEPARTMENT OF GENERAL SERVICES METI Ministry of Economy, Trade and Industry

Steel manufacturers

Short-term fulfillment is difficult for BOF steel players due to different technology options and high financing requirements for new assets

EAF players with offerings already addressing the growing market demand, high quality scrap supply crucial.

The **Global steelmakers** are starting to reduce GHG emissions **through investment in process optimization & technology innovation** e.g. Hydrogen steelmaking, CCUS, etc

NIPPON STEEL posco TATA STEEL SSAB voestalpine ArcelorMittal

Technology suppliers

Equipment supplier key to provide technical solutions for steel players to help them reach their decarbonization targets

Competitive solutions portfolio needed inc. potential prioritization of selected solutions

PRIMETALS TECHNOLOGIES SMS group DANIELI

Source : Company websites;

Basic Oxygen Furnace ("BOF") is steel-making process that uses oxygen in which liquid, carbon-rich pig iron is made into steel ;
Electric Arc Furnace ("EAF") is electric furnace that uses an electric arc to melt scrap into steel

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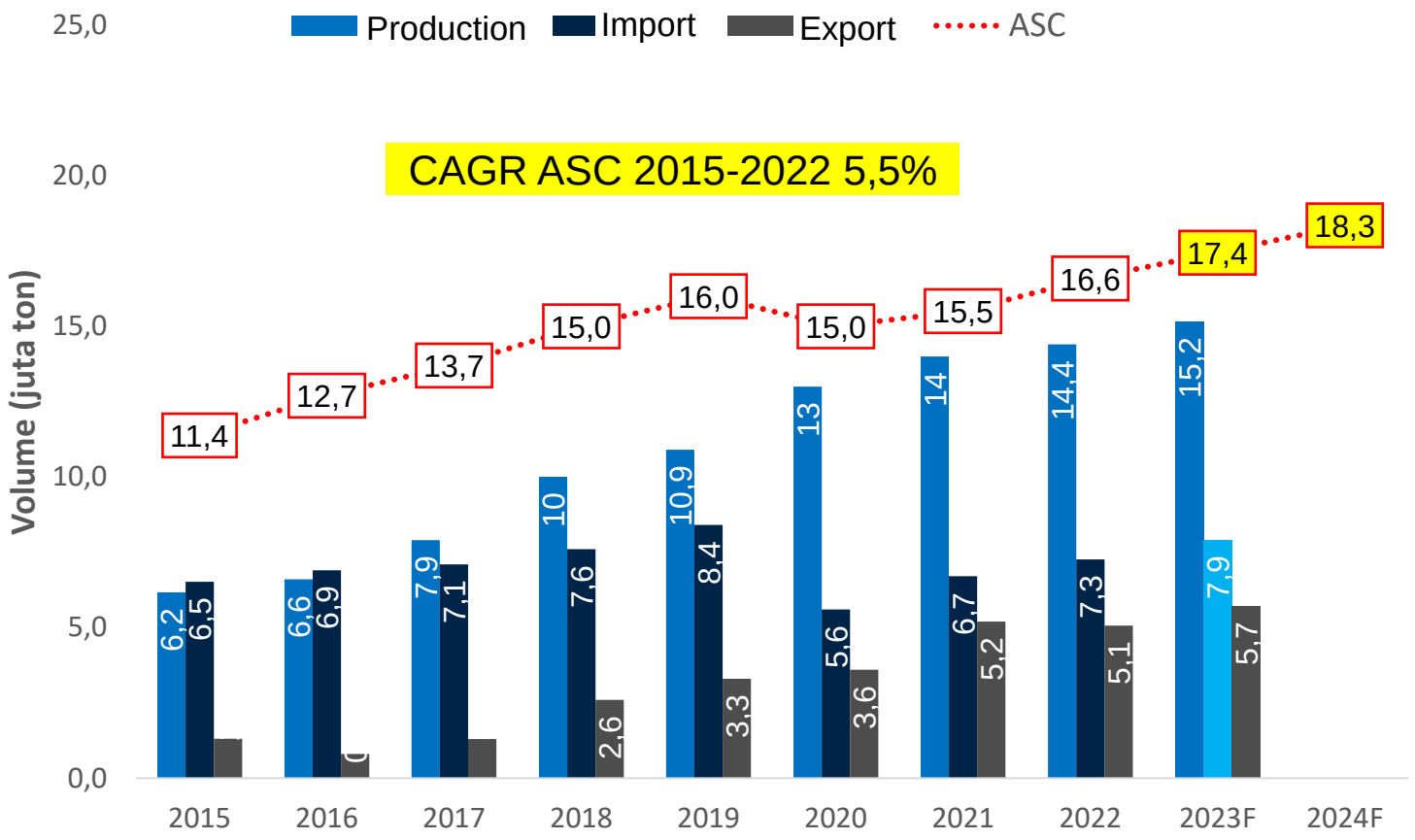
Development of the National Steel Industry 2015 – 2024, throughout the 2015-2022 period, national steel consumption grew at a CAGR rate of 5.5% (1/6)



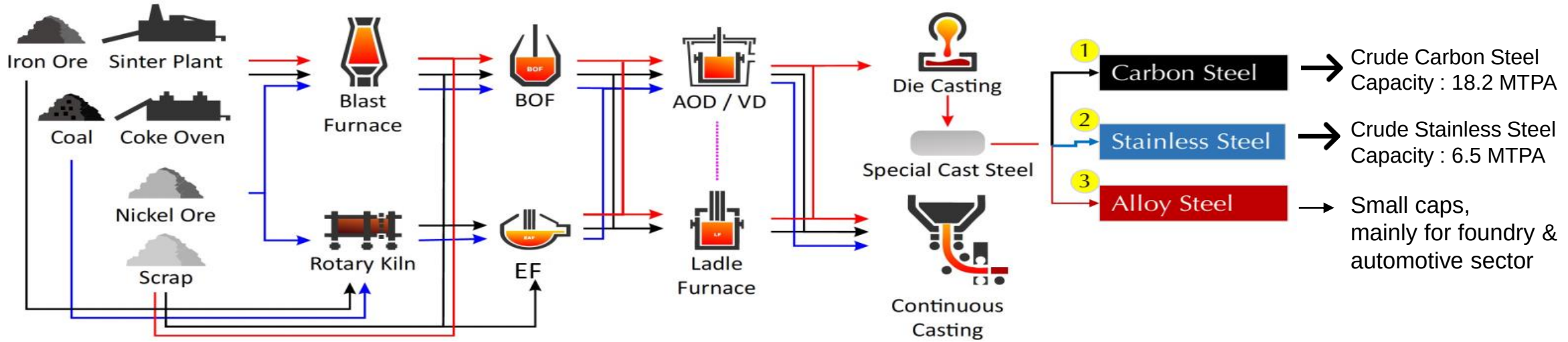
- Throughout the 2015-2023 period, national steel consumption grew at a **CAGR rate of 5.5%** from 11.4 million tonnes in 2015 to 16.6 million tonnes in 2022
- Steel consumption is expected to **continue to grow by around 5%** to 17.9 million tonnes in 2023 and 18.3 million tonnes in 2024.
- **Production and exports continue to experience growth,** even during COVID-19 in 2020
- Imports tend to continue to increase, **only decreasing during COVID-19** and then increasing again although not yet reaching pre-COVID levels

During COVID-19, imports fell drastically but national production increased significantly

✓ Proving the ability of the National Steel Industry to substitute imported products

Source : The Indonesian Iron & Steel Industry Association (IISIA), 2023

Indonesian Steel Industry is classified into 3 types of product i.e. Carbon Steel, Stainless Steel and Alloy Steel (2/6)



- In general, steel products can be classified into 3 types : Carbon Steel, Stainless Steel, and Alloy Steel
- Carbon steel products are the most widely used products (more than 95%), followed by stainless steel (around 2-3%)

Steel Classification	Market	Raw Materials	Investment Drivers
Carbon Steel	• Domestic Market >95% CS • Target Industry : Domestic • Domestic Demand : 16 Million tons	• Iron Ore: Import • Coking Coal: Import • Scrap: Import + Local	• Growth of Domestic Market Potential • Capacity restriction/reductions in China
Stainless Steel	• Domestic Market : 3.5 -5.5 % Stainless Steel • Target Industry : Export • Domestic Needs : 600-800 thousand tons	• Nickel Ore: Local • Coal: Local	• Nickel Ore export ban • Availability of raw materials nickel ore, coal

BOF : Basic Oxygen Furnace, AOD : Argon Oxygen Decarbonization, VD : Vacuum Degassing, EF : Electric Arc Furnace

Source : The Indonesian Iron & Steel Industry Association (IISIA), 2023

Indonesia has committed to reducing GHG emissions by 31.89% in 2030 and Net Zero Emissions in 2060 (3/6)

Indonesia has conveyed the *updated* NDC with the target…….

-31.89% Reduce Greenhouse Gas (GHG) emissions by 2030 including LULUCF*

-43.20% Reduce Greenhouse Gas (GHG) emissions by 2030 with international support

~0% Net Zero Emission in 2060

…projected BAU[1] and emission reduction from each sector…….

Energy Sector
GHG Emission reduction target of **358 Mio ton CO2e** or **12.5%** of Total BAU

Waste Sector
GHG Emission reduction target of **40 Mio ton CO2e** or **1.4%** of Total BAU

IPPU Sector[2] (incl. Iron & Steel Industry)
GHG Emission reduction target of **7 Mio ton CO2e** or **0.2%** of total BAU

Agriculture Sector
GHG Emission reduction target of **10 Mio ton CO2e** or **0.3%** of total BAU

FOLU Sector[3]
GHG Emission reduction target of **500 Mio ton CO2e** or **17.4%** of total BAU

…by developing regulations to encourage the implementation of decarbonization initiatives

Presidential Regulation No. 98 of 2021	Implementation of Carbon Economic Values to achieve National Contribution Targets and Control of GHG Emissions in National Development
Reg. of Minister of Environment no. 21 of 2022	Procedures for Implementing Carbon Economic Values
Regulation of the Minister of Energy and Mineral Resources 16 of 2022	Procedures for Implementing Carbon Economic Value in the Power Generation Sub-Sector
Presidential Regulation no. 55 of 2019	Drive the development of the EV ecosystem

And more…

*) LULUCF = Land Use, Land – Use Change and Foresty

Source: Enhance Nationally Determined Contribution Republic of Indonesia document

1. Business as Usual
2. IPPU : Industrial Process and Product Use (***iron & steel industry, sub-category 2C1***)
3. FOLU : Forest and Other Land Uses

Iron and steel industry is a highly energy-intensive industrial activity and also a large contributor of emission (4/6)

worldsteel ASSOCIATION

Total energy consumption for steel industry:

8% of **Global energy**
(The 2nd largest after the chemical sector)

Total CO_2 emission for steel industry:

7% of **Global emission**
(a ¼ of total industrial emissions)

or

2.6 of **GTon** CO_2 **equivalent**
(More than the amount generated by all road freight)

KRAKATAU STEEL

6.3 Mio GJ

Total Energy Consumption of Krakatau Steel **)

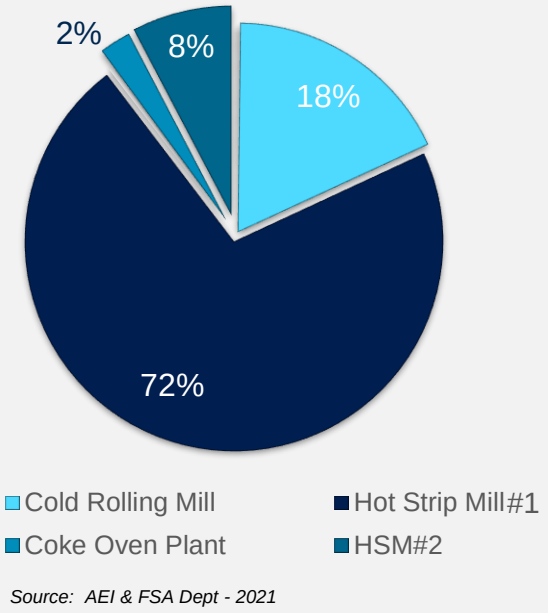
0.8 x10^{-3} GTon CO_2

Total Emission
(CO2 equivalent)

72% Natural gas

28% Electricity

Energy Consumption per plant in 2021 (NG+Electricity)



Source: AEI & FSA Dept - 2021

***) Steel industry is an energy-intensive user, Total energy Consumption of Krakatau Steel is equivalent to electricity consumption per annual for North Sulawesi Province with total land area 13,892 km^2 and 2.5 mio population (Ristek KS)*

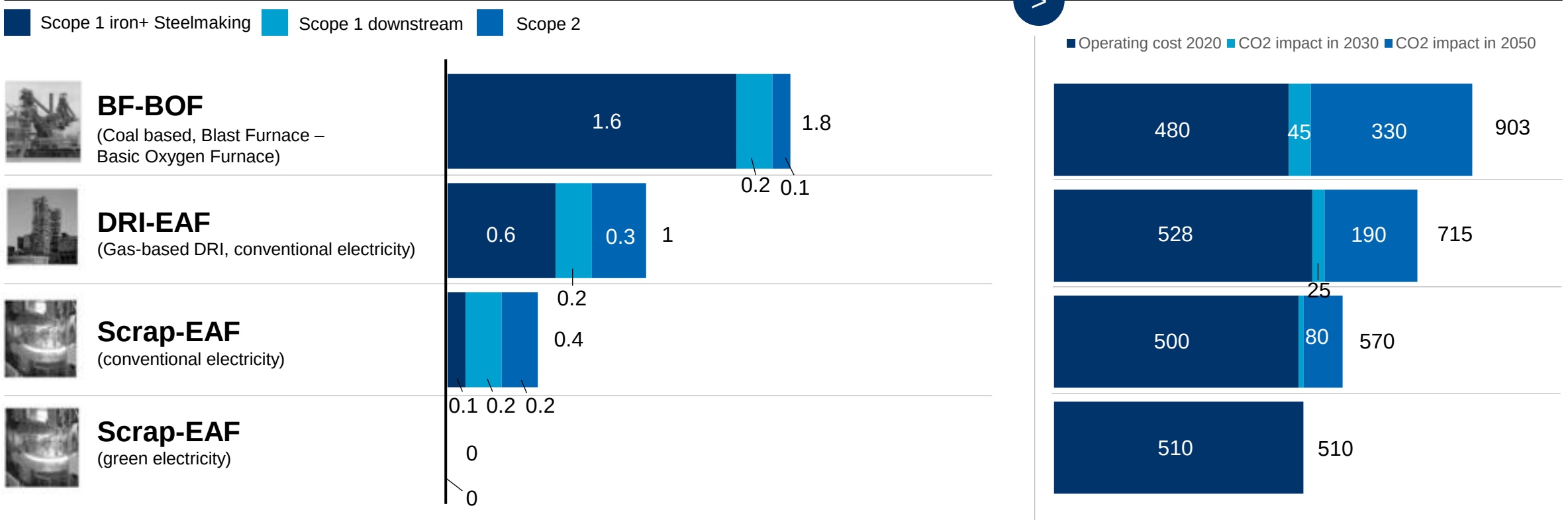
Rising CO2 costs will eventually lead to unsustainable cost pressure for traditional steelmaking technologies i.e. BF-BOF and natural gas-based routes (5/6)

Indicative

Route

Scope 1 & 2 CO2 emissions from mine to finished steel, t CO2/t crude steel

Operating cost USD/t crude steel



1. Mining + preparation (calcining, cokemaking, sintering)
2. Including indirect emissions
3. Assumption: 30% of CO2 emissions not covered by free allowances, CO2 cost of 70EUR/t CO2
4. Assumption: 100% of CO2 emissions not covered by free allowances, CO2 cost of 150EUR/t CO2

Source : McKinsey & Company

Technologies with the most potential to reduce carbon are still not mature except for scrap-based EAF, which is however limited by scrap availability (6/6)

Capturing | Considered as green steel | High | Low

Not exhaustive

	BF-BOF efficiency	Direct smelting	BF-BOF+HBI	BF-BOF bio-mass+scrap maximization	BF-BOF +CCS	DRI-EAF with Natural Gas + CCS	EAF on 100% scrap	DRI+EAF with Green H2
Approach	Improve efficiency to **reduce BF coke input**	Produce iron ore directly using **iron ore fines and non-coking coal** instead of BF	Replace **~20% of iron ore** (62% Fe) with **carbon-free HBI** (92% Fe) in BF	**Replace~40% coke by biomass** in BF, **increase share of scrap** in BOF	Use carbon capture storage to **eliminate CO2 emissions**	Use DRI+EAF with **natural gas** and **carbon capture storage**	Melt **100% scrap** in EAF Exposed grades can be produced on max ~80% scrap	Replace fossil fuels in DRI process with **hydrogen** produced via **electrolysis**
CO2 reduction with renewable electricity mix,%	0-10%	5-10%	10-20%	~40-50%	50-80%	90-95%	95-99%	95-99%
Challenges /Capex	Complete emission **elimination not possible**	Eliminate coke breeze use at the sinter line and heating the gas at coke ovens	Complete emission **elimination not possible**	**Biomass supply limited**	Political restrictions and **Capex >~250 EUR/t steel**	Political restrictions and **Capex >~80 EUR/t steel**	**Limited supply** of high quality **scrap**	**Capex>~1,000 EUR/t Steel** for electrolyzer, DRI plant and EAF
Maturity					No CCS Cases	Only Emirates Steel		Demo plant

1. Across scope 1-2
2. % vs average BF-BOF with emissions 1.7-2.2t CO2 / t liquid steel

Source : KS R&T Team analysis, company publications, McKinsey (2022)

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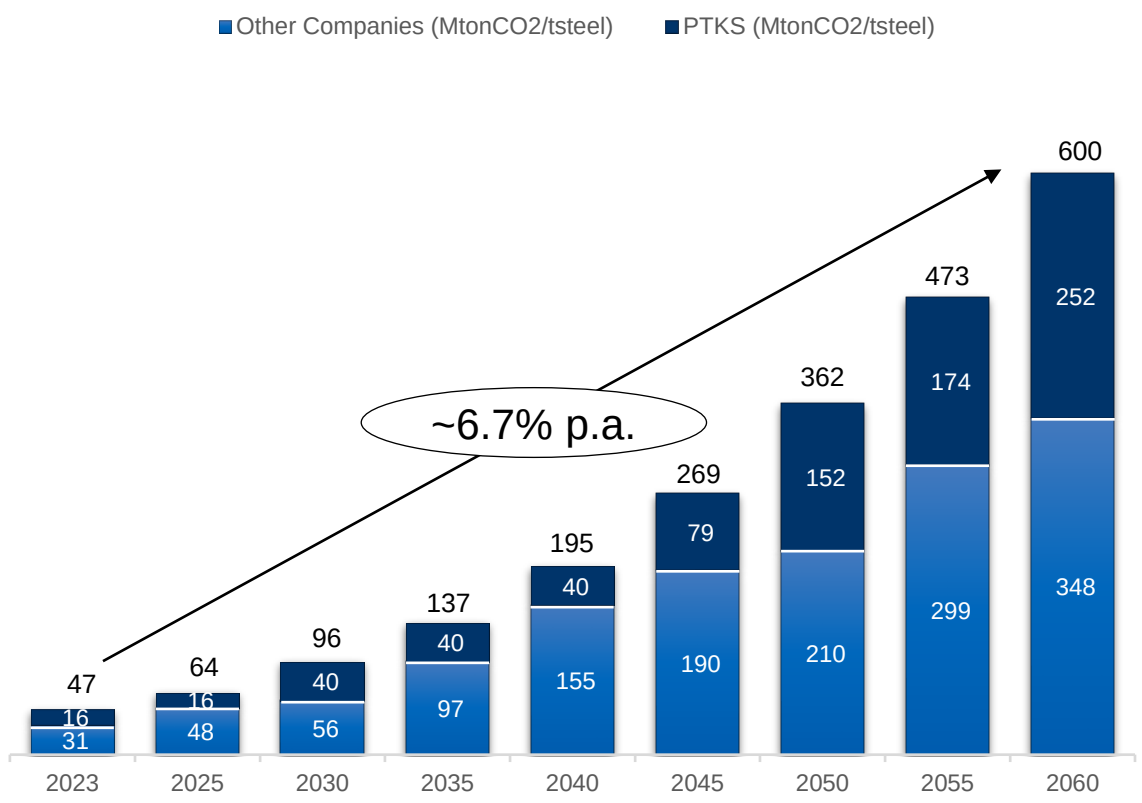
The Indonesian steel demand will achieve ~207 MTPA by 2060 along with generating 600 $MTCO_2$ of emissions….

Projected Indonesian Iron & Steel Industry Emission ($MTCO_2$/tsteel)



*) Source: PwC, IISIA, KS's SP Department (2023) adjusted projection
Assuming emission steel Intencity 2.9 tCO_2/tSteel PTKS

…..will be following Indonesia's achievement in 2060 as one of the Big 4 of the biggest GDP Countries (1/4)

Steel Demand-Supply (x1000 ton)		2023	2030	2050	2060
1	**Indonesia**	**16,000**	**33,000**	**125,000**	**207,000**
	KS Holding	2,400	-	-	-
	KS Affiliation [1)]	3,000	13,700	52,500	87,000
	Others	10,600	19,300	72,500	120,000
2	**KS Steel Supply (%)**	**34%**	**42%**	**42%**	**42%**

KS Holding & Affiliates are foreseen to contribute **252 $MTCO_2$** in 2060 or **42% of total emissions** generated by the Indonesian Iron & Steel Industry

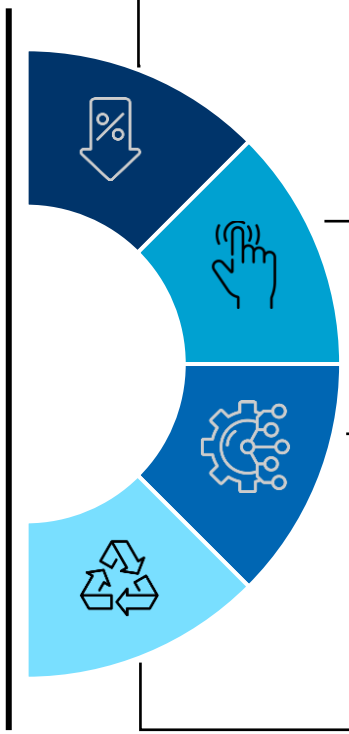
[1)] KS Affiliaties: Krakatau Posco ("KP"), Baowu Group Zhongnan ("BGZ")

To be able to overcome the issues of steel production growth, iron & and steel industry needs to have a mindset beyond the circular economy approach. Resource Efficiency & Cleaner Production and ESG are the solutions… (2/4)

Steel is Green

Steel products are being repaired, reused, returned, and recycled to rebuild capital, whether it is financial, manufacturing, human, social or natural.

This approach enhances the flow of goods and services.



Reduce

Reducing the weight of products which give direct impact on reducing amount of material and energy used

Reuse

Steel can be reused or repurposed in many ways, with or without remanufactured

Remanufacture

Steel product can be remanufactured for reuse or take advantage of the durability

Recycle

Steel is 100% recyclable, and all of steel industries has been carried out “recycling” in their business process

>>

Sustainability is the key activity

All stakeholders should prioritize the sustainability principle in all activities.

Social / Governance
Social Life Cycle Assessment (SLCA)

Environmental
Life Cycle Assessment (LCA)

Economic
Life Cycle Costing (LCC)

To achieve Resource Efficiency & Cleaner Production ("RECP") in the circular economy, Indonesia's Iron & Steel Industry has had world-class renewable energy and abundant Raw Materials which align with the Decarbonization Programmes (3/4)

NBS[1] and carbon market

- **NBS:** 2nd Biggest potential of global low cost NBS with 1.5 $GtCO_2e$ per year
- **Carbon market:** one of biggest carbon market, facilitate the transaction of ~150 Mn t CO_2 /year in 2030[1]

Renewable energy

- **Geothermal:** Has highest global potential, take 25% of global geothermal potential (28 GW)
- **Solar:** 200+ GW of power generation coming from high irradiation
- **Bioethanol:** Indonesia has ~180k Ha cane agricultural are which produce ~35 Mn ton of ethanol

Hydrogen & carbon capture

- **Hydrogen:** 2+ Mtpa of demand in 2030, Industries contribute more than a half.
- **CCUS[3]:** Has 200 Mtpa as potential sequestration

EV ecosystem

- **Battery:** has highest nickel reserve by 20+% out of global reserve (21 Mn ton)
- **EV[2]:** Potential growth 30+% p.a, it is estimated ~200k EV will be sold in 2030

Local Raw Material

Local content: Indonesia has had abundant local raw material that is waiting to be used e.g. Iron sand, low grade iron ore, rare earth material, etc

*) Source: KBUMN, 2023

1. Nature Based Solution
2. Electric Vehicle
3. Carbon Capture, Utilization & Storage

CO2 reduction efforts which focus on enhancing cost competitiveness as well as creating New Green Businesses are the key to deciding decarbonization efforts @ Krakatau Steel Group & Affiliates (4/4)

Programmes toward Carbon Neutral

Krakatau Steel Group and its affiliates have had a programme to reduce CO_2 emissions by 33% in 2030 and achieve **carbon neutrality in 2060 by embracing digitization & RECP**

2023 - 2025
▼11% of CO_2

Green Behavior (Quick Wins)
Energy conservation, renewable energy, circular economy & implementing "Go-Green" behavior, research related to smelter-hydrogen reduction based, raw material *substitution*, ESG, EPD & CBAM, Eco-Ind Park;

2025- 2040
▼33% of CO_2

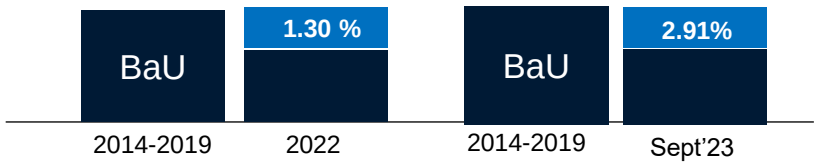
Electrification, CCUS & Hydrogen-based
EV Ecosystem, Natural Gas and H2 gas injection at BF & CCUS, H2 Hub at KIK & hydrogen-based reduction for +10 mtpa steel in BF-BOF development with KP(phase2) & ISM reactivation with BGZ and internal studies related to H2 steel plant.

2040- 2060
▼100% of CO_2

New green field of H_2 Steel Plant
Building a new factory with the "Green Steel" concept using the latest and environmentally friend technology in stages.

KS Achievements and Strategies toward Green Industry

Emission Reduction by Initiation



Achievement & Green Behavior Programme (Selected)

2019-2023

Energy Conservation

▼27% Transparent Roof

▼61% LED Conversion

▼21% COG at RHF 1 HSM

▼49% BFC Air Compressor

▼31% Solar Panel at Technology Building

Others Digital Transformation, Life Cycle Assessment etc

Emission Reduction/year
~8.3 ktCO2

Saving/year
USD ~4.5 Mio

2023-2025

Next Step Program for Green Industry

Go Green activities | ESG Report | Energy Mgt. (ISO 50001) | EPD & CBAM | Eco-Ind. Park

CCUS: Carbon Capture & Utilization Storage

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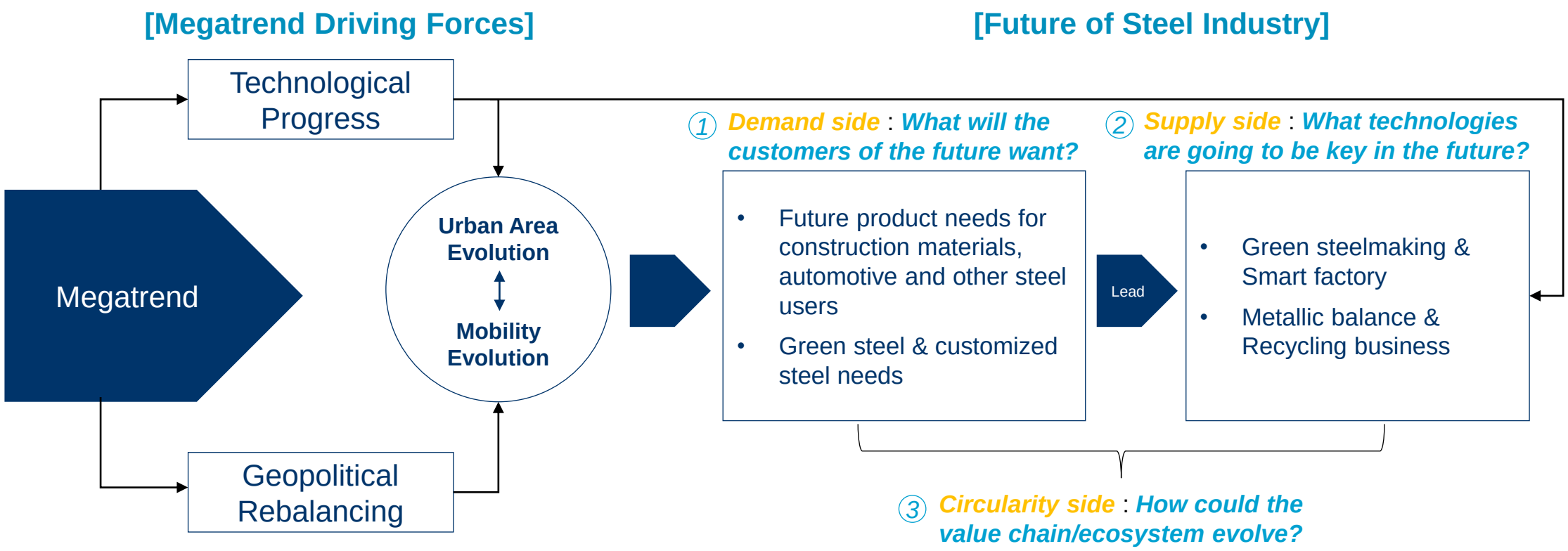
#1 On Megatrends - How steel business will thrive under rapidly changing on business environment? (1/2)

Sustainable and resilient steelmaker : Eco-friendly and digital producer of smart, green and customized solutions



Source : KS R&T Team analysis, Worldsteel & SEAISI Research (2022)

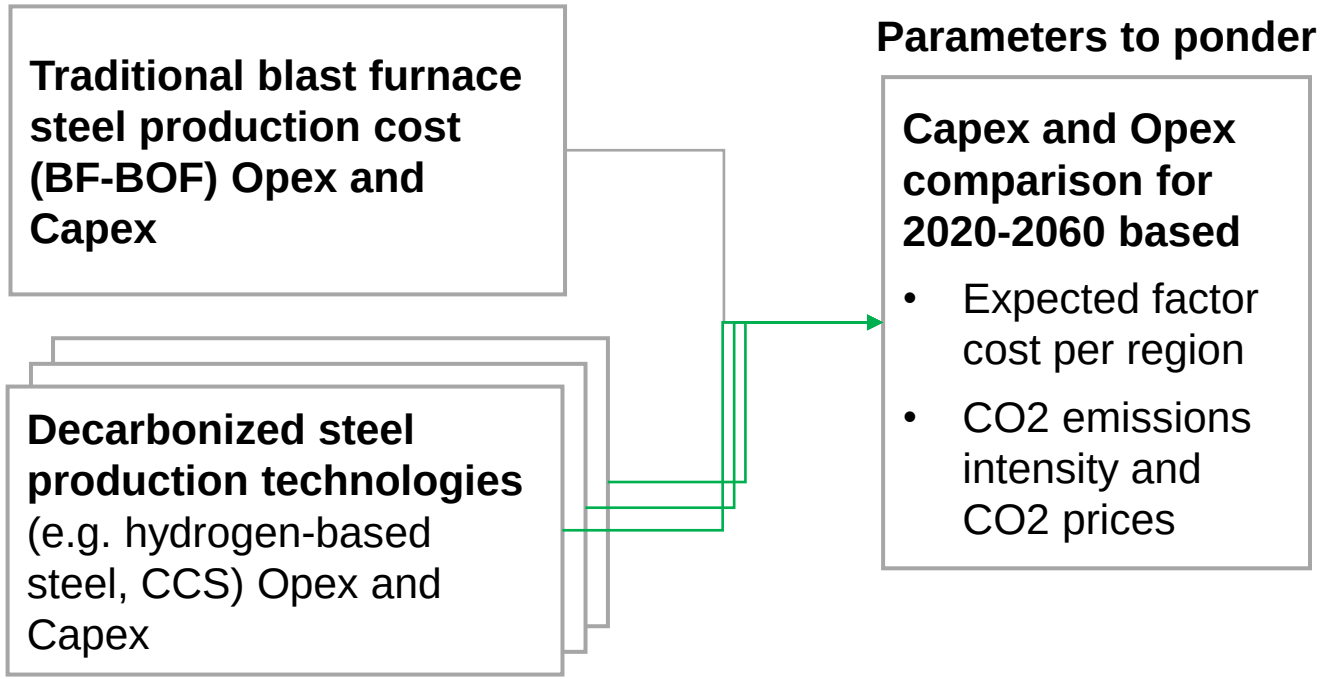
#2 CO_2 reduction potential and cost competitiveness are key in deciding the right options technology for Steel Industry (2/2)

What are the parameters for the steel industry to catch up with the megatrends?

Key questions about steel decarbonization

- **Technology**: What is the CO_2 reduction potential of different technologies?
- **Cost of competitiveness**: Which technology is most competitive with respect to production cost (Opex)?
- **Investment**: How big is the investment related to the technology (Capex)?
- **Timing**: When is the right time to invest in decarbonization technologies?

> Steel decarbonizations cost model



Source : Steel decarbonization cost model