

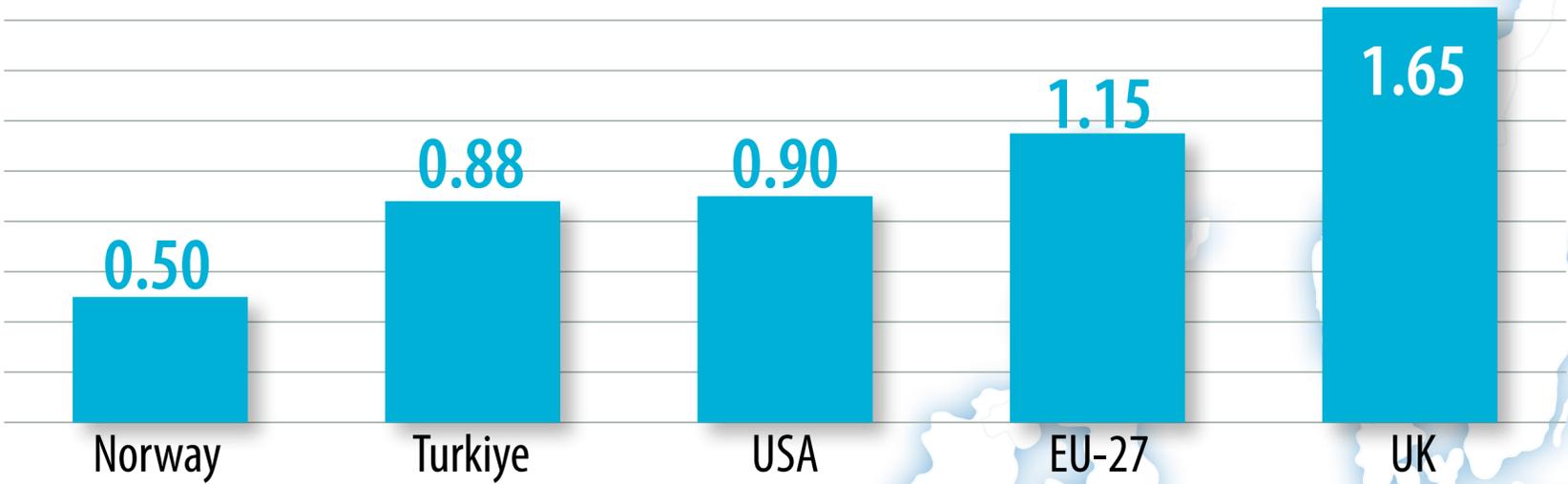
# GREEN STEEL TODAY

## UP TO 2035

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# THE EU HAS POTENTIAL FOR FURTHER DECARBONIZATION

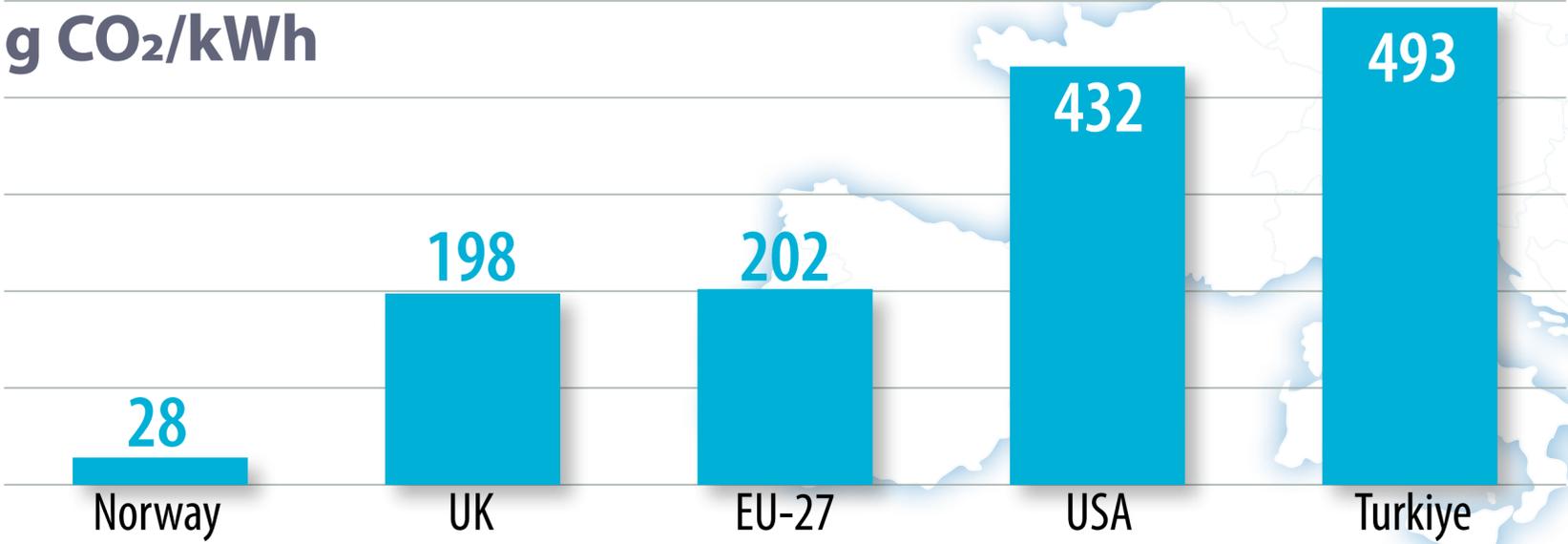
## CARBON INTENSITY OF CRUDE STEEL, t CO<sub>2</sub>/t steel\*



Data source: JRC

\* Scope 1 & Upstream + Scope 2

## CARBON INTENSITY OF ELECTRICITY GENERATION, g CO<sub>2</sub>/kWh



Data source: European Environmental Agency, Electricity maps

The EU is not leader in average carbon intensity of steel production. For example, in the EU 44.8% of steel is produced in EAFs, while in USA – 68.3%. That is why USA has lower carbon intensity of steel production.

The EU also lags behind some countries in average carbon intensity of electricity generation. In 11m 2024 28% of electricity was generated from fossil fuels in the EU. Coal is the source for 9.7% of electricity, natural gas – for 14.7%.

To be real leader globally the EU should intensify efforts in decarbonization.

# ALL MAJOR STEEL PRODUCERS OFFER “GREEN” STEEL BRANDED PRODUCTS



Company	“Green” steel brand
thyssenkrupp Steel	bluemint
ArcelorMittal Europe	XCarb
voestalpine	greentec
Salzgitter	SALCOS
Kobe Steel	Kobenable
POSCO	Greenate
US Steel	verdeX
Nippon Steel	NS Carbolex Neutral
JFE Steel	JGreeX
Hyundai Steel	HyECOsteel
Tata Steel Ijmuiden	Zeremis Carbon Lite
Tata Steel UK	Optemis Carbon Lite
Arvedi	Arvzero
Acciaierie d'Italia	Penisola steel
Saarstahl	Pure Steel+
SSAB	SSAB Zero
Nucor	Econiq
Tosyali	Tosyali V-Green
Tokyo Steel	enso, Near Zero

Majority of brands are based on certificates which follows the mass balance approach to allocate achieved emission reductions to specific steel products. It does not mean that offered steel products are physically produced with lower carbon intensity.

Consumers do not want to buy “green” steel which is not physically CO<sub>2</sub>-reduced. Carbon offsets are also considered as greenwashing. Only possibility to sell “green” steel products is production of physically CO<sub>2</sub>-reduced steel.

# EVERYONE HAS OWN UNDERSTANDING OF “GREEN” STEEL

## GMK CENTER’S DEFINITIONS BASED ON CARBON INTENSITY (Scope 1 + Scope 2)

“GREEN”  
STEEL

**0.25 and less t CO<sub>2</sub> per ton of steel**

*“Green” steel is produced via the most progressive technologies:*

- *BF-BOF + CCUS*
- *DRI-EAF or smelters + EAF with share of H<sub>2</sub> in gas mix – 80% & more*
- *iron electrolysis*

SCRAP-  
BASED  
EAF STEEL

**0.2-0.4 t CO<sub>2</sub> per ton of steel**

“Green” steel became a subjective judgment and more marketing term.

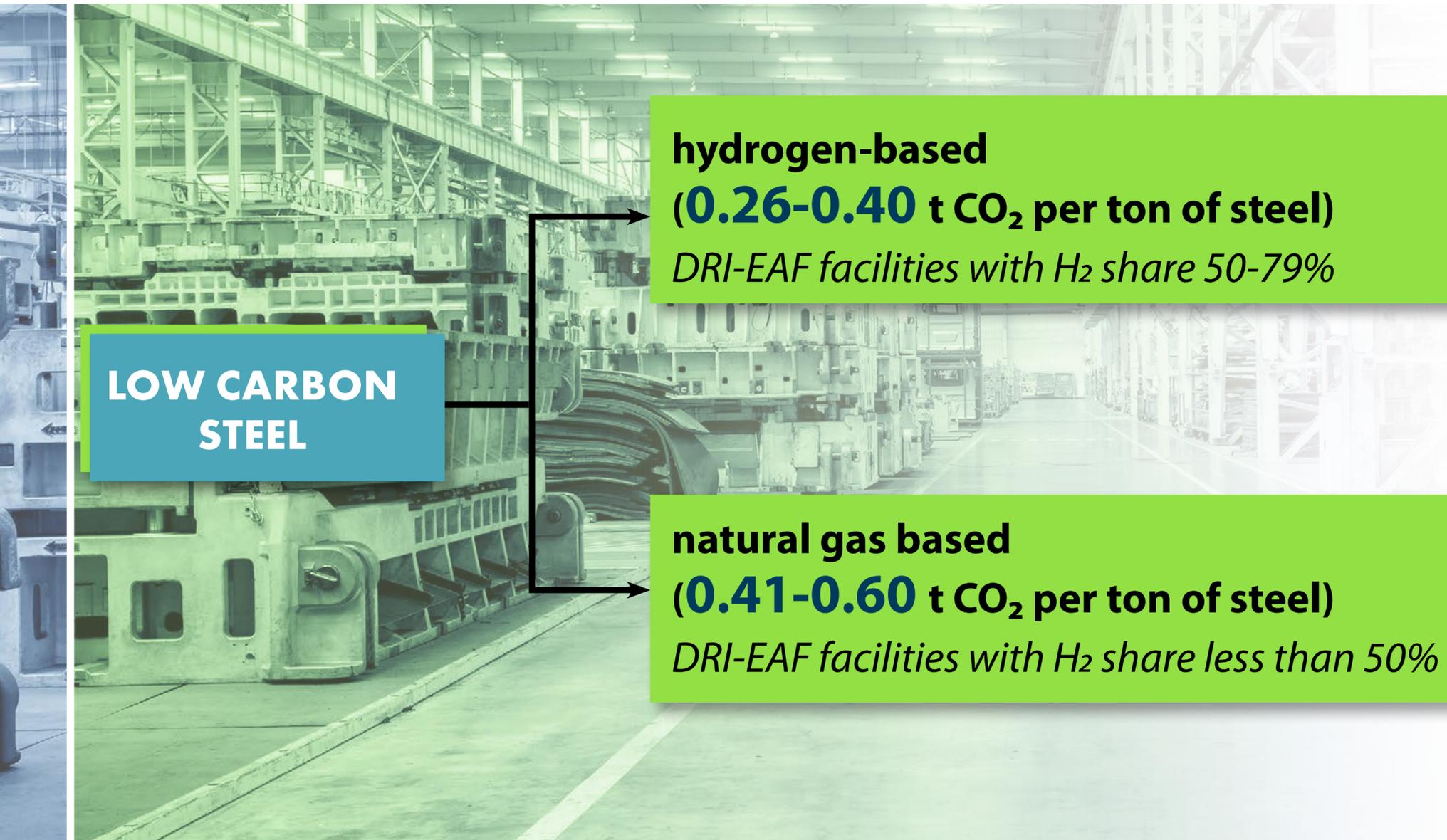
GMK Center distinguished “green” steel based on carbon intensity and production technologies used.

“Green” steel should be produced with the lowest carbon emissions using the most progressive technologies and max share of H<sub>2</sub>.

Scrap-based EAF steel is reviewed separately. Decarbonization trend requires all steel manufacturers, incl. EAF-based, to reduce emissions from current levels.

# LOW CARBON STEEL HAS HIGHER CARBON EMISSIONS THAN “GREEN” STEEL

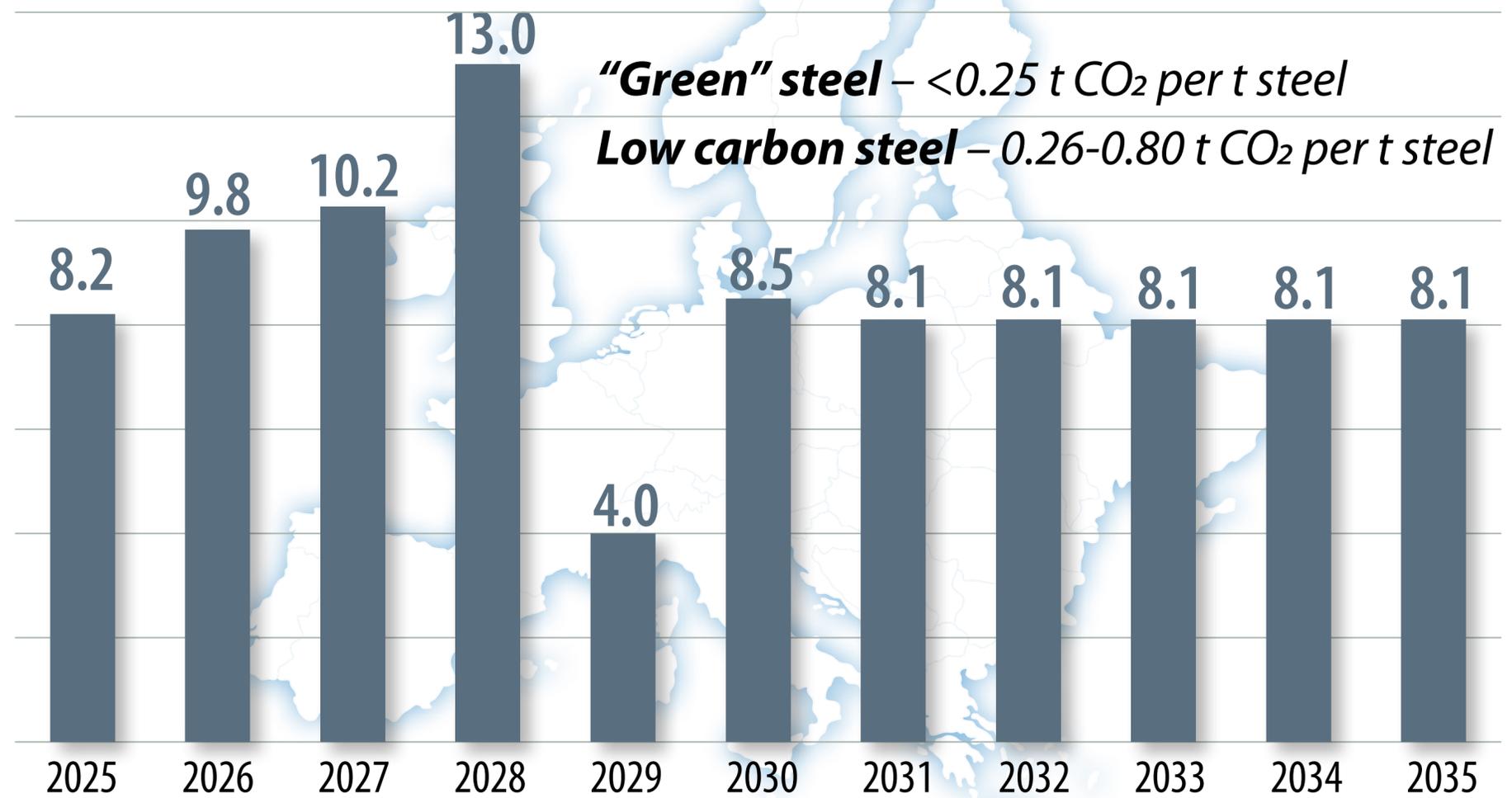
GMK CENTER’S DEFINITIONS BASED ON CARBON INTENSITY  
(Scope 1 + Scope 2)



- We consider low carbon steel as DRI-EAF based.
- Carbon intensity of low carbon steel depends on H<sub>2</sub> share in gas mix used in steel production.
- Low carbon steel can be natural gas based, but with some share of H<sub>2</sub> (up to 50%).

# MAJORITY OF EUROPEAN COMPANIES ANNOUNCED PLANS TO EXPAND THEIR GREEN STEEL CAPACITIES

## COMMISSIONING NEW "GREEN" STEEL CAPACITIES IN EU, mln tons



Data source: companies' reports, GMK Center estimates

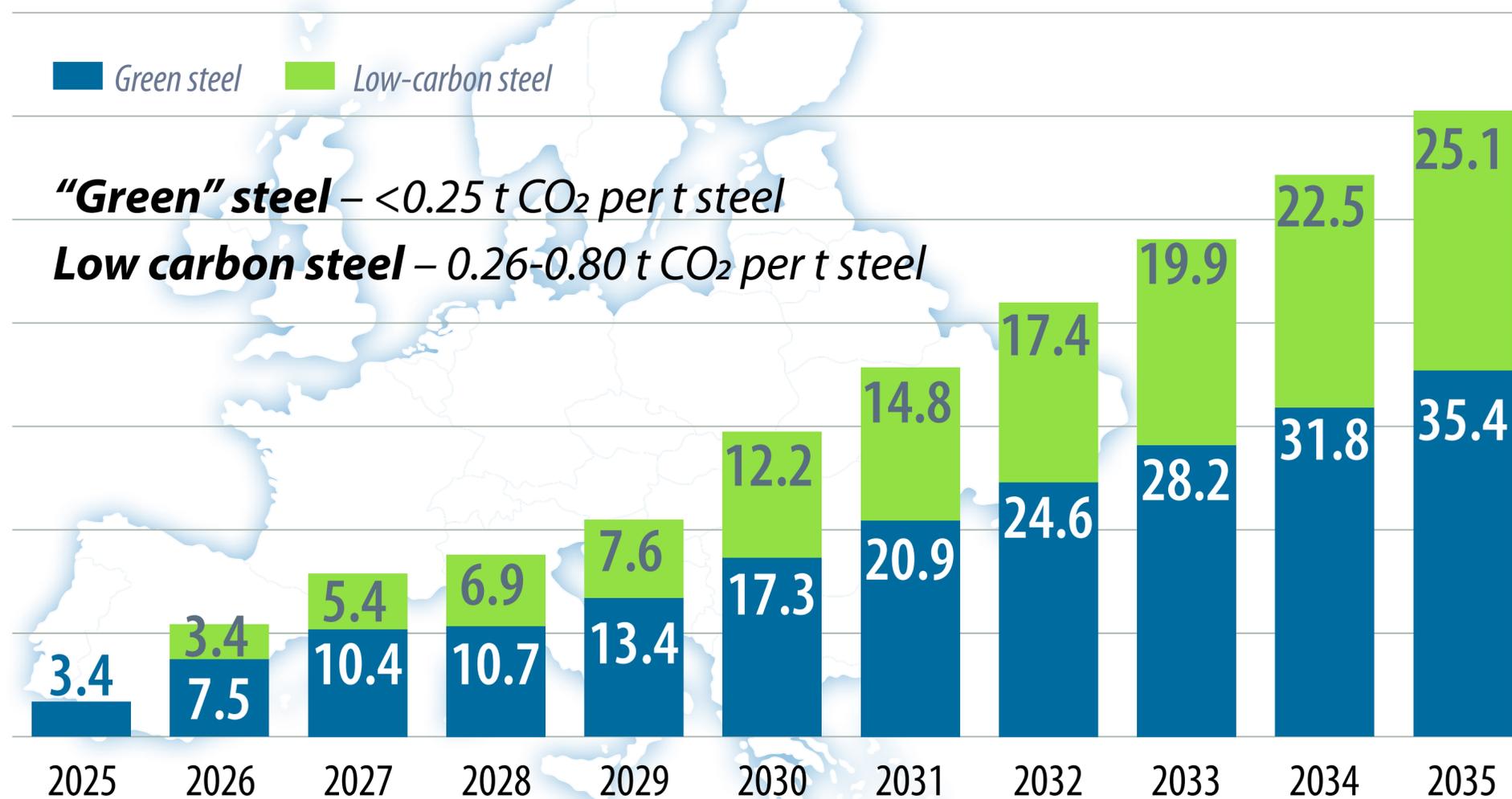
The implementation period for the announced plans is until 2030. We found no plans after 2030. So, for 2030-2035 we forecasted commissioning 'green steel' capacities as annual average in previous years.

The implementation of projects after 2030 will depend on how much companies achieve their emissions reduction targets. If companies meet their goals, it is quite possible that there will be no new large-scale projects until 2035.

Financial performance of companies in 2027-2030 will also impact on announcements of projects after 2030. Market stagnation and unsatisfactory results from past projects may negatively affect the expansion of capacity.

# TILL 2035 EUROPEAN STEEL INDUSTRY MAY DECARBONIZE ABOUT 48% OF CURRENT STEELMAKING

## GREEN AND LOW-CARBON STEEL PRODUCTION IN EU, mln tons



Data source: calculations of GMK Center

- We include in forecast only production of “physically reduced” steel. In our opinion, production of “certificate-based” steel should not be recognized as decarbonization.
- We suggest all projects constructing “green” steel capacities in EU till 2030 have been already announced. There will be no new projects, other than those already announced.
- There is high uncertainty about projects after 2035.

# FACTORS DEFINING “GREEN” AND LOW-CARBON STEEL PRODUCTION IN THE EU

- 
- Carbon pricing, including EU ETS, CBAM
  - Available technologies
  - Investments in “green” steel projects
  - Progress of projects to launch “green” steel facilities
  - “Green” premiums
  - Demand for “green” steel from government and private sector
  - “Green” steel production costs in EU and third countries
  - Development of renewable energy sector
  - Supply of “green” hydrogen and its price
  - Availability of DR-grade iron ore

# PRODUCTION OF “GREEN” STEEL WILL NEED DRI SUPPLIES AND EAFS INSTALLATION

## BROWNFIELD PROJECTS

Close  
BF  
and BOF

Launch  
DRI-unit  
and EAF

## GREENFIELD PROJECTS

Construct  
hydrogen-based  
DRI and EAF

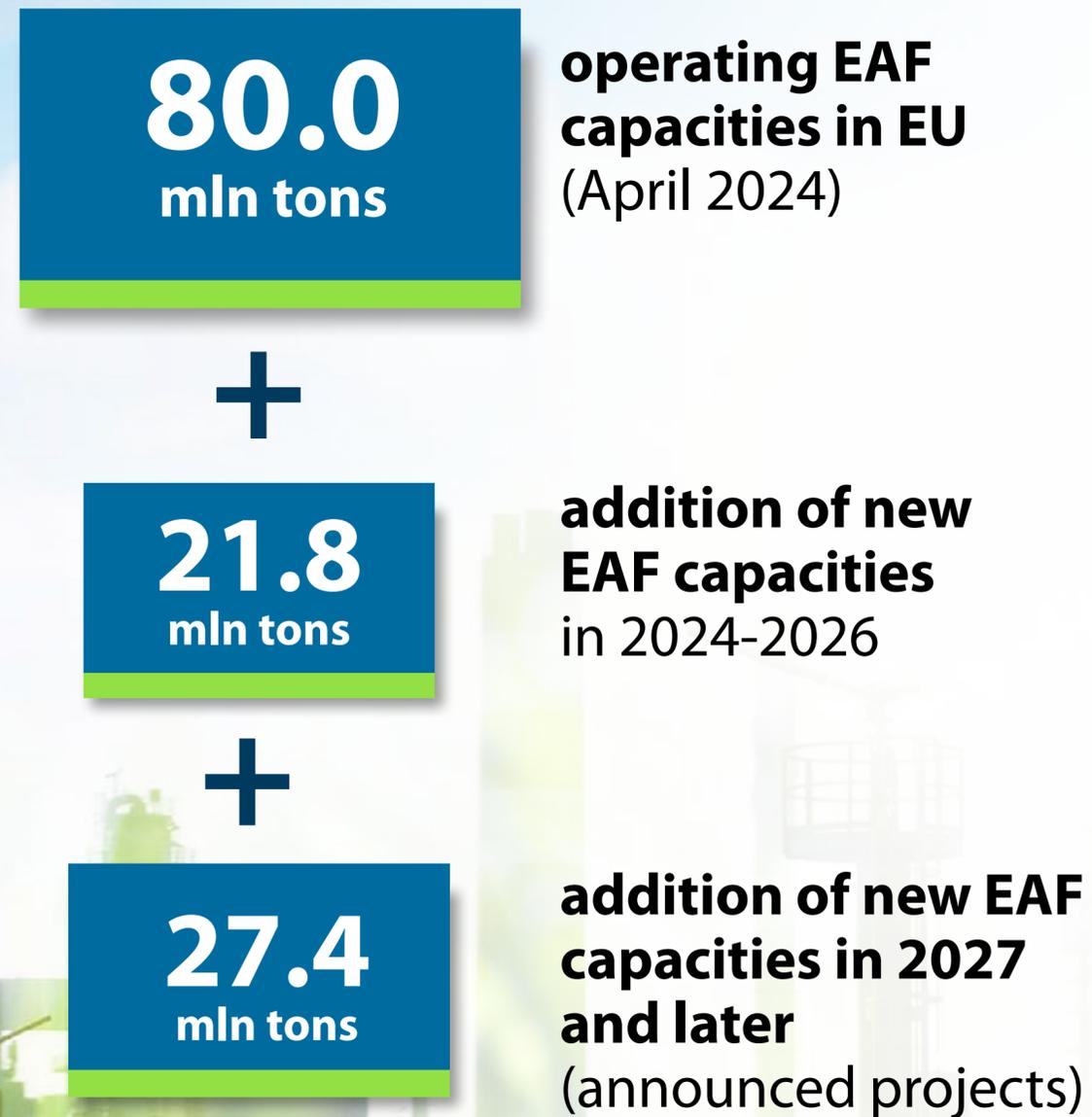
DRI-EAF route is recognized as leading technology for decarbonization in EU.

Integrated steelmakers plan to substitute BFs and BOFs by DRI units and EAFs. According to GMK Center estimations, in 2030 total capacity of such brownfield projects may reach 25.8 mln tons of DRI/HBI.

New low-carbon projects plan to construct hydrogen-based DRI units and EAFs together with modern energy infrastructure. According to GMK Center estimations, in 2030 total capacity of such greenfield projects may reach 13.7 mln tons of DRI/HBI.

DRI-EAF route is not the only option for “green” steel production. For example, Primetals developed smelter which can substitute BF and continue to work with BOF (there is no need to construct EAF to replace BOF). This technology can change decarbonization plans of European steelmakers.

# STEEL COMPANIES IN EU PLAN TO ADD AT LEAST 49 mln tons OF EAF CAPACITIES

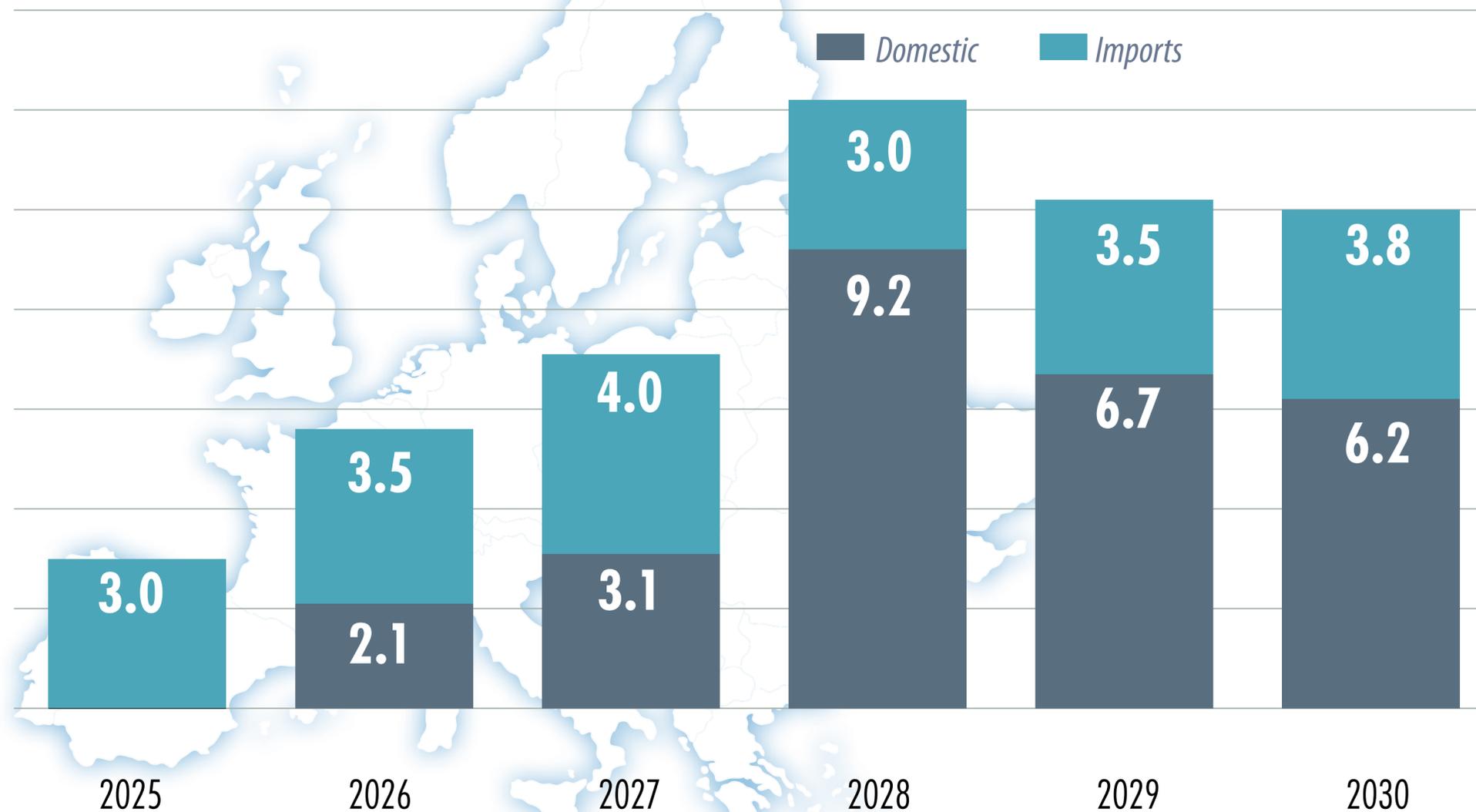


- Decarbonization projects of European steel companies are based on commissioning new EAF capacities.
- According to announced projects, EAF capacities in EU will increase at least by 60% compared to 2024. Since not all companies have announced capacities of planned EAFs, the increase rate may be larger.
- New EAFs will need additional scrap supply, even if company plans to construct DRI plant. Scrap and DRI are complementary resources, which are used together.

Data source: Global Energy Monitor, OECD, companies' data, GMK Center calculations

# DRI/HBI SUPPLIES WILL DETERMINE POSSIBILITIES OF “GREEN” STEEL PRODUCTION IN EU

POTENTIAL HBI/“GREEN” HBI SUPPLY IN EUROPE, mln tons



Data source: GMK Center calculations

According to GMK Center calculations, possible domestic supply of HBI in the EU could be up to 6.2 million tons, considering the partial orientation of new market players to merchant HBI.

Massive commissioning of European HBI projects is expected in 2027-2028, that creates opportunity to meet 10 mln tons demand for HBI in 2030, together with 3.8 mln tons of imports.

New market players will develop their own “green” steel production that will lead to decreasing merchant HBI supplies.

# POTENTIAL INCREASE IN DRI DEMAND ATTRACTS NEW COMPANIES TO IMPLEMENT DRI PROJECTS IN THE EU

## GREENFIELD DRI/HBI PROJECTS IN THE EU

PROJECT	Capacity, mln tons	Expected launch
H2GS BODEN (1)	2.1	2026
PRIMETALS GRAVITHY	2.5	2027
H2GS BODEN (2)	2.0	2027
H2GS IBERIA (1)	2.5	2028
BLASTRGREENSTEEL	2.5	2028
H2GS IBERIA (2)	2.5	2030
METINVEST/DANIELI	n/a	2027
HYDNUM STEEL	n/a	2030

Internet media, GMK Center estimations

While existing European steel companies announced captive DRI/HBI projects, new players also want to commission greenfield DRI/HBI facilities.

Projects like Stegra (H2 Green Steel), Gravithy, BlastrGreenSteel may create domestic HBI market in the EU.

Project of Danieli and Metinvest will meet needs of captive EAF plant aimed on production of flat products. Potential investment in the project may reach €2.5 bln. DR-pellets will be supplied from Ukraine.

# UKRAINE CAN PARTICIPATE IN EUROPEAN DRI SUPPLY CHAINS, CONTRIBUTING TO “GREEN” TRANSFORMATION OF STEEL SECTOR IN EU

## MAIN COMPETITIVE ADVANTAGES OF UKRAINE

Deposits of iron ore suitable for DRI production

Short delivery terms to EU

Potential to increase production of DR-grade products

**20-25**  
mln tons

potential merchant supply of DR-grade feed from Ukraine in mid-term



**180**  
mln tons

potential demand growth for DR-grade feed globally in 2030, according to announced projects, about 60 mln tons in EU countries

Ukraine is a traditional and well-known supplier of iron ore products for EU. Ukraine can also supply DR-grade iron ore pellets for DRI/HBI production.

Ferrexpo and Metinvest (Central mining & processing plant) have already launched production of DR-grade pellets. Before the war Southern mining & processing plant was considering to launch production of such product.

Metinvest in collaboration with Danieli plans to construct new EAF-based steel plant in Italy. DR-pellets will be supplied from Ukraine. Potential investment in the project may reach €2.5 bln. It will be major step to “green” transformation of Metinvest and steel industry of EU.

# VISION BY GMK CENTER

## UKRAINIAN IRON & STEEL INDUSTRY IN 2035

	2021	2023	2035
Nominal steelmaking capacities, mln tons	27.0	17.8	15.0
Steel output, mln tons	21.4	6.2	12.0
Scrap-based EAF output, mln tons	1.0	0.8	2.0
Low carbon steel output, mln tons	-	-	5.0
Steel export (finished), mln tons	15.1	3.3	7.1
HBI export, mln tons	-	-	2.0

\* Assuming the actual front-line



# VISION BY GMK CENTER

## “GREEN” STEEL SUPPLY IN THE EU IN 2035



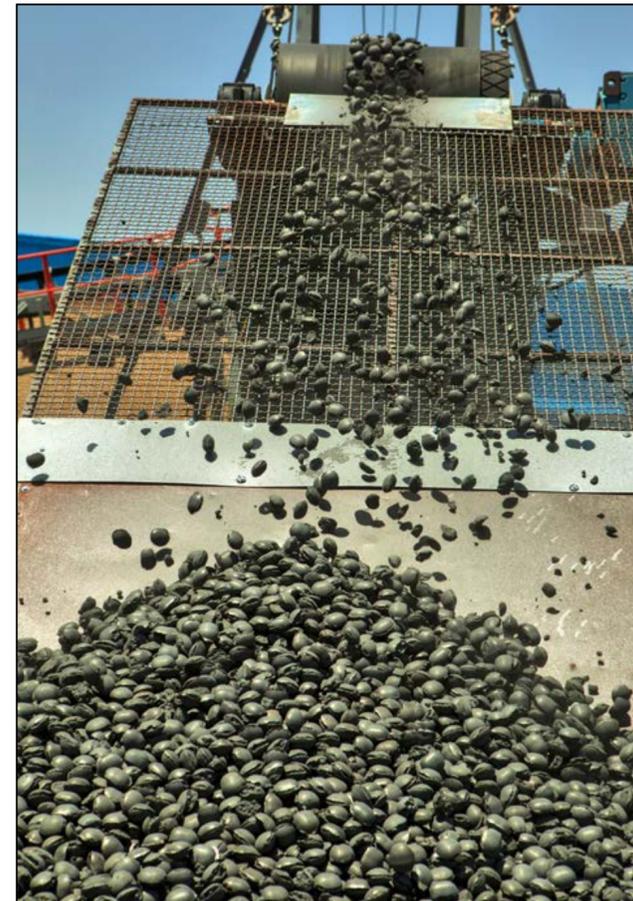


Ukrainian based consulting company focused on European steel market

## GMK CENTER SERVICES



**PROSPECTS OF GREEN STEEL MARKET IN THE EU TILL 2030**



**TRENDS ON GLOBAL DRI/HBI MARKET**



**COMPARATIVE ANALYSIS OF DECARBONIZATION STRATEGIES OF GLOBAL IRON & STEEL COMPANIES**



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