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# Promoting Enhanced EU ETS Alignment in Türkiye's Emerging ETS

*This activity is part of the European Union Climate Dialogues Project (EUCDs)*

## Iron & steel

*Fabio Romani and Matias Franke*

*23 – 07 - 2026*

*This publication was funded by the European Union. Its contents are the sole responsibility of the author and do not necessarily reflect the views of the European Union*



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## MODULE 2 — CBAM-RELEVANT PRODUCT BENCHMARKS BY SECTOR

# Online Day 2 — Iron & Steel

*Free allocation benchmarks · system boundaries · BDR data · worked calculation*

**BF / BOF** integrated route

**DRI / EAF** gas-based primary

**Scrap / EAF** secondary route

Experts: F. Romani / M. Franke



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## Training Presentation: iron & steel

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## DAY 2

# Agenda for the day

|   |                                                                                       |                                |
|---|---------------------------------------------------------------------------------------|--------------------------------|
| 1 | Introduction: Routes and benchmark map (EU ETS ↔ CBAM)                                |                                |
| 2 | How emissions are counted (MRV & mass balance)                                        |                                |
| 3 | The production routes in technical detail & the benchmark curve                       | Detailed sector:<br>Iron&steel |
| 4 | System boundaries and relation between EU ETS benchmarks and CBAM                     |                                |
| 5 | Full worked calculation EAF – high alloy steel (Emissions + allocation + CBAM factor) | Case study:<br>Iron&steel      |
| 6 | Example of a full integrated plant (Emissions + allocation) - <i>overview</i>         |                                |
| 7 | Q&A                                                                                   |                                |



## CONTINUITY

# What is new in 2026

### Covered in the 2024 training (Day 2)

- EU ETS iron & steel product benchmarks
- Blast-furnace and EAF system boundaries
- ETS layout of a steel plant

### New focus in 2026

- The EU ETS ↔ CBAM interface
- Route-based CBAM benchmarks
- Crude-steel routes
- Free-allocation of iron and steel

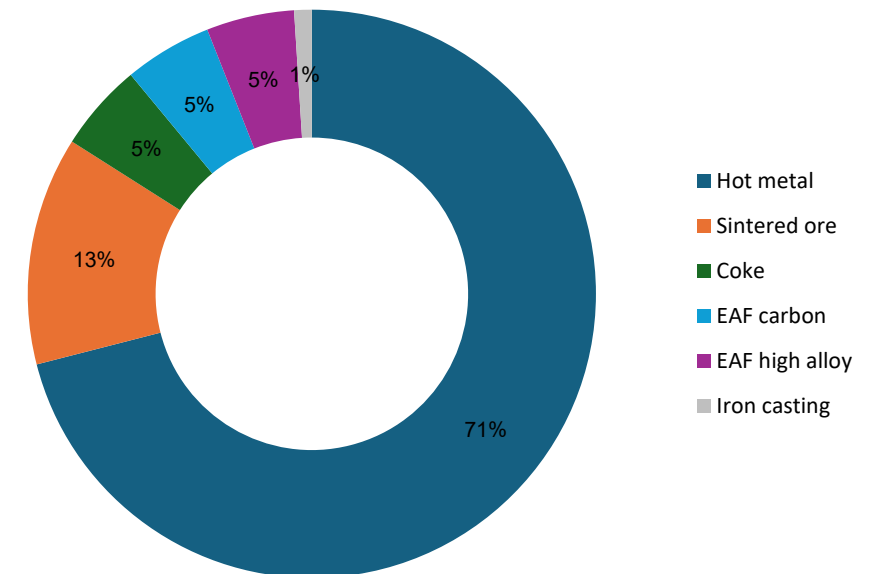


## CONTEXT

# Why iron & steel: weight in the EU ETS and CBAM

- Iron & steel is the largest product-benchmark sector in the EU ETS
- Hot metal dominates emissions within the sector
- All iron & steel benchmarks are on the carbon-leakage list (CLEF = 1)
- All are within CBAM scope — so free allocation is being phased out

Benchmarked emissions, metal sector (2016/17 avg)

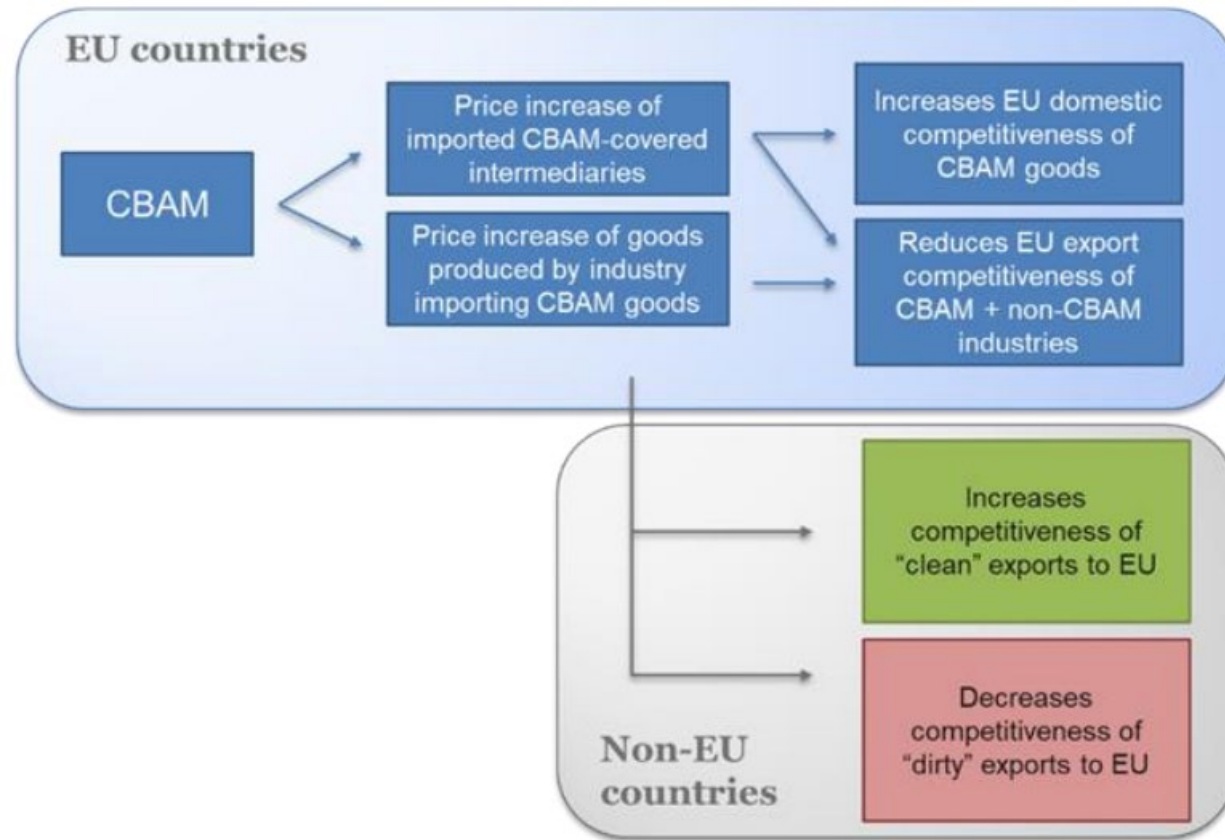


Source: EU benchmark-curve factsheet, 12 Oct 2021 (attributed 2016/17 emissions). [research material/]



OECD - Carbon Border Adjustments: The potential effects of the EU CBAM along the supply chain

## Value of imports covered by CBAM by exporting sector, 2022.



### EU Countries

- Price increase of imported CBAM-covered intermediaries
- Price increase of goods produced by industry importing CBAM goods
- Increases EU domestic competitiveness of CBAM goods
- Reduces EU export competitiveness of CBAM + non-CBAM industries

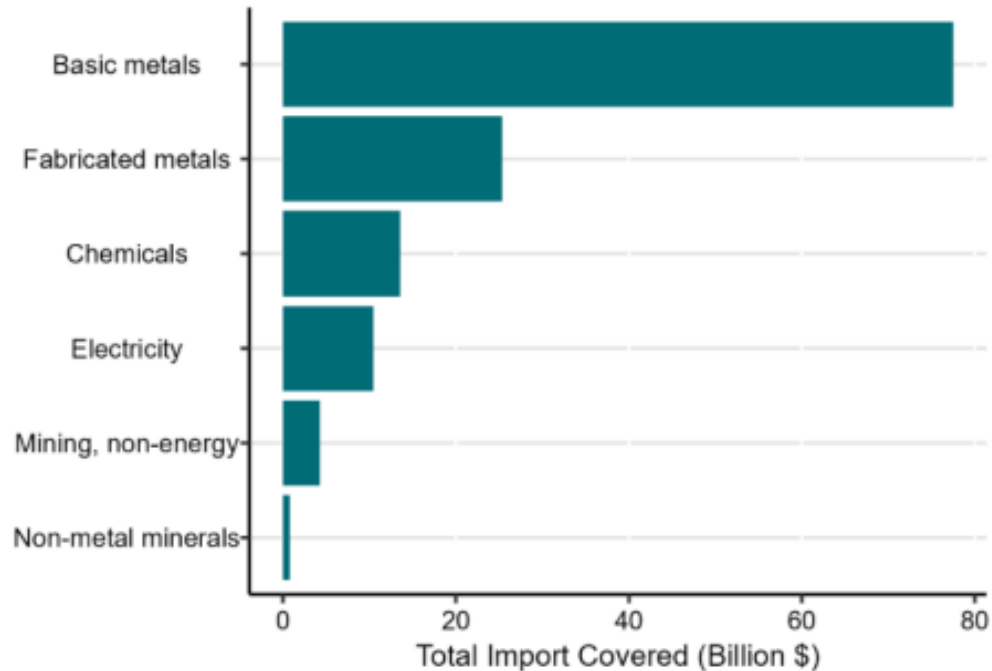
### Non-EU Countries

- Increases competitiveness of "clean" exports to EU
- Decreases competitiveness of "dirty" exports to EU



OECD - Carbon Border Adjustments: The potential effects of the EU CBAM along the supply chain

## Value of imports covered by CBAM by exporting sector, 2022.

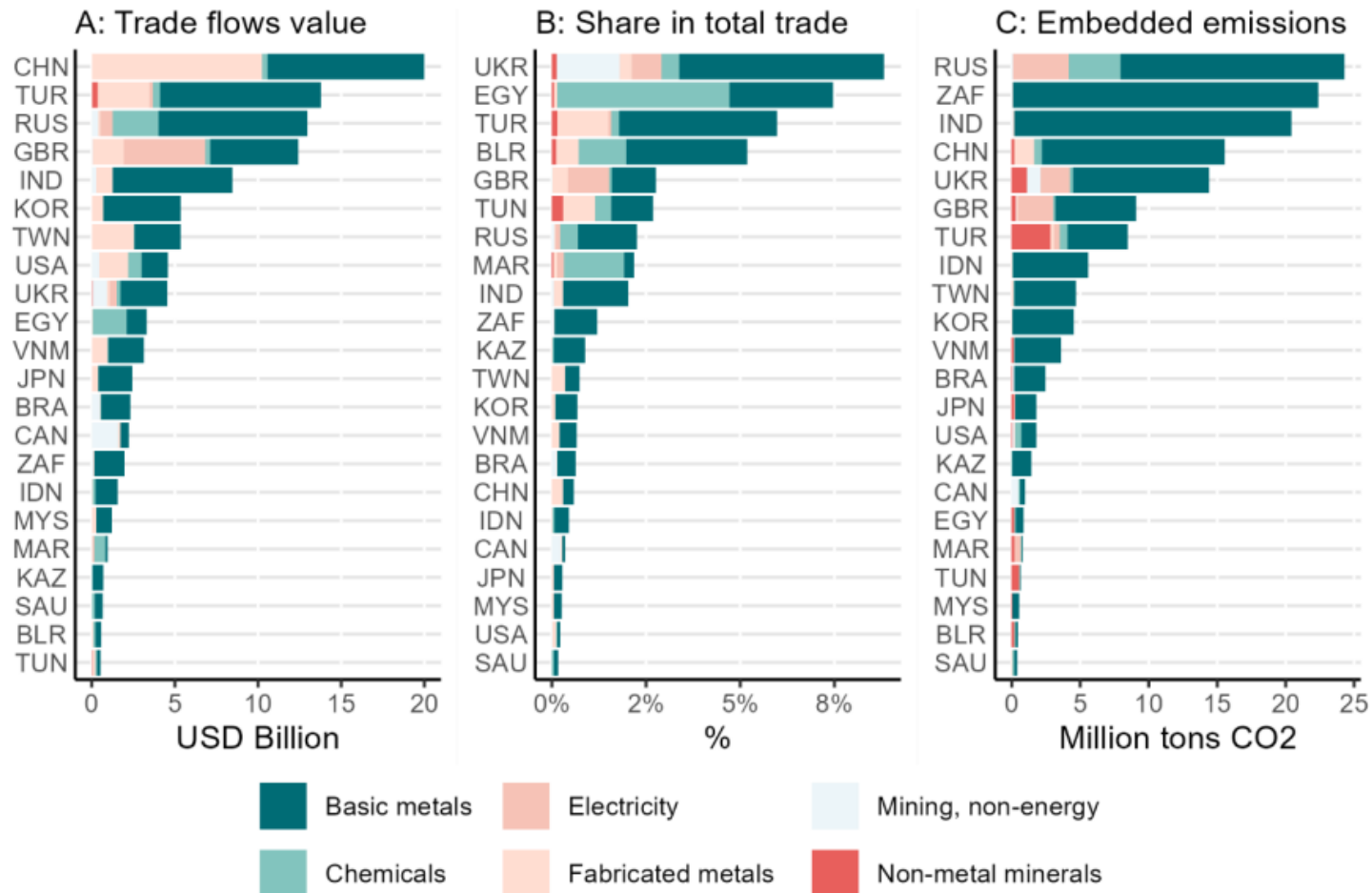


- **Basic metals** → Iron, steel, aluminium.
- **Fabricated metals** → Tubes, pipes, structures, screws, bolts, containers, cables, etc.
- **Chemicals** → Fertilisers and hydrogen.
- **Electricity** → Electrical energy.
- **Mining, non-energy** → Kaolinic clays and clinker.
- **Non-metal minerals** → Cement and clinker.



OECD - Carbon Border Adjustments: The potential effects of the EU CBAM along the supply chain

## Trade and emission flows covered by the CBAM by exporting country and producing sector, 2022



- A: trade covered by CBAM
- B: that trade as a share of the exporter's total trade, and
- C: the resulting Scope 1 embedded emissions.
- Bars are split by sector and exporting country, using Comtrade data and 2019 emission intensities.
- Note: This reflects coverage, not the final cost, as existing carbon pricing abroad is not deducted.



CONTEXT — RESEARCH MATERIAL

## CBAM coverage in numbers — where Türkiye stands

### USD 132 billion covered

Only 0.37% of global trade in goods and services — but 3% of all non-EU exports to the EU

### 171 Mt CO<sub>2</sub>e embedded

Emissions embedded in covered imports; ≈24% of them are Scope 2 and 3 (electricity, precursors)

### Türkiye is No. 2

Covered trade by origin (2022): China USD 20.0 bn · Türkiye USD 13.8 bn  
· Russia USD 12.9 bn — mostly basic metals

### ≈ EUR 14.7 bn / year

Potential CBAM revenue at EUR 80/t CO<sub>2</sub> — a carbon price paid at origin is deducted and stays at home

Source: OECD — The potential effects of the EU CBAM along the supply chain (2022 trade data). [research material/]



## OECD - Carbon Border Adjustments: The potential effects of the EU CBAM along the supply chain

### Results

|                         |                        | EU ETS price | CBAM | Removal of free allowances         |
|-------------------------|------------------------|--------------|------|------------------------------------|
| <b>Baseline</b>         |                        | EUR 25       | No   | No (2019 free allowance endowment) |
| <b>Policy Scenarios</b> | Scenario 1             | EUR 80       | No   | Only non-EITE sectors              |
|                         | Scenario 2             | EUR 80       | No   | Non-EITE sectors and CBAM sectors  |
|                         | <u>Full Policy Mix</u> | EUR 80       | Yes  | Non-EITE sectors and CBAM sectors  |

#### Baseline:

- The starting point: 2019 economy with a low carbon price (€25).
- No CBAM, and all sectors receive free allowances as they did that year.

#### Policy Scenario 2

- Builds on Scenario 1: the €80 carbon price remains.
- Now, free allowances are also removed for CBAM sectors.
- However, no CBAM is in place yet, so these sectors face the full carbon price without border protection.

#### Full Policy Mix

- The most complete scenario: €80 carbon price, free allowances removed for both non-EITE and CBAM sectors, and CBAM is now introduced.
- This is the closest representation of the actual EU regulation – industries lose free allowances but gain border carbon adjustment protection via CBAM.

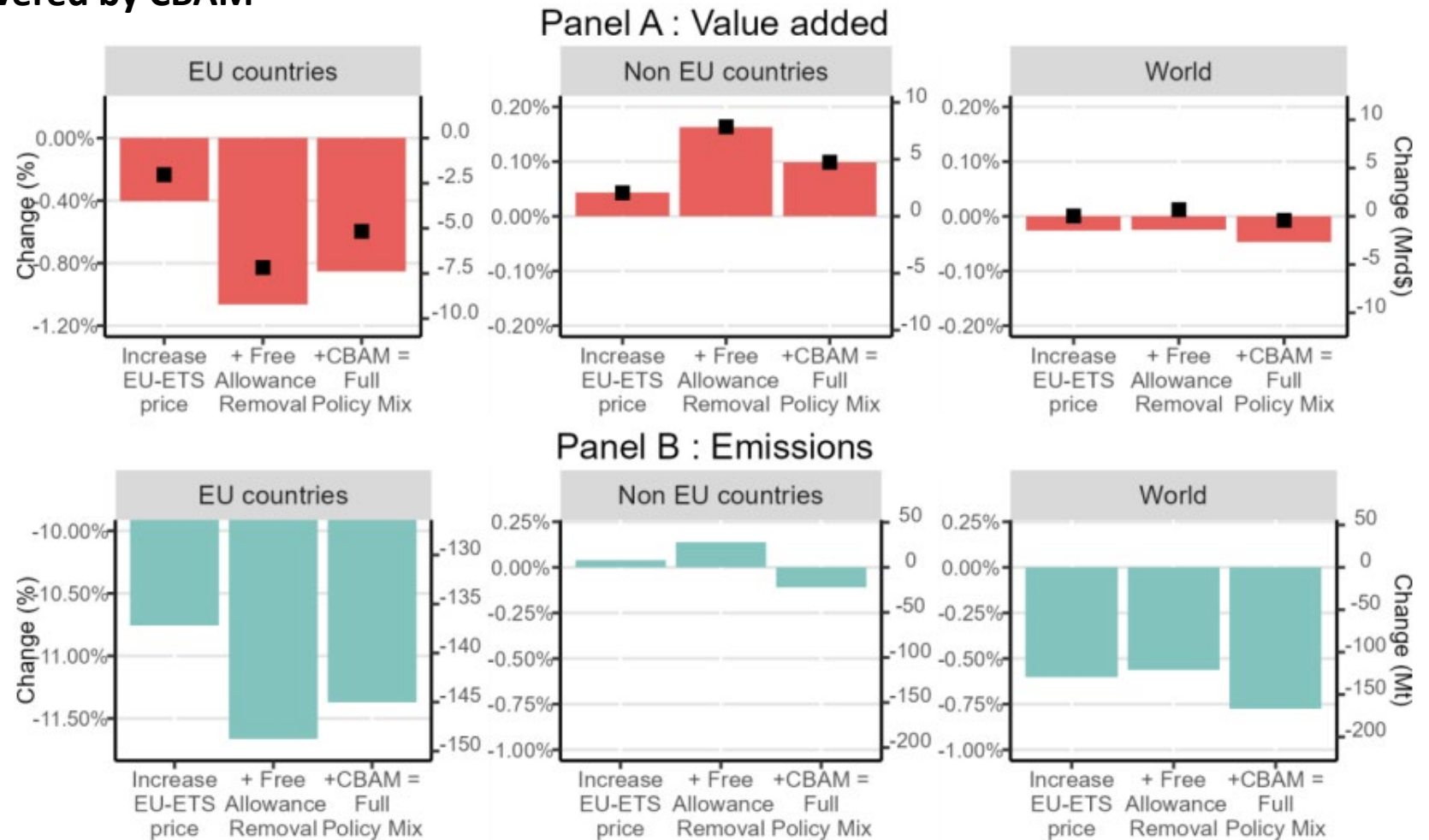
#### Policy Scenario 1

- Only the EU ETS reform is applied: carbon price jumps to €80.
- Free allowances are removed, but only for non-EITE sectors.
- CBAM sectors are still fully protected – they keep 100% of their free allowances.
- No CBAM is introduced.



## OECD - Carbon Border Adjustments: The potential effects of the EU CBAM along the supply chain

### Results: only in the industries covered by CBAM





CONTEXT — RESEARCH MATERIAL

## Effects along the supply chain — beyond the covered sectors

### Downstream cost push

Non-covered sectors (construction, electrical equipment, machinery) face higher input costs and lose competitiveness

### 83% of the loss

Non-targeted sectors carry 83% of the total EU value-added loss — the indirect, supply-chain effect dominates

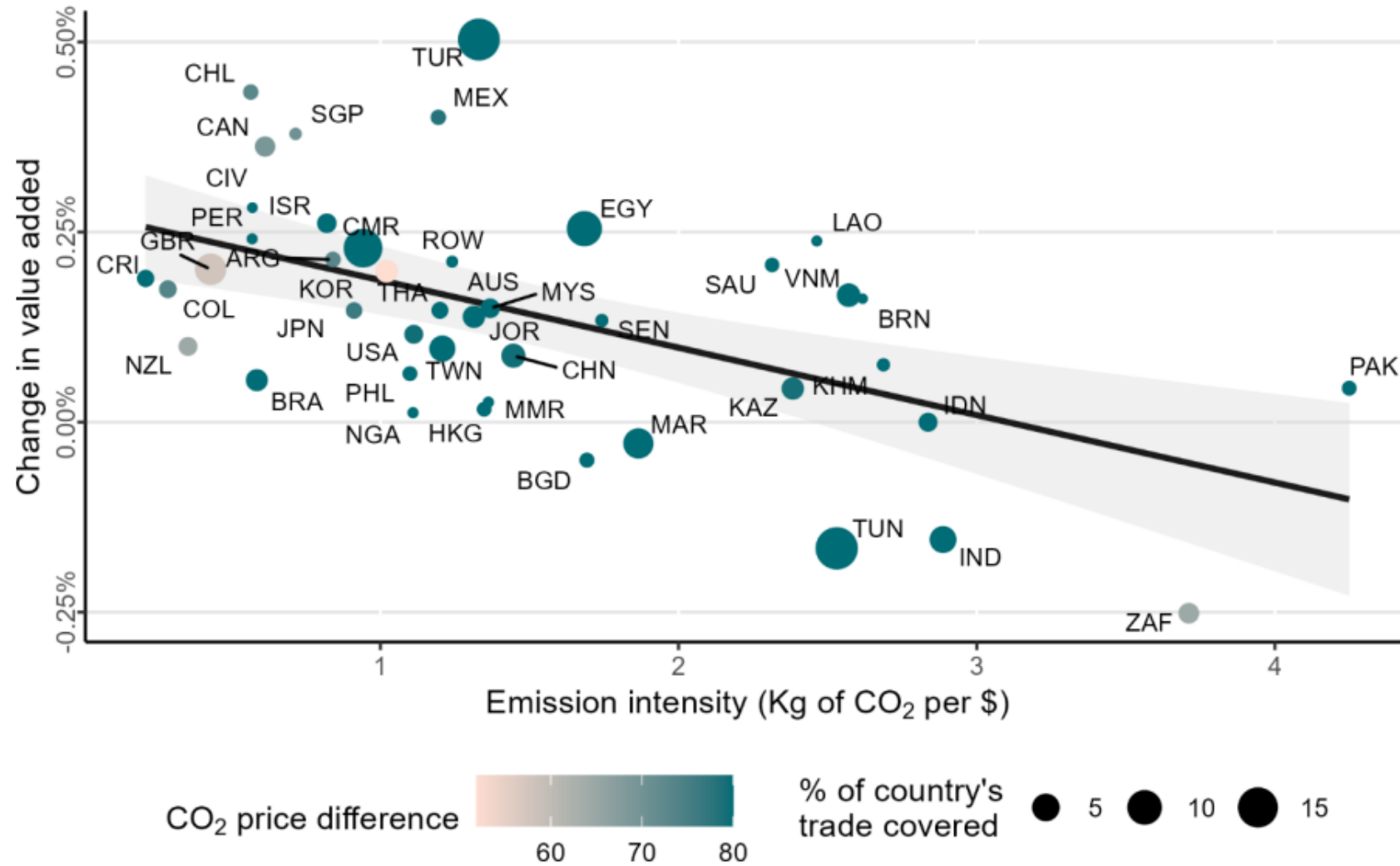
### Macro effect unchanged

EU-wide value added falls  $\approx 0.29\%$  with or without CBAM — downstream losses offset gains in covered industries

### Leakage reversed

Without CBAM, 0.19 t leak abroad per t saved in the EU; with CBAM, sourcing shifts to cleaner origins — global cuts rise 36%

Source: OECD — *The potential effects of the EU CBAM along the supply chain.* [research material/]





## CBAM — MAIN ELEMENTS

# Five CBAM definitions to keep for the day

**Embedded emissions** — direct (production) + indirect (electricity) emissions in a good, in t CO<sub>2</sub>e/t — Reg (EU) 2023/956, Art. 3

**Default values** — fallback emission intensities per CN code, used when actual data are missing — Reg (EU) 2025/2621

**Precursor** — a CBAM good consumed to make another CBAM good; its embedded emissions carry into the final good

**Verification** — declared embedded emissions checked by accredited verifiers — Reg (EU) 2025/2546

**Transitional → definitive** — 2023–25 reporting only; certificates from 2026; 50 t/yr de-minimis exempts small importers — Reg (EU) 2025/2083



## EU ETS — HOW THE SECTOR IS REGULATED

# Free allocation, carbon leakage and the road to CBAM

### How free allocation works

- Given on product benchmarks: hot metal, sintered ore, EAF carbon/high alloy steel, coke, iron casting
- On the carbon-leakage list → CLEF = 1 (100%): maximum protection
- Allocation = Benchmark × historical activity level × CLEF × CBAM factor

### Sector specifics

- Most allocation under activity code 24 (hot metal, incl. blast-furnace waste gases)
- Benchmarks re-set each period (Phase IV → 2021–30; –0.2 – 2.5 %/yr).

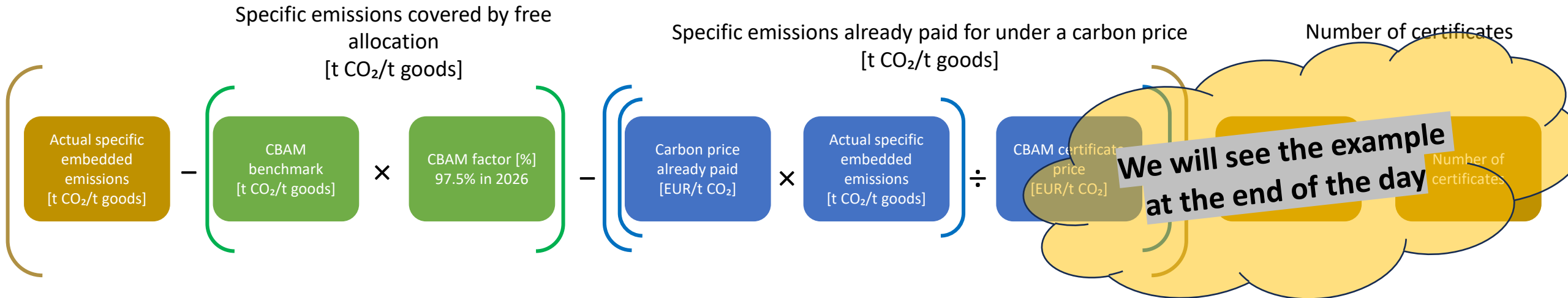
**From 2026 the CBAM factor gradually replaces free allocation** — it falls to 0% by 2034 while CBAM rises on imports. This is the EU ETS ↔ CBAM bridge we develop today.

Sources: Oeko-Institut/UBA (Climate Change 56/2024) §2.5.1; FAR (EU) 2019/331; Directive 2003/87/EC Arts. 10a–10b. [research material/ · ETS/]



## WORKED CALCULATION • THE CBAM SIDE

# How CBAM certificates are calculated



- The lower the embedded emissions of the good, the lower the CBAM cost
- Türkiye's steel production relies heavily on the scrap-based EAF route, which accounts for around 70–72% of crude steel output and generally has a lower carbon intensity than the BF-BOF route. This structural advantage helps limit the embedded emissions of Turkish steel and reduces potential CBAM costs.



## RECAP

# What we covered — Introduction: the EU ETS ↔ CBAM picture

### Biggest ETS emitter

Iron & steel  $\approx 200$  Mt CO<sub>2</sub> (2019),  $\approx 13\%$  of the whole EU ETS — the largest industrial source

### Route drives carbon

BF/BOF  $\approx 1.85$  vs scrap-EAF  $\approx 0.15$  t CO<sub>2</sub>/t; BF/BOF = 59% of output but 89% of emissions

### EU ETS protection

Free allocation on benchmarks; sector on the carbon-leakage list  $\rightarrow$  CLEF = 1 (100%)

### Türkiye & CBAM

From 2026 CBAM replaces free allocation; steel is the most resilient sector

*Next: how emissions are counted (MRV & mass balance).*



DAY 2

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| 7 | Q&A                                                                                   |                                |



## EU ETS — MONITORING & REPORTING (MRV)

# How emissions are counted: the calculation toolkit

### Combustion

$$Em = \text{Fuel} \times \text{NCV} \times \text{EF} \times \text{OF}$$

### Process

$$Em = \text{Activity data} \times \text{EF} \times \text{Conversion factor}$$

### Mass balance

$$Em = \sum (AD_i \times C_i) \times 3.664$$

(inputs +, outputs -)

- Or measurement-based (CEMS): continuous CO<sub>2</sub> monitoring in the stack
- Every fuel/material is a source stream; 3.664 = molar mass CO<sub>2</sub> ÷ carbon (44/12)
- Tier system = data-quality levels (higher tier = higher accuracy); fixed in the Monitoring Plan, with an uncertainty assessment
- For an integrated steel works the mass balance — carbon in minus carbon out — is the workhorse method

Sources: Monitoring & Reporting Regulation (EU) 2018/2066 (Arts. 24–25); EU ETS M&R training material. [ETS/ · ETS/training material/]



EU ETS — EMISSIONS ACCOUNTING EXAMPLE

Worked example: mass balance of an integrated works

Emissions = ( carbon IN – carbon OUT not emitted ) × 3.664

Carbon IN (+)

- Coke & coking coal
- Pulverised coal injection (PCI)
- Natural gas, fluxes (limestone)
- Electrodes, alloying carbon

Carbon OUT (–, not emitted)

- Carbon in the crude steel (≈ 0.2–0.5%)
- Carbon in slag and dust
- Waste gases exported off-site
- Carbonates to stock

| Per tonne of crude steel (illustrative)      | tC/t    | → t CO <sub>2</sub> |
|----------------------------------------------|---------|---------------------|
| Carbon in (coke + ...)                       | 0.80    | 0.80 × 3.664 × t    |
| Carbon out, not emitted (steel)              | - 0.003 | - 0.003 × 3.664 × t |
| Σ All products – mass balance and combustion |         | Total emissions     |



## DAY 2

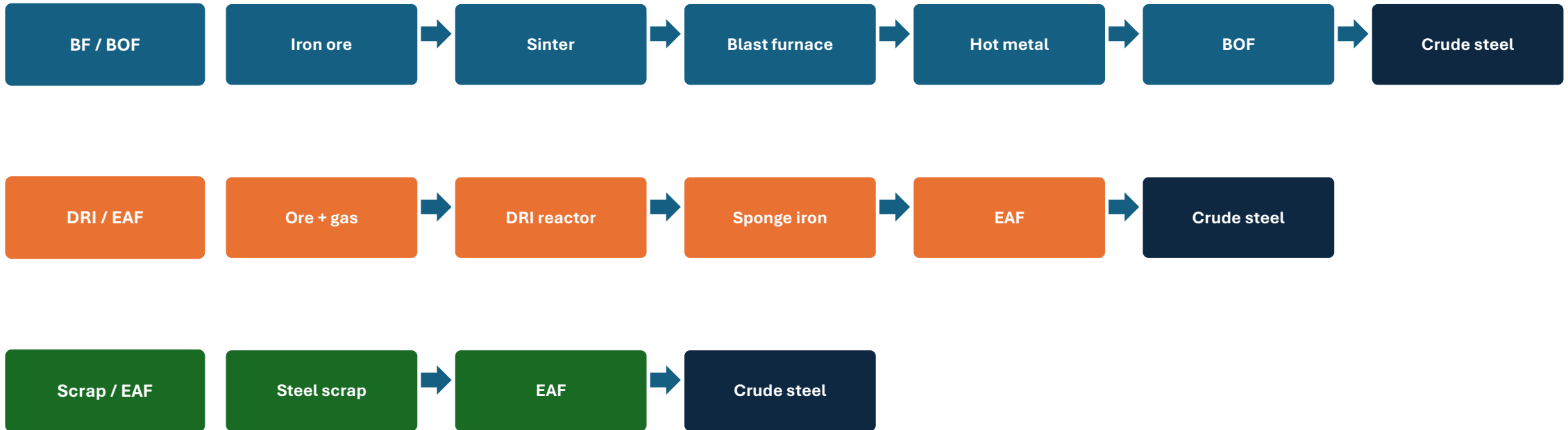
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## PRODUCTION ROUTES — TECHNICAL DETAIL

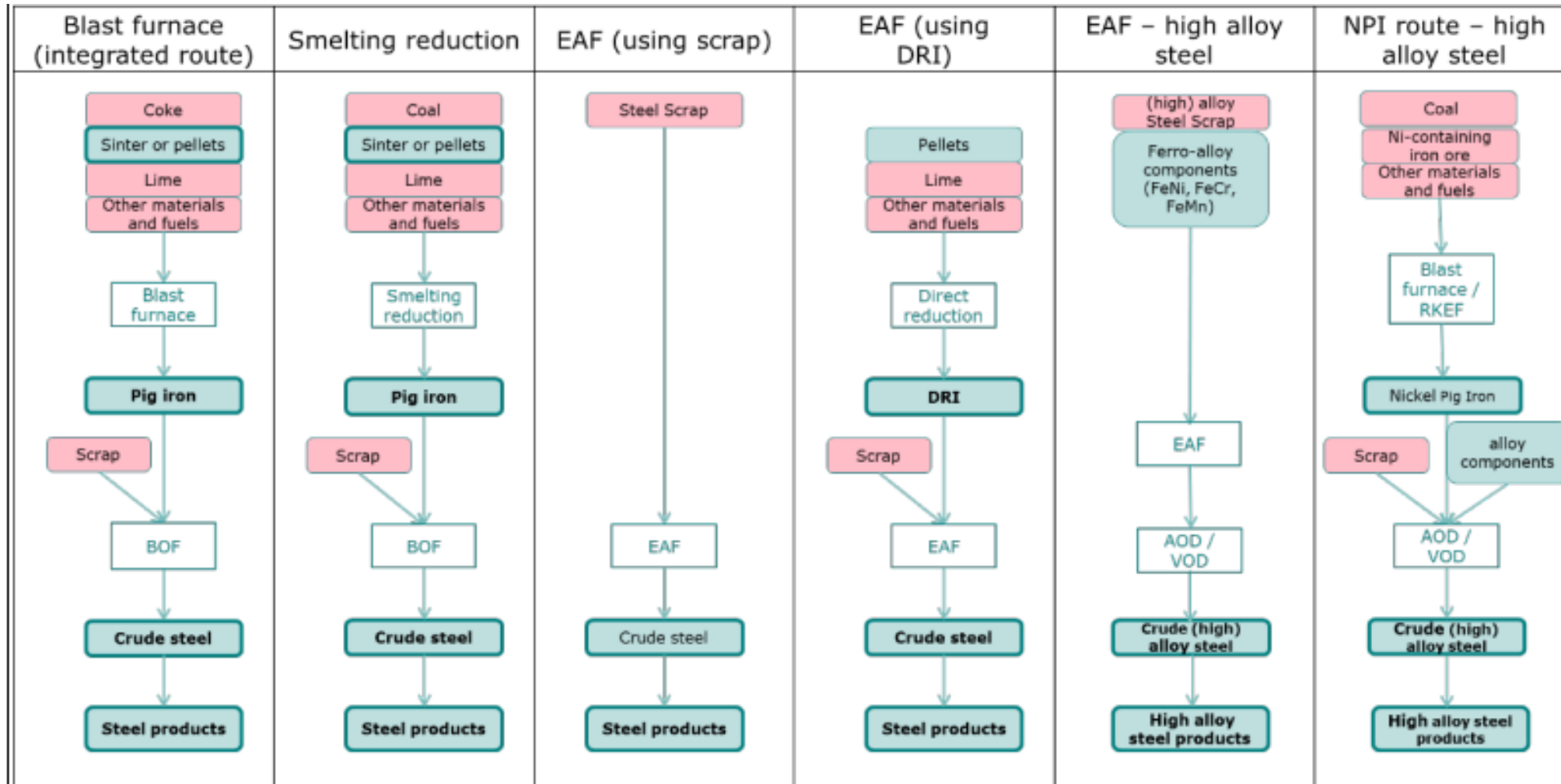
# The three main steelmaking routes



*Same final product (crude steel) — very different emissions per tonne*



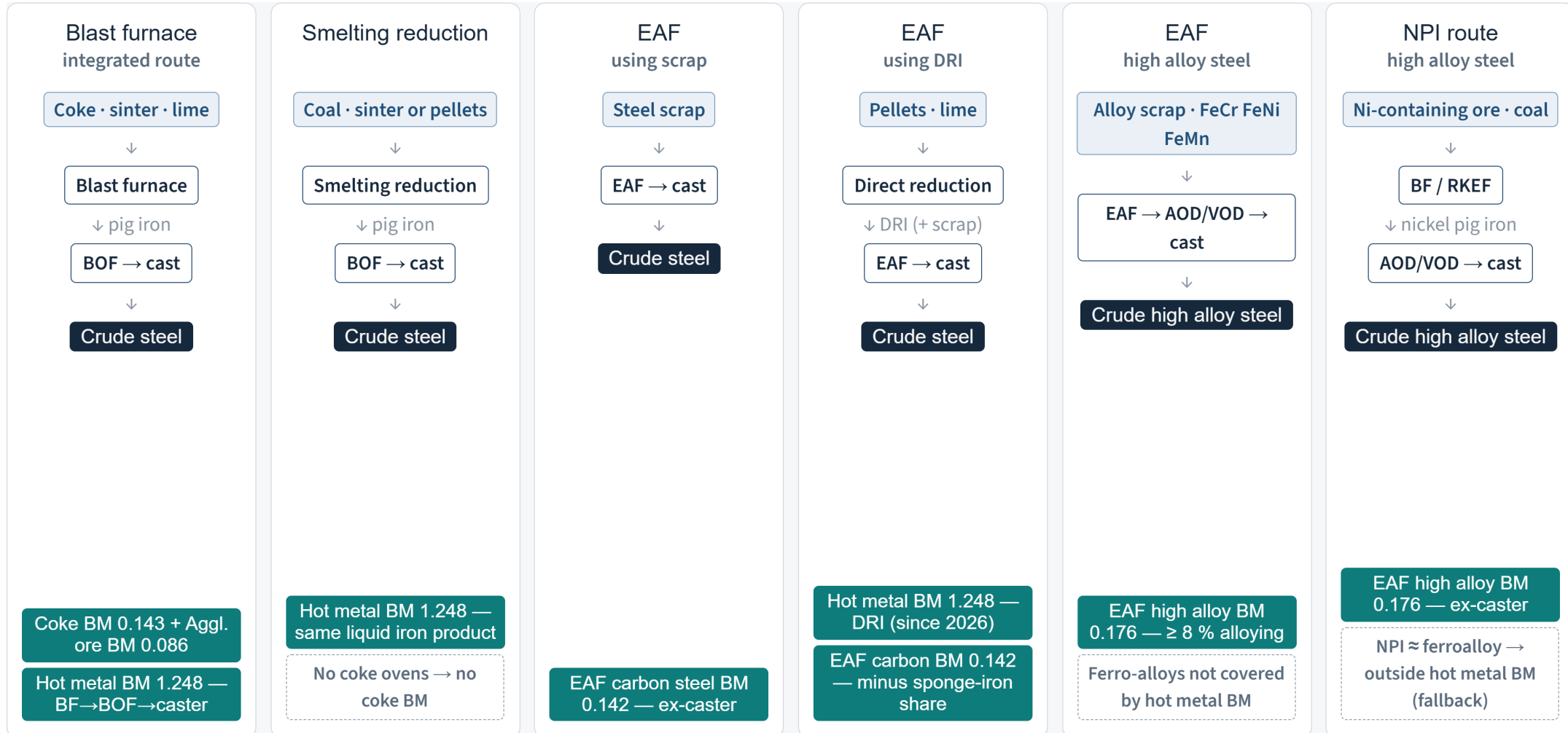
## PRODUCTION ROUTES — TECHNICAL DETAIL





PRODUCTION ROUTES — TECHNICAL DETAIL

# Production Routes — Benchmark Map





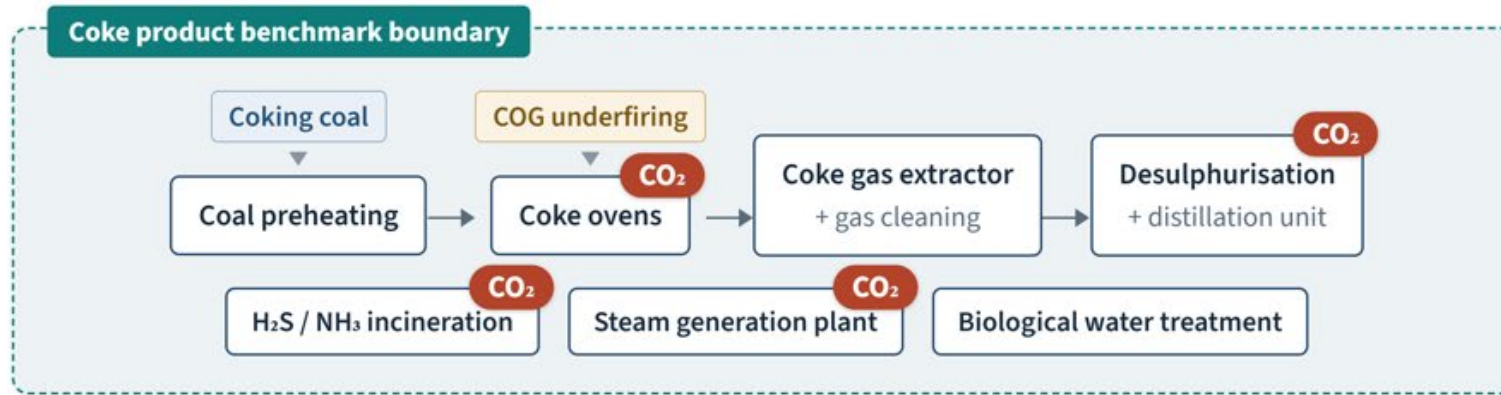
## PRODUCTION ROUTES — TECHNICAL DETAIL

| Benchmark                        | Unit of product                 | Measurement point                               | 2021–25 | 2026–30      | CBAM good                      |
|----------------------------------|---------------------------------|-------------------------------------------------|---------|--------------|--------------------------------|
| <b>2 · Coke</b>                  | Tonnes of dry coke              | Discharge of coke oven                          | 0.217   | <b>0.143</b> | No — CBAM factor = 1           |
| <b>3 · Agglomerated iron ore</b> | Tonnes of agglomerated ore      | Leaving the sinter plant                        | 0.157   | <b>0.086</b> | Yes — factor of the year       |
| <b>4 · Hot metal</b>             | Tonnes of hot metal             | BF exit (liquid iron) or DRI exit (sponge iron) | 1.288   | <b>1.248</b> | Yes — factor of the year       |
| <b>5 · EAF carbon steel</b>      | Tonnes of crude secondary steel | Ex-caster                                       | 0.215   | <b>0.142</b> | Yes — factor of the year       |
| <b>6 · EAF high alloy steel</b>  | Tonnes of crude secondary steel | Ex-caster                                       | 0.268   | <b>0.176</b> | Yes — factor of the year       |
| <b>7 · Iron casting</b>          | Tonnes of liquid iron           | Melting shop (liquid iron alloyed)              | 0.282   | <b>0.163</b> | Partly — CBAM / non-CBAM split |



## PRODUCTION ROUTES — TECHNICAL DETAIL

### Coke



► **Dry coke — benchmark product, measured at oven discharge**

► Surplus COG → blast furnace stoves, sinter plant, power plant (emissions counted at the consumer, GD 8)

► Exported steam — not covered; separate heat benchmark sub-installation if eligible

Excluded: lignite coke, coking in refineries (CWT methodology), emissions of consumed electricity.

| Benchmark                 |
|---------------------------|
| 2 · Coke                  |
| 3 · Agglomerated iron ore |
| 4 · Hot metal             |
| 5 · EAF carbon steel      |
| 6 · EAF high alloy steel  |
| 7 · Iron casting          |

**BM VALUE 2026–30**

**0.143**

allowances / t dry coke ·  
C(2026) 4372

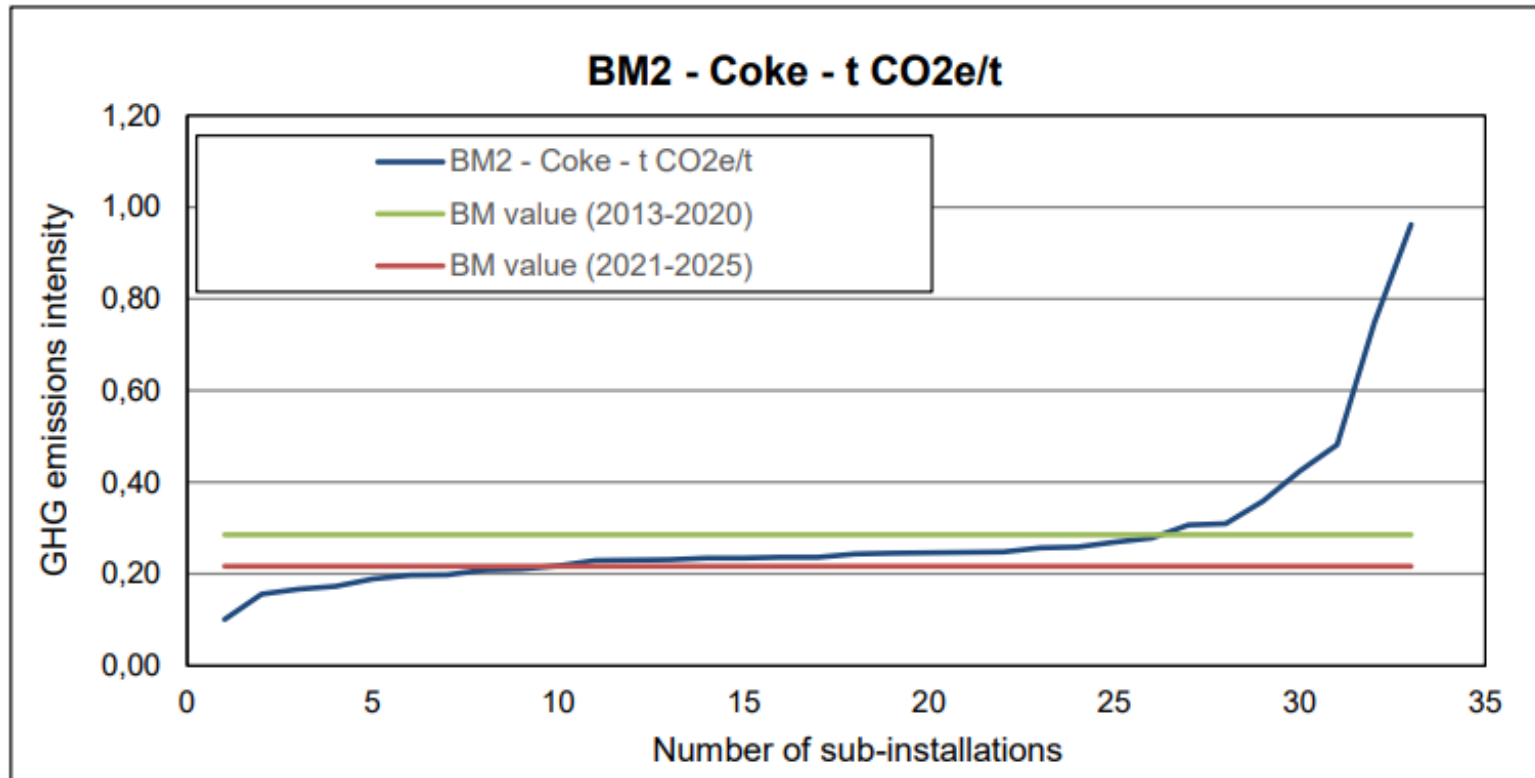
**Process:** the coal blend is carbonised at  $\approx 1\,000\text{--}1\,100\text{ }^{\circ}\text{C}$  for 15–20 h in the absence of air. Volatiles leave as raw coke oven gas ( $\approx 55\text{--}60\%$   $\text{H}_2$ ,  $\approx 25\%$   $\text{CH}_4$ ); gas cleaning recovers tar, benzole and sulphur, and the clean COG underfires the ovens or is exported.

**Boundary detail:** underfiring (COG/BFG), gas treatment, desulphurisation and steam generation are inside; the measurement point is **dry coke at oven discharge**.



## PRODUCTION ROUTES — TECHNICAL DETAIL

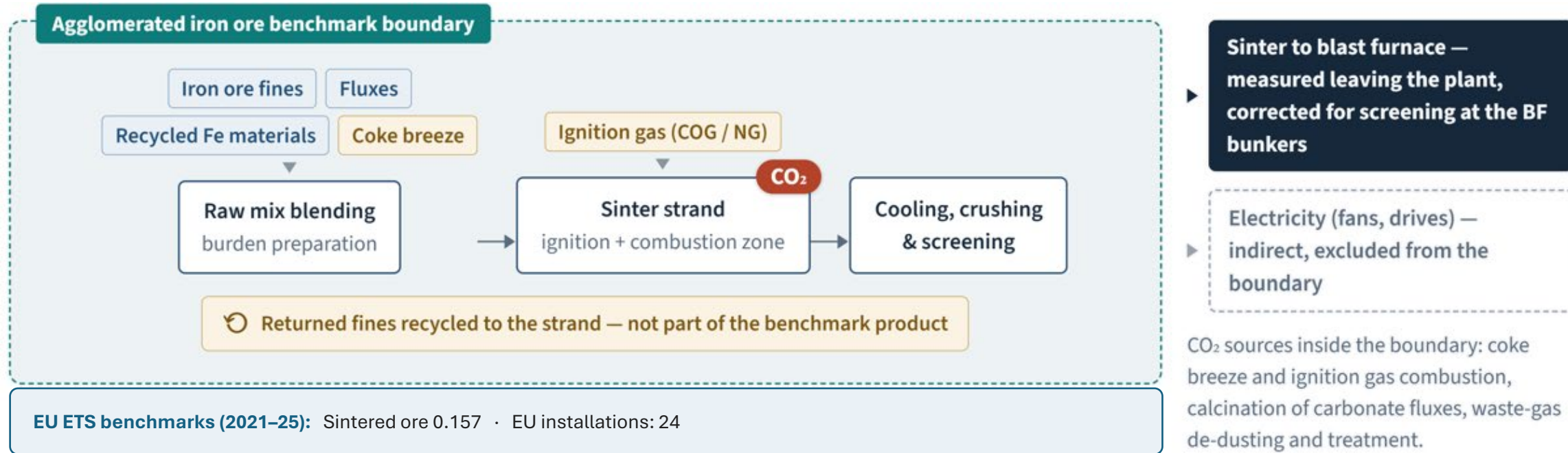
### Coke





## PRODUCTION ROUTES — TECHNICAL DETAIL

# Sintered ore — Agglomerated iron ore



- Benchmark
- 2 · Coke
- 3 · Agglomerated iron ore
- 4 · Hot metal
- 5 · EAF carbon steel
- 6 · EAF high alloy steel
- 7 · Iron casting

**BM VALUE**  
**2026–30**

**0.086**

allowances / t  
agglomerated  
ore

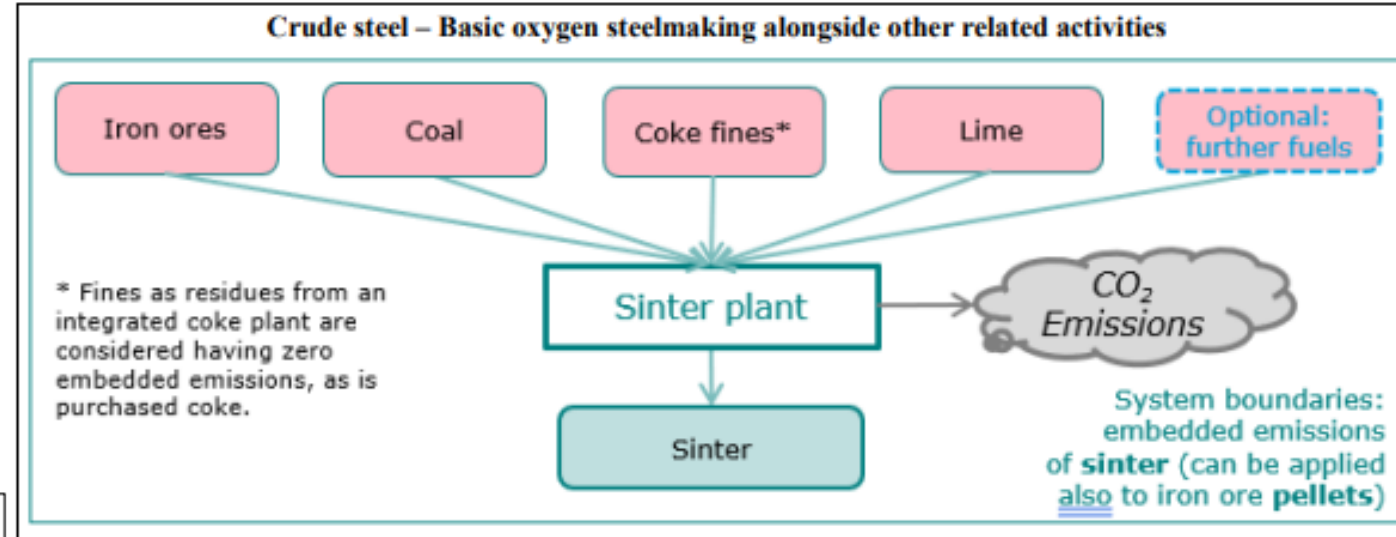
**Process:** Iron ore fines are mixed with recycled fines, fluxes (such as limestone), and 3–5% coke breeze, then ignited with natural gas or coke oven gas. As the coke breeze burns, temperatures reach around 1,300°C, fusing the particles into porous sinter for the blast furnace. The main CO<sub>2</sub> emissions come from coke breeze combustion, with additional emissions from limestone calcination.

**Boundary detail:** blending beds, mixing, hot screening and sinter cooling are inside. Returned fines recirculated to the strand are not product — the activity level is agglomerated ore leaving the sub-installation, corrected for BF screening rejects.

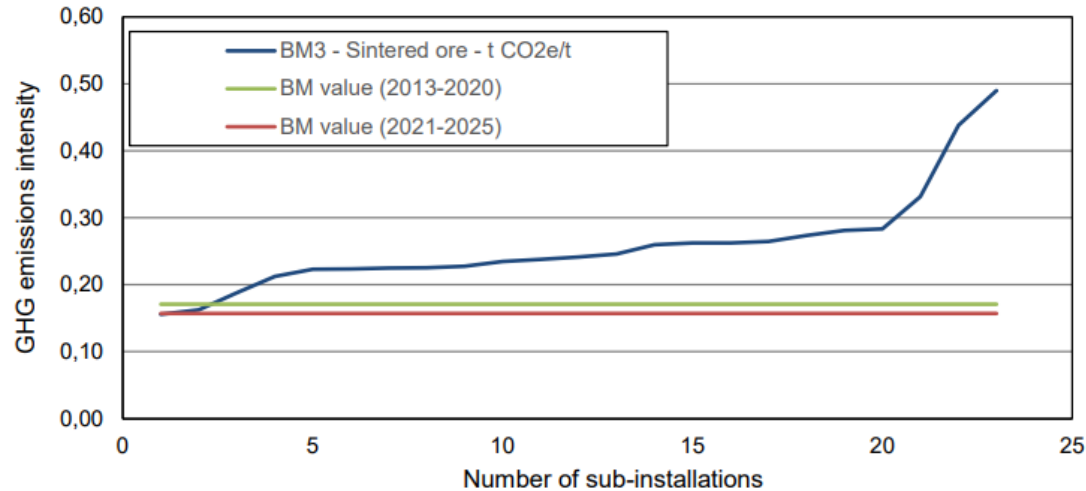


## PRODUCTION ROUTES — TECHNICAL DETAIL

### Sintered ore — Agglomerated iron ore



BM3 - Sintered ore - t CO<sub>2</sub>e/t





## PRODUCTION ROUTES — TECHNICAL DETAIL

# Sintered ore — Agglomerated iron ore

### What it is

- Agglomerated iron-bearing material (sinter/pellets) fed to reduction
- Unit: tonnes of agglomerated ore leaving the plant
- Returned (recycled) agglomerated ore is not counted as product
- Boundary: all processes directly/indirectly linked to agglomeration

### Benchmark facts

**Unit** t agglomerated ore

**CLEF** 1 (100%)

**CBAM scope** yes

**CN code** 2601 12 00

ETS weighted average emission value

**0,248** t CO<sub>2</sub>e/t

EU ETS benchmark (2021–25)

**0.157** t CO<sub>2</sub>e/t · 24 EU installations

EU ETS benchmark (2026–30)

**0.086** t CO<sub>2</sub>e/t · 24 EU installations

CBAM default emission value (2026)

**0,231** t CO<sub>2</sub>e/t · CN 2601 12 00

CBAM Benchmark

**0.086** t CO<sub>2</sub>e/t · CN 2601 12 00



## PRODUCTION ROUTES — TECHNICAL DETAIL

# Hot Metal – Blast furnace

### Definition and explanation of products covered

According to the FAR this product benchmark covers:

*“Iron produced from iron ores for primary steelmaking including*

*a) liquid iron saturated with carbon for further processing, considered as product of blast furnaces, and expressed in tonnes of liquid iron at the exit point of the blast furnace, excluding liquid iron produced from sponge iron under b),*

*b) sponge iron at the exit point of a direct reduced iron reactor, and expressed in tonnes of sponge iron at the exit point of the direct reduced iron reactor. Similar products such as ferroalloys are not covered by this product benchmark. Residual material and by-products are not to be considered as part of the product.”*

The liquid iron is considered to be the product of blast furnaces and sponge iron the product of direct reduced iron reactors. Within the given system boundaries, the benchmark also indirectly covers steel produced by the blast furnace route.

Similar products such as ferroalloys are not covered by this product benchmark.

This product benchmark refers to the hot metal in primary steel production rather than its end products. As such, there are no applicable PRODCOM codes for the benchmarked product. The broader PRODCOM codes for the steel sector do not differentiate between

#### Benchmark

2 · Coke

3 · Agglomerated  
iron ore

4 · Hot metal

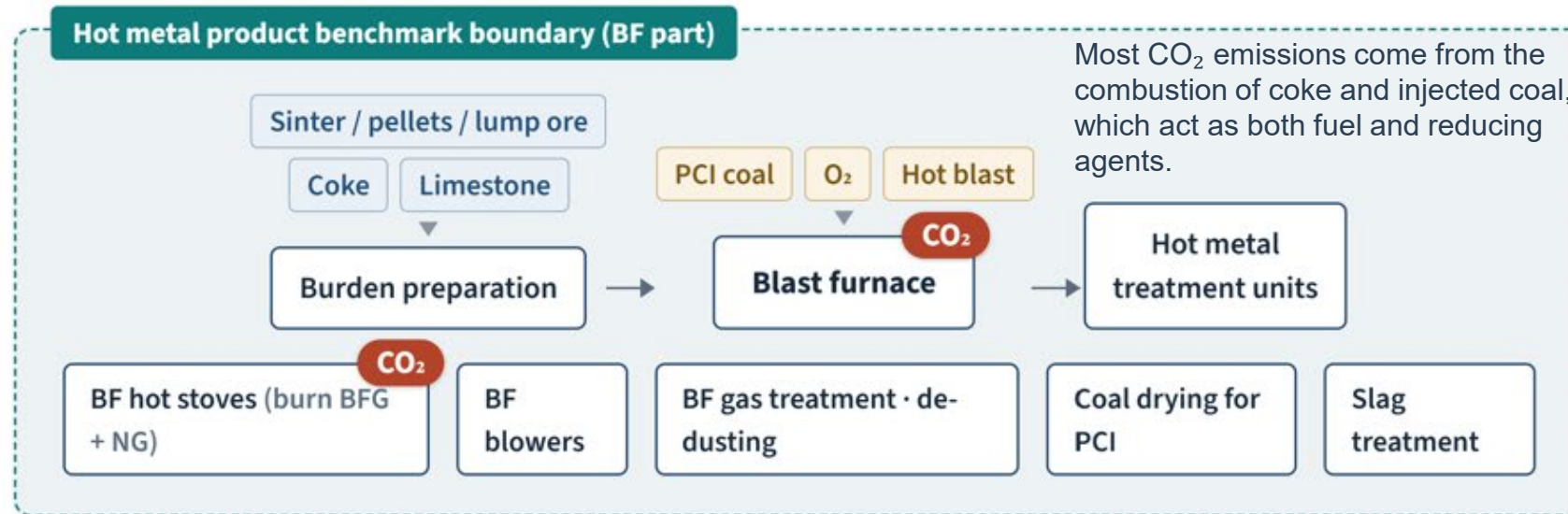
5 · EAF carbon  
steel

6 · EAF high  
alloy steel



## PRODUCTION ROUTES — TECHNICAL DETAIL

# Hot Metal – Blast furnace



**Liquid iron at BF exit — benchmark product (t hot metal); the boundary continues to BOF & casting**

Surplus BF gas → on-site power plant: emissions attributed to electricity production, no free allocation (GD 8)

Ferroalloys and similar products are not covered. Emissions of consumed electricity are excluded.

**Process:** Iron ore (sinter, pellets, or lump ore) and coke are charged from the top of the blast furnace, while hot air is injected from the bottom. The coke and injected coal provide both the heat and the carbon needed to reduce the iron ore into molten iron. The process also produces slag and blast furnace gas, which is recovered and reused as a fuel.

**Boundary detail:** The system boundary includes the blast furnace and all downstream steelmaking steps, from oxygen blowing in the BOF to secondary metallurgy and continuous casting. Blast furnace gas emissions are accounted for where the gas is burned (e.g. in the stoves or power plant). Fuel used after casting is reported separately.



## PRODUCTION ROUTES — TECHNICAL DETAIL

# Hot Metal – Blast furnace

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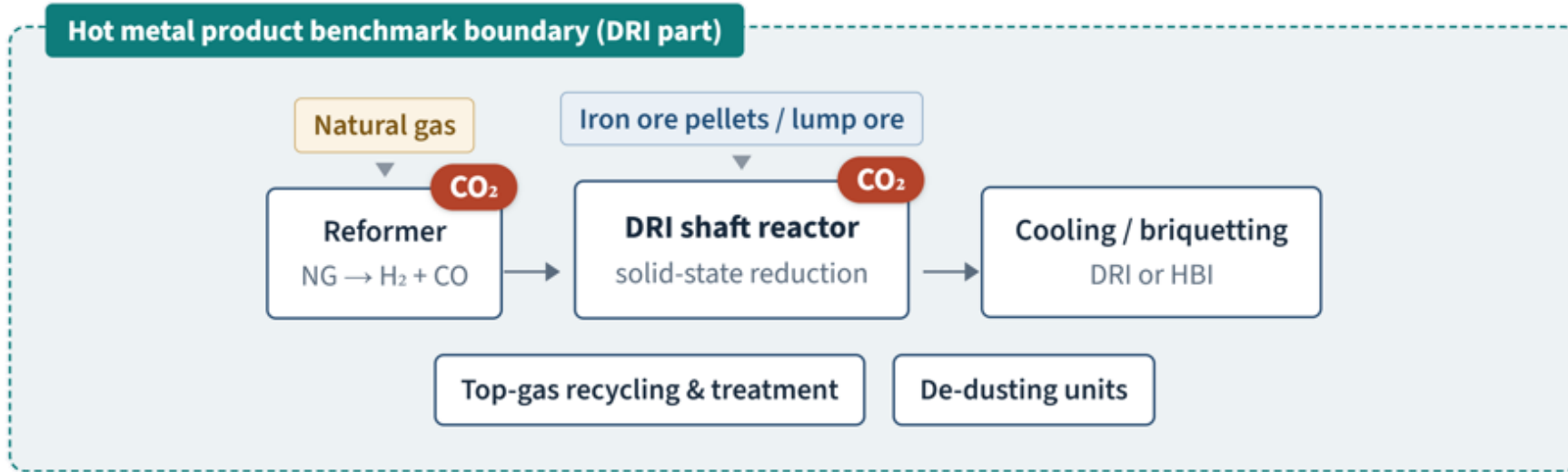
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## PRODUCTION ROUTES — TECHNICAL DETAIL

# Hot Metal - DRI



► **Sponge iron at reactor exit — benchmark product (t), same benchmark as BF hot metal**

► Electricity (compressors, drives) — indirect, excluded

Anti-double-counting: sponge iron allocated here must later be deducted from EAF steel activity levels (→ DRI/EAF slide).

New from 2026: in 2021–2025 DRI had no product benchmark (fallback: fuel BM / process emissions). Reg. (EU) 2024/873 added sponge iron to the hot metal BM for 2026–2030.

Benchmark

- 2 · Coke
- 3 · Agglomerated iron ore
- 4 · Hot metal
- 5 · EAF carbon steel
- 6 · EAF high alloy steel
- 7 · Iron casting

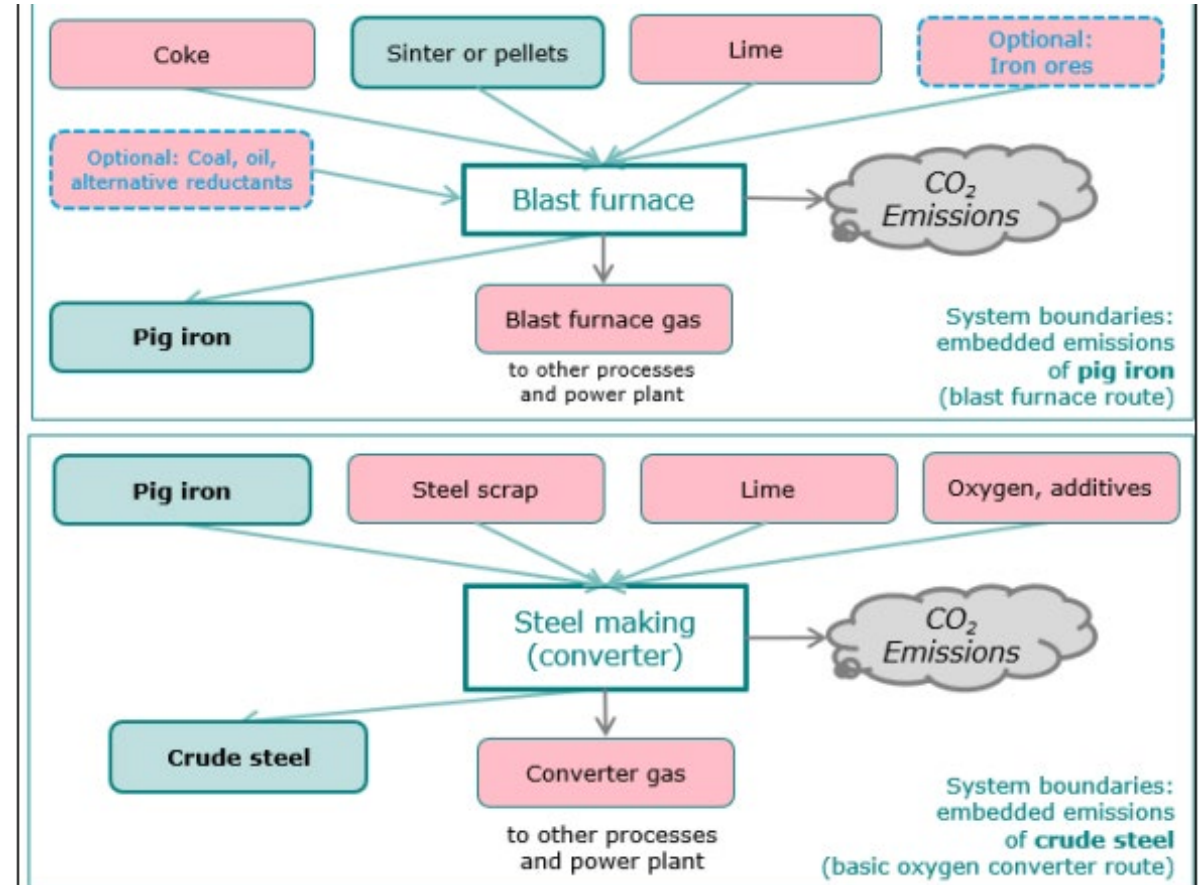
**Process:** Natural gas is converted into a reducing gas (mainly hydrogen and carbon monoxide), which removes oxygen from iron ore pellets and lump ore inside a shaft furnace. The ore is reduced in the solid state at around 950°C, producing Direct Reduced Iron (DRI), which can be used directly or compacted into HBI. The top gas is recycled to improve energy efficiency.

**Boundary detail:** The boundary covers the reformer, shaft furnace and DRI processing units. Direct emissions come mainly from the reformer/heaters and carbon in the DRI, while electricity emissions are excluded. DRI allocated here must be deducted from EAF production to avoid double counting.

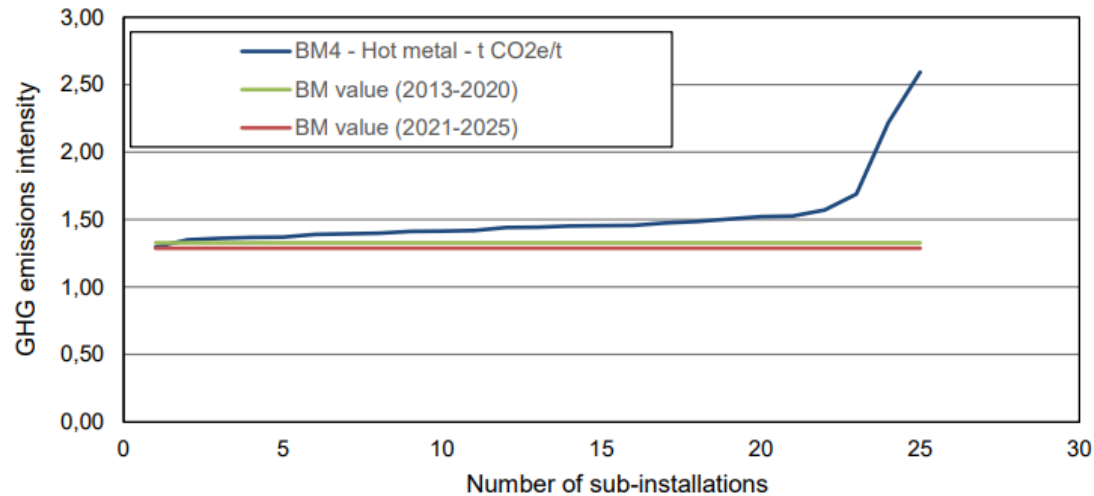


## PRODUCTION ROUTES — TECHNICAL DETAIL

# Hot Metal - DRI



BM4 - Hot metal - t CO<sub>2</sub>e/t





## PRODUCTION ROUTES — TECHNICAL DETAIL

# Hot metal — definition and system boundaries

### Definition — two products

- (a) liquid iron at the exit of the blast furnace
- (b) sponge iron at the exit of the DRI reactor
- Indirectly covers steel made by the blast-furnace route
- Unit: tonnes of liquid iron; ferro-alloys excluded

### Inside the boundary

- BF, hot stoves, blowers
- DRI reactor; EAF for sponge iron
- BOF; secondary metallurgy
- Casting, slag/gas treatment, dedusting
- Electricity emissions excluded

ETS weighted average emission value

**1,495** t CO<sub>2</sub>e/t

EU ETS benchmark (2021–25)

**1,288** t CO<sub>2</sub>e/t · 28 EU installations

CBAM default emission value (2026)

**2,079** t CO<sub>2</sub>e/t · CN 7205

CBAM Benchmark

**1,288** t CO<sub>2</sub>e/t · CN 7205

**Key:** hot metal bundles the BF route AND DRI / sponge iron — there is no separate crude-steel benchmark.

Sources: FAR 2019/331 Annex I 'Hot metal' + GD9 §4; benchmark-curve factsheet. [ETS/]



## PRODUCTION ROUTES — TECHNICAL DETAIL

### EAF route



#### Benchmark

2 · Coke

3 · Agglomerated  
iron ore

4 · Hot metal

5 · EAF carbon  
steel

6 · EAF high alloy  
steel

7 · Iron casting

#### Inputs that ARE CBAM goods / indirect

- DRI
- Pig iron
- Ferro-alloys — 7202 (FeMn, FeCr, FeNi)
- Electricity — a CBAM good, counted as indirect (dominant)

#### Inputs NOT under CBAM

- Steel scrap — zero embedded emissions in CBAM
- Lime / fluxes
- Graphite electrodes

#### EU ETS benchmarks (2021–25):

- EAF carbon steel: 0,215 · EU installations: 76
- EAF high alloy steel: 0,268 · EU installations: 82



## SAF STEEL

# SAF carbon vs SAF high alloy steel — how to tell them apart

### SAF high alloy steel

- $\geq 8\%$  metallic alloying elements, OR
- High surface quality / processability
- Adds slow-cooling pit to the boundary
- Excludes FeCr converter & cryogenic gas storage

### SAF carbon steel

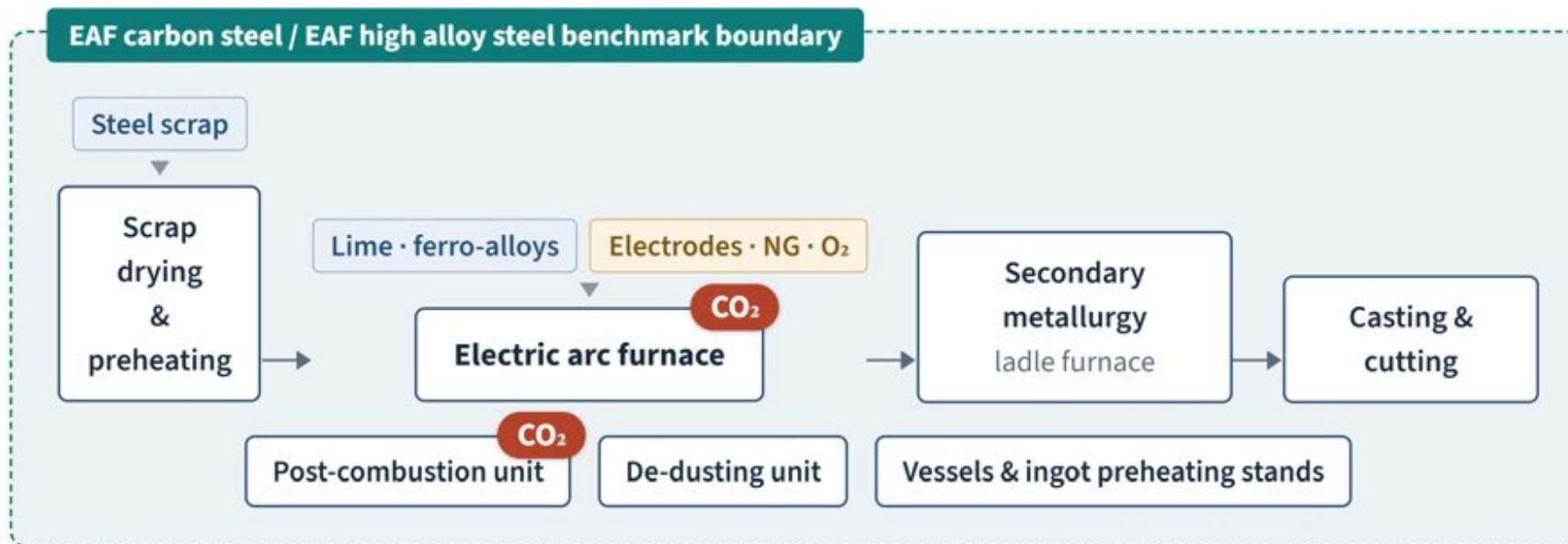
- $< 8\%$  alloying elements, and
- None of the high-quality criteria met
- E.g. concrete reinforcing bar

*Quality criteria assessed per cast (or per steel grade if not possible at cast level) and aggregated annually.*



PRODUCTION ROUTES — TECHNICAL DETAIL

## Scrap based EAF



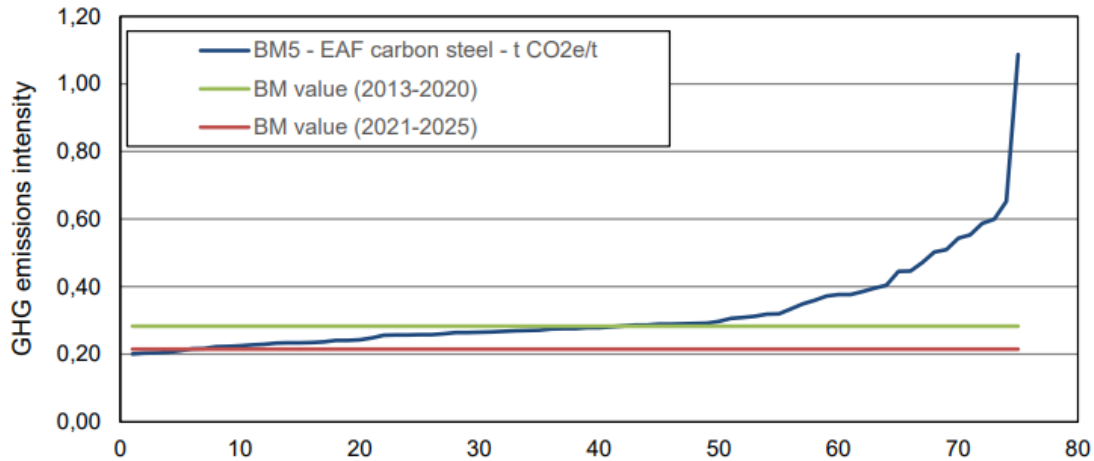
**Crude secondary steel ex-caster  
— benchmark product**

Electricity (arc power) — indirect,  
excluded; total electricity  
consumption is still collected as  
data

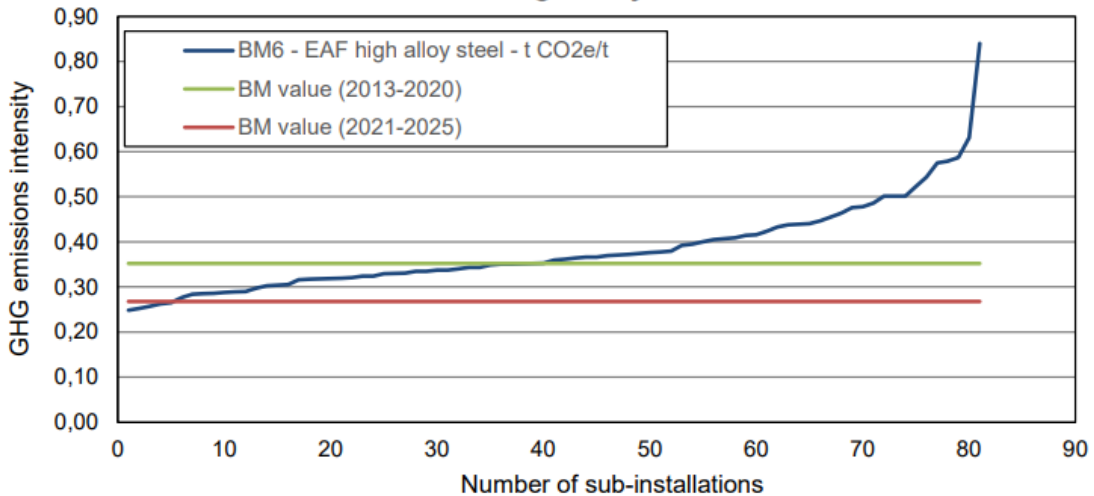
**Carbon vs. high alloy:**  $\geq 8\%$  metallic  
alloying elements, or GD9 surface-  
quality / processability criteria met  $\rightarrow$   
EAF high alloy steel benchmark;  
otherwise EAF carbon steel. FeCr  
converter and cryogenic gas storage:  
not included.



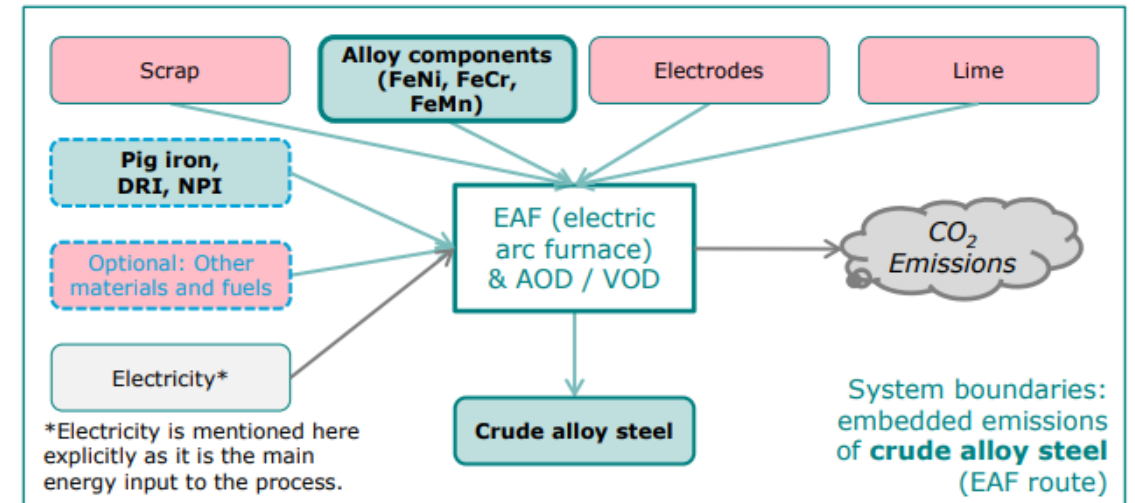
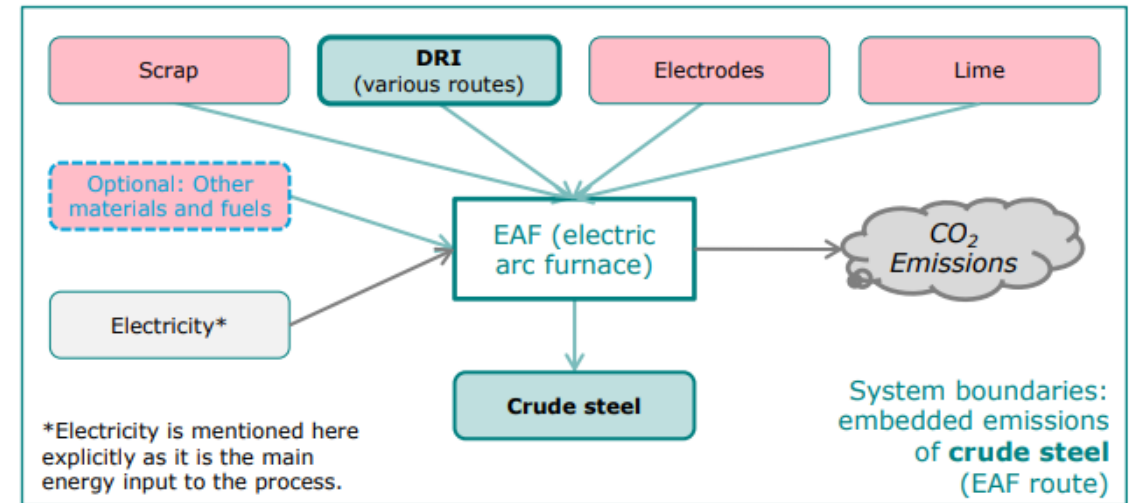
BM5 - EAF carbon steel - t CO<sub>2</sub>e/t



BM6 - EAF high alloy steel - t CO<sub>2</sub>e/t



Crude steel – EAF alloy and non-alloy steel production route





## PRODUCTION ROUTES — TECHNICAL DETAIL

### EAF route

#### EAF Carbon steel

CBAM default emission value (2026)

**2,541** t CO<sub>2</sub>e/t · CN 7207 11 11 (C): BF/BOF - as an example

CBAM Benchmark

**1,364** t CO<sub>2</sub>e/t · CN 7207 11 11 (C): BF/BOF

CBAM Benchmark

**0,475** t CO<sub>2</sub>e/t · CN 7207 11 11 (D) → Carbon steel produced using the DRI/EAF route

#### EAF high alloy steel

CBAM default emission value (2026)

**7,645** t CO<sub>2</sub>e/t · CN 7224 10 (F): BF/BOF

CBAM Benchmark

**1,807** t CO<sub>2</sub>e/t · CN 7224 10 (F): BF/BOF

CBAM Benchmark

**1,180** t CO<sub>2</sub>e/t · CN 7224 10 (J): High-alloy steel (produced using the EAF route)

#### EAF Carbon steel

ETS weighted average emission value

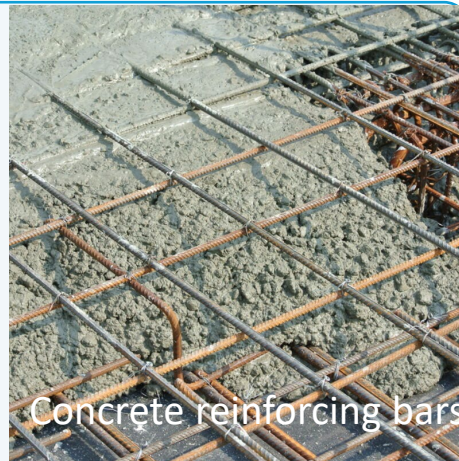
**0,255** t CO<sub>2</sub>e/t

EU ETS benchmark (2021–25)

**0,215** t CO<sub>2</sub>e/t · 76 EU installations

EU ETS benchmark (2021–25)

**0,142** t CO<sub>2</sub>e/t ·



Concrete reinforcing bars

#### EAF high alloy steel

ETS weighted average emission value

**0,323** t CO<sub>2</sub>e/t

EU ETS benchmark (2021–25)

**0,268** t CO<sub>2</sub>e/t · 76 EU installations

EU ETS benchmark (2021–25)

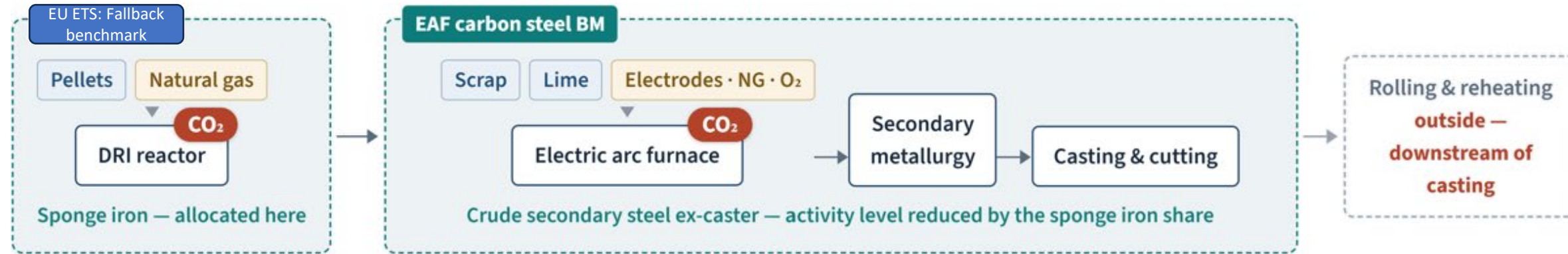
**0,176** t CO<sub>2</sub>e/t ·





## PRODUCTION ROUTES — TECHNICAL DETAIL

### DRI – EAF combination



#### BM VALUES

2026–30

Hot metal 1.248

EAF carbon 0.142

allowances / t ·

C(2026) 4372

**Process chain:** The route is split into two benchmark sub-installations: DRI production and EAF steelmaking. The DRI transferred to the EAF is the measurement point separating the two benchmarks.

**Sponge-iron deduction (GD9 §5):** Steel produced from DRI already covered by the hot metal benchmark is excluded from the EAF benchmark. Only the scrap-based share remains, avoiding double counting.

#### Two plants in europe:

- **ArcelorMittal Hamburg (Germany):** Uses natural gas as fuel. It receives ~0.5 t CO<sub>2</sub> per tonne of DRI produced under the fall-back approach.
- **Höganäs (Sweden):** Uses coal gasification. Its emissions are significantly higher, reaching aprox 0.79 t CO<sub>2</sub> per tonne of product.



## PRODUCTION ROUTES — TECHNICAL DETAIL

### Scrap/EAF route (secondary)



#### Benchmark

2 · Coke

3 · Agglomerated  
iron ore

4 · Hot metal

5 · EAF carbon  
steel

6 · EAF high alloy  
steel

7 · Iron casting

#### Inputs that ARE CBAM goods / indirect

- Ferro-alloys — 7202 (FeMn, FeCr, FeNi)
- Electricity — a CBAM good, counted as indirect (dominant)

#### Inputs NOT under CBAM

- Steel scrap — zero embedded emissions in CBAM
- Lime / fluxes
- Graphite electrodes

**EU ETS benchmarks (2021–25):** Iron casting 0,282 · EU installations: 32

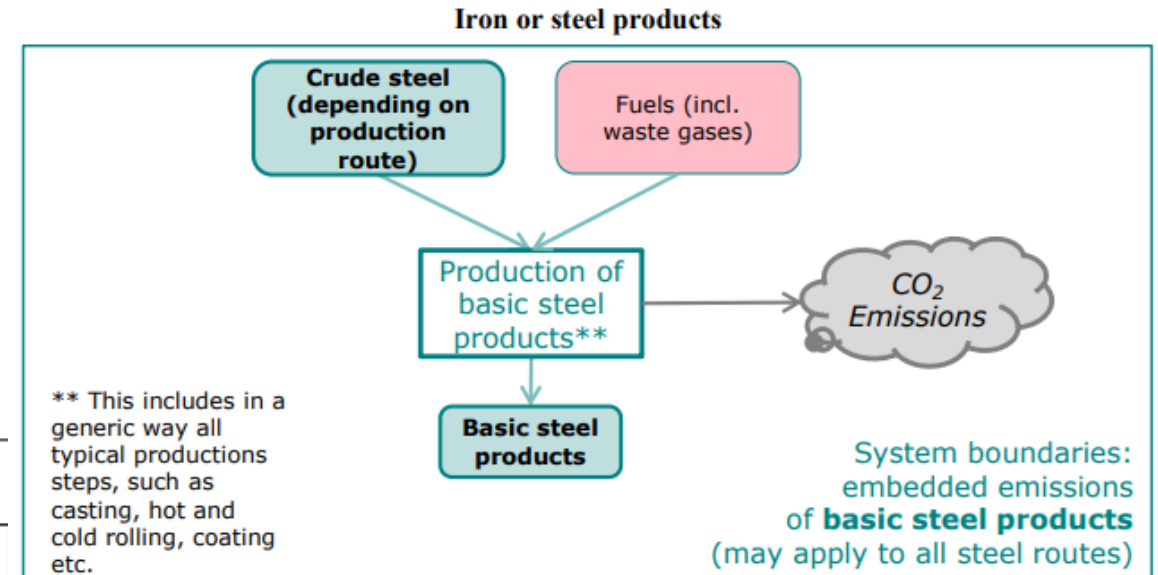
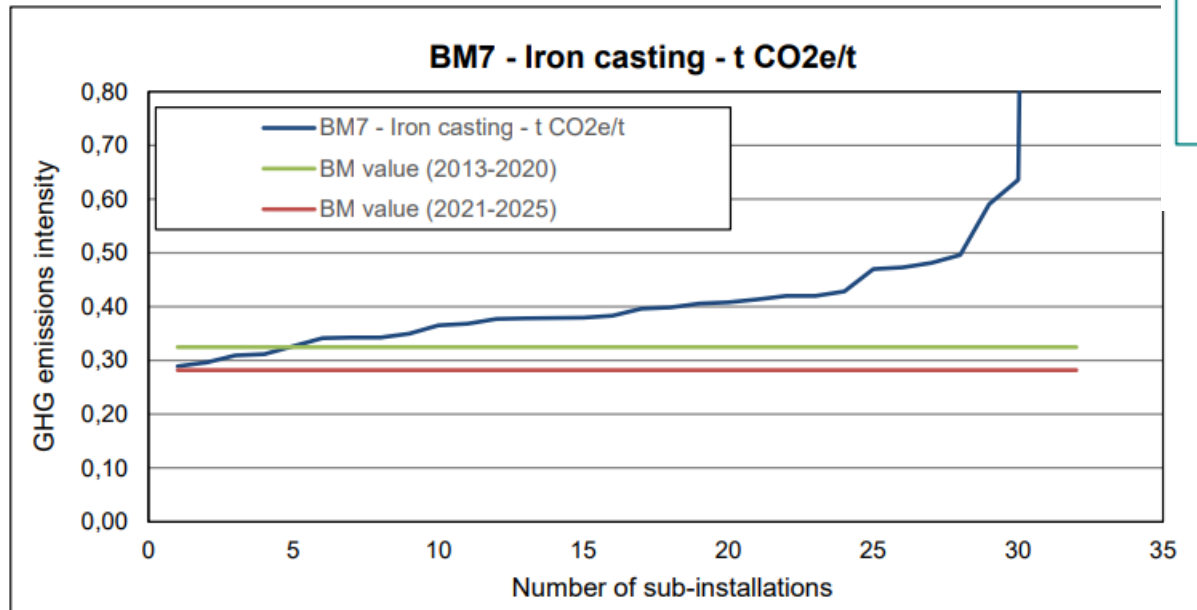
**Process:** high-current electric arcs melt the scrap (~400–600 kWh/t); little chemical reduction, so the lowest direct CO<sub>2</sub>. CBAM exposure is mainly indirect (electricity) plus the alloy precursors.

Sources: JRC EUR 31653 (2023); CBAM iron & steel sector presentation; CBAM benchmark Annex (ferro-alloys 7202). [research material / · CBAM/]



## PRODUCTION ROUTES — TECHNICAL DETAIL

### Scrap/EAF route (secondary)



umweltbundesamt<sup>®</sup>



## RECAP

# What we covered — emissions counting & the production routes

### Production routes

Coke, iron ore, Hot metal, EAF and iron casting

### CBAM precursors

Sintered ore (2601 12 00), pig iron (7201), DRI (7203), ferro-alloys (7202) are CBAM goods; coke, scrap and lime are not

### How to count

Calculation (combustion / process) or mass balance (C in – C out) × 3.664; integrated works → mass balance

### Intensity by route

BF/BOF ≈ 1.85 vs DRI-EAF ≈ 0.79 vs scrap-EAF ≈ 0.15 t CO<sub>2</sub>/t — the spread the benchmarks reflect

*Next: the EU ETS product benchmarks and how they meet CBAM.*



## DAY 2

# Agenda for the day

|   |                                                                                       |                                |
|---|---------------------------------------------------------------------------------------|--------------------------------|
| 1 | Introduction: Routes and benchmark map (EU ETS ↔ CBAM)                                |                                |
| 2 | How emissions are counted (MRV & mass balance)                                        |                                |
| 3 | The production routes in technical detail & the benchmark curve                       | Detailed sector:<br>Iron&steel |
| 4 | System boundaries and relation between EU ETS benchmarks and CBAM                     |                                |
| 5 | Full worked calculation EAF – high alloy steel (Emissions + allocation + CBAM factor) | Case study:<br>Iron&steel      |
| 6 | Example of a full integrated plant (Emissions + allocation) - <i>overview</i>         |                                |
| 7 | Q&A                                                                                   |                                |



## SYSTEM BOUNDARIES

# Sub-installation logic — product benchmarks + fallbacks

- Each product benchmark = one product-benchmark sub-installation
- An integrated works has several (sinter, hot metal, EAF...)
- Residual scope goes to fallbacks: heat, fuel, process-emissions sub-installations
- Waste gases (COG, BF gas, BOF gas) need special treatment
- No emission may be counted under two sub-installations

### Attribution hierarchy

#### 1 Product benchmarks

#### 2 Heat benchmark

#### 3 Fuel benchmark

#### 4 Process emissions



## ALLOCATION RULES

# Cross-cutting allocation rules

### Sub-installation hierarchy

Product benchmark first; only then heat benchmark, fuel benchmark and process emissions sub-installations for what remains outside product boundaries.

### No double counting

Processes inside a product benchmark never receive additional allocation via fall-back approaches. Safety flaring is always covered by the product benchmark.

### Electricity excluded

Emissions from production of consumed electricity are outside every boundary shown. For EAF benchmarks, total electricity consumption is still reported as data.

### Measurable heat

Heat export is not covered by these product benchmarks — export to non-ETS consumers may form separate heat benchmark / district heating sub-installations (GD 6). Heat imported from non-ETS production is deducted (FAR Art. 21).

### Sponge iron deduction

Sponge iron allocated under the hot metal benchmark is netted out of downstream EAF steel activity levels, in proportion to its share of total iron input.

### Waste gas flaring — from 2026

Non-safety flaring of waste gases not used for heat or electricity reduces the product benchmark allocation by the historical flaring emissions (FAR Art. 16(5), GD 8).



## SYSTEM BOUNDARIES

# Avoiding double counting — sponge iron fed to an EAF

- Sponge iron already received allocation under the Hot metal benchmark
- When melted in an EAF, reduce the EAF activity level accordingly
- Reduction = share of iron from sponge iron × iron content of the steel

### Worked example (GD9 §5)

1. Sponge iron = 10% of the iron input to the EAF
2. Crude steel total iron content = 25,000 t
3. Reduction =  $25,000 \times 10\% = 2,500$  t
4. → subtract 2,500 t from the EAF activity level



## EU ETS

# Product benchmarks for iron & steel

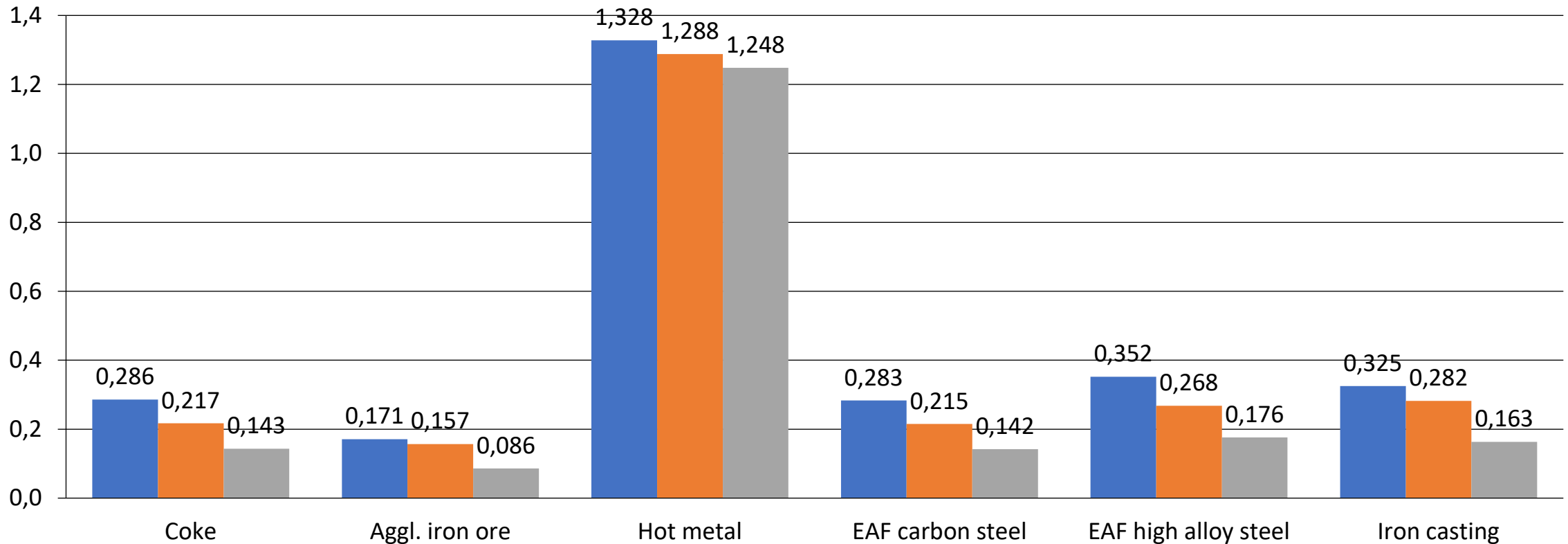
| EU ETS product benchmark             | Unit          | 2026 - 2030 | 2021- 2025 | Ph-3 ref. | # EU inst. |
|--------------------------------------|---------------|-------------|------------|-----------|------------|
| Coke                                 | t dry coke    | 0.143       | 0.217      | 0.286     | 33         |
| Agglomerated iron ore (sintered ore) | t aggl. ore   | 0.086       | 0.157      | 0.171     | 24         |
| Hot metal                            | t liquid iron | 1.248       | 1.288      | 1.328     | 28         |
| EAF carbon steel                     | t crude steel | 0.142       | 0.215      | 0.283     | 76         |
| EAF high alloy steel                 | t crude steel | 0.176       | 0.268      | 0.352     | 82         |
| Iron casting                         | t liquid iron | 0.163       | 0.282      | 0.325     | 32         |



## Iron & steel benchmarks: evolution across trading periods

EU ETS product benchmarks (allowances/t)

■ Ph-3 ref. (2013-2020) ■ 2021-2025 ■ 2026-2030





Eu ETS BENCHMARKS and the relation with the CBAM

Crude steel — production routes Reg. 2025 / 2621

| Production route | How the EU ETS covers the crude steel                                                                | CBAM code |
|------------------|------------------------------------------------------------------------------------------------------|-----------|
| BF/BOF           | Hot metal benchmark — covers the integrated BF route up to crude steel                               | C         |
| DRI/EGF          | Sponge iron under Hot metal + EAF benchmark on melting; sponge-iron deduction avoids double counting | D         |
| Scrap/EGF        | EAF carbon steel / EAF high alloy steel benchmark                                                    | E         |

**Key point:** the EU ETS has no single “crude steel” benchmark — coverage depends on the route. CBAM instead splits crude steel into route codes C/D/E (benchmark values on the CBAM-side slide).

Sources: FAR 2019/331 Annex I (Hot metal, EAF benchmarks) + GD9 §4–6; CBAM benchmark Annex, Reg (EU) 2025/2620 (codes C/D/E). [ETS/ · CBAM/]



BENCHMARK 3 OF 6

## DRI (natural-gas based) — EU ETS vs new CBAM benchmark

### EU ETS

- Sponge iron (DRI) is covered by the Hot metal benchmark — part (b); no separate ETS value
- Free allocation applies the polluter-pays principle (Art. 191(2) TFEU; Del. Reg. (EU) 2019/331)
- In the first CBAM years, the hot-metal adjustment would exceed the embedded emissions of natural-gas DRI → no CBAM certificates due

### CBAM

- Dedicated CBAM benchmark for natural-gas based DRI (CN 7203 10 00 & 7203 90 00)
- Values: 0.295 (col. A) / 0.397 (col. B)
- Level set so DRI obligations fall below primary BF steel but above secondary (scrap-EAF) steel
- Preserves CBAM environmental integrity and shields EU secondary steel from carbon leakage

*Polluter pays in practice: without differentiation, higher-carbon gas-based DRI imports would owe no CBAM certificates while cleaner secondary steel would — Recital 16, Implementing Regulation (EU) 2025/2620.*



## PRODUCTION ROUTES — TECHNICAL DETAIL

# What each route needs: inputs and CBAM precursors

| Route                                                   | Main material inputs                                              | CBAM goods among the inputs (precursors)             |
|---------------------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------|
| BF/BOF (integrated primary)                             | Iron ore, sinter/pellets, coke, limestone, oxygen, scrap (in BOF) | Sintered ore 2601 12 00 → pig iron 7201              |
| DRI/EAF (gas-based primary)                             | DR-grade pellets, natural gas, electricity, ferro-alloys, scrap   | Sintered ore 2601 12 00, DRI 7203, ferro-alloys 7202 |
| DRI + steel products (pig iron) EAF (gas-based primary) | Pig iron, natural gas, electricity, ferro-alloys, scrap           | Pig iron 12 00, DRI 7203, ferro-alloys 7202          |
| Scrap /EAF (secondary)                                  | Steel scrap, electricity, ferro-alloys, lime, graphite electrodes | Ferro-alloys 7202                                    |

**CBAM precursor** = a CBAM good consumed to make another CBAM good; its embedded emissions are carried into the final good. **Not CBAM:** coke, scrap, limestone, natural gas, electrodes. Electricity is itself a CBAM good but is counted as indirect emissions.

Sources: JRC Technical Report EUR 31653 (2023); CBAM iron & steel sector presentation (CN codes); CBAM benchmark Annex, Reg (EU) 2025/2620. [research material/ · CBAM/]

# Interactive Q&A



[partici.fi/23503622](https://partici.fi/23503622)





DAY 2

## Agenda for the day

|   |                                                                                       |                                |
|---|---------------------------------------------------------------------------------------|--------------------------------|
| 1 | Introduction: Routes and benchmark map (EU ETS ↔ CBAM)                                |                                |
| 2 | How emissions are counted (MRV & mass balance)                                        |                                |
| 3 | The production routes in technical detail & the benchmark curve                       | Detailed sector:<br>Iron&steel |
| 4 | System boundaries and relation between EU ETS benchmarks and CBAM                     |                                |
| 5 | Full worked calculation EAF – high alloy steel (Emissions + allocation + CBAM factor) | Case study:<br>Iron&steel      |
| 6 | Example of a full integrated plant (Emissions + allocation) - <i>overview</i>         |                                |
| 7 | Q&A                                                                                   |                                |



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the European Union



REPUBLIC OF TÜRKİYE  
MINISTRY OF ENVIRONMENT,  
URBANIZATION AND CLIMATE CHANGE

Case study – EAF high alloy steel

MRR · FAR

Electric Arc Furnace — High-Alloy Steel Plant

# Monitoring Emissions & Calculating Free Allocation

A complete, worked methodology — from source streams and the mass-balance method through to product- and fuel-benchmark free allocation.

**26**

monitored source streams

**2**

benchmark sub-installations

**≈236 kt**

CO<sub>2</sub> reported per year

**≈179 k**

free allowances per year



## THE INSTALLATION

# A high-alloy steel plant at a glance

The site produces **special (high-alloy) steel** through a fully electric route. Steel scrap, purchased pig iron, direct-reduced iron and ferroalloys are melted in electric arc furnaces, refined, cast into semi-finished shapes, then reheated and rolled, forged and heat-treated.

Because there is no iron-making, carbon enters mainly with **charge carbon, graphite electrodes and ferroalloys** — and leaves in the steel, slag and dust. That balance is the heart of the emissions calculation.

**2 × 100 t**

electric arc furnaces

**≈1.15 Mt**

crude steel / year

**NACE  
24.10**

basic iron & steel

### MELT SHOP

2 electric arc furnaces (AC + DC) · 3 ladle refining furnaces · 3 continuous casters

### ROLLING & FORGING

3 rolling mills · reheating (walking-beam) furnaces · forging line  
— all natural-gas fired

### HEAT TREATMENT

quench & temper, annealing and normalising furnaces · ladle & tundish heaters — natural gas

### ANCILLARY

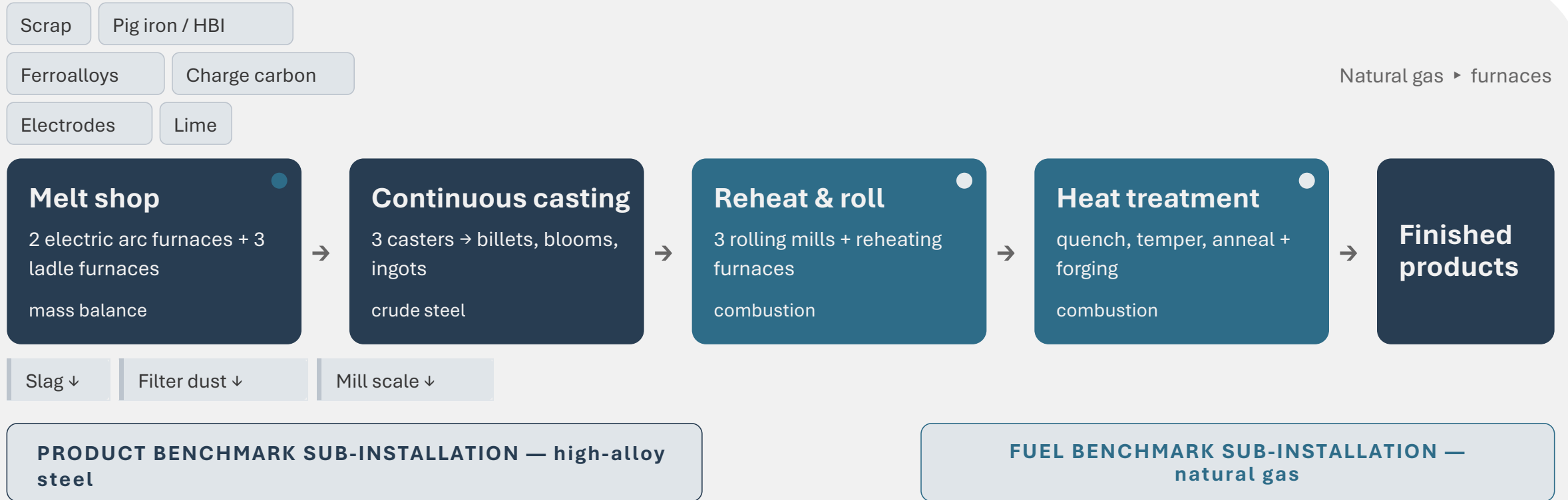
emergency diesel gensets & fire motor-pumps · civil heating boilers



## PROCESS MAP

# Block flow diagram of the installation

● CO<sub>2</sub> emission point    ■ Carbon-bearing output





## SCOPE

# Drawing the EU ETS system boundary

Annex I activities covered by the permit

- 01** Production of pig iron or steel, incl. continuous casting
- 02** Processing of ferrous metals — rolling mills, reheaters & heat-treatment furnaces
- 03** Combustion of fuels in units > 20 MW total rated thermal input

### ✓ INSIDE THE BOUNDARY

All fuel combustion · process carbon in the mass balance ·  
emergency gensets & motor-pumps · on-site civil heating

### ✗ NOT IN DIRECT EMISSIONS

Imported grid electricity (indirect) · biogenic CO<sub>2</sub> fraction  
(monitored but zero-rated)



## WHAT WE MONITOR

# Source streams & emission sources

## Mass-balance streams

22 streams

Carbon-bearing inputs & outputs of the melt shop

Anthracite

Coke

Pet coke

Electrodes

Lime

Scrap

Pig iron

HBI / DRI

Ferroalloys (8)

Polymers

outputs (subtracted):

Crude steel

Slag

Dust

Scale

Carbon content of each is set by **laboratory analysis**.

## Combustion streams

4 streams

Fuels burned purely for heat / power

Natural gas

Diesel

LPG

Civil-line gas

### EMISSION SOURCES (physical units)

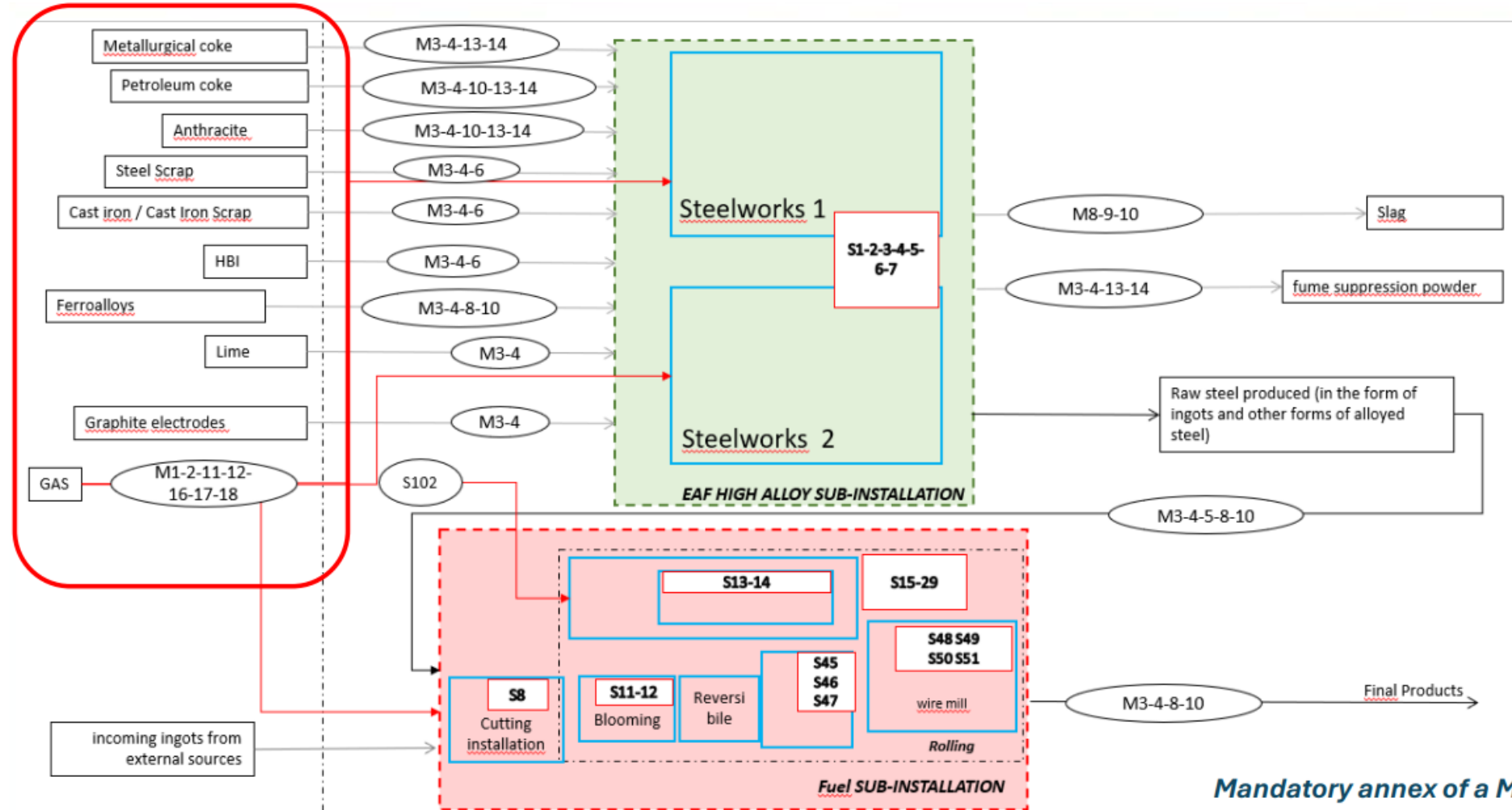
100+ units, e.g. 2 arc furnaces, ladle furnaces, reheating & heat-treatment furnaces, ladle / tundish heaters, diesel gensets and fire motor-pumps.

We report on **streams** ; each source is mapped to the stream that feeds it.



## WORKED EXAMPLE · EAF high alloy steel plant

### Layout



*Mandatory annex of a MMP*



## HOW CO<sub>2</sub> IS CALCULATED

# Two calculation methodologies

## Mass balance

Melt shop — track carbon in vs. carbon out

$$\text{CO}_2 = \sum(\text{AD}_i \times \text{C}_i) \times \frac{44}{12}$$

AD<sub>i</sub> mass of each stream (t)

C<sub>i</sub> carbon content (t C / t) — lab

44/12 = 3.664, CO<sub>2</sub>-to-carbon ratio

Inputs count **positive**, products & by-products **negative**. The residual carbon left the process as CO<sub>2</sub>.

## Standard combustion

Gas-fired furnaces & engines — burn for heat

$$\text{CO}_2 = \text{AD} \times \text{NCV} \times \text{EF} \times \text{OF}$$

AD fuel consumed (t or 1000 Nm<sup>3</sup>)

NCV net calorific value (GJ/unit)

EF emission factor (t CO<sub>2</sub>/TJ)

OF oxidation factor (≈ 1)

Fuel quantity × its energy content × how much CO<sub>2</sub> per unit of energy.



## DATA QUALITY

# Activity data, calculation factors & monitoring

### ACTIVITY DATA

#### How much?

**Weighbridges** — accuracy class III, calibrated annually; all solids & materials

**Fiscal gas meters** — turbine meters with P/T volumetric correction at custody transfer

### CALCULATION FACTORS

#### How carbon-rich?

**Lab analysis** — carbon content of each material, on a documented sampling plan

**NCV & EF** for fuels — analysis or approved default values

**Accredited laboratories** — results traceable in the monitoring plan

### TIERS & UNCERTAINTY

#### How accurate?

Each stream meets a minimum **MRR tier**

Backed by a simplified **uncertainty assessment**

MAJOR

MINOR

DE-MINIMIS



## SPLITTING THE INSTALLATION

# Sub-installations & avoiding double counting

### PRODUCT BENCHMARK

## High-alloy steel from EAF

The melt shop: arc furnaces, ladle refining, continuous casting. Covers the process emissions (mass balance) and its own fuel use.

activity → tonnes of steel

### FUEL BENCHMARK (fallback)

## Downstream gas-fired heat

Rolling mills, reheating & heat-treatment furnaces. No product benchmark applies — allocation follows the fuel actually burned.

activity → TJ of fuel

### THE RULE

## No stream counted twice

Each source stream, unit of heat and tonne of output is assigned to **exactly one** sub-installation.

The FAR system boundaries are mutually exclusive — the benchmark **hierarchy** decides ties: product ► heat ► fuel ► process.



WORKED EXAMPLE · PART 1 OF 2

## Emissions accounting for the year

rounded & anonymised

### ① MASS BALANCE — melt shop

| stream               | t         | C     | t CO <sub>2</sub> |
|----------------------|-----------|-------|-------------------|
| Anthracite           | 13,100    | 0.79  | 37,800            |
| Pig iron             | 122,100   | 0.041 | 18,300            |
| Coke + pet coke      | 5,900     | 0.89  | 19,000            |
| Electrodes           | 2,800     | 1.00  | 10,300            |
| Polymers             | 9,400     | 0.77  | 23,800            |
| Scrap + HBI + alloys | 1,213,000 | —     | 15,400            |
| – Crude steel        | 1,147,000 | 0.003 | –13,300           |
| – Slag, dust, scale  | 218,000   | —     | –3,000            |

Net (× 44/12)

**≈ 108,300 t**

### ② COMBUSTION — natural gas

$$60,700 \text{ k} \cdot \text{Nm}^3 \times 37.6 \text{ GJ} = 2,283 \text{ TJ} \times 56.0 \text{ t/TJ} = \mathbf{127,900 \text{ t CO}_2}$$

+ diesel, LPG & civil gas ≈ 240 t → **≈ 128,100 t**

TOTAL REPORTED

**≈ 236,400** t CO<sub>2</sub> / yr

108,300 (process) + 128,100 (combustion). Biogenic ≈ 2,500 t monitored but **zero-rated**.



FREE ALLOCATION · THE FRAMEWORK

## How free allowances are calculated

$$\text{Allocation} = \text{HAL} \times \text{Benchmark value} \times \text{CLEF} \times (\text{CSCF})$$

### HAL

#### Historical activity

Median output over the baseline period — fixes the volume.

### BENCHMARK

#### EU efficiency yardstick

Allowances per tonne of product, or per TJ of fuel / heat.

### CLEF

#### Carbon-leakage factor

= 1 for exposed sectors like steel; lower otherwise.

### HIERARCHY

#### Which benchmark?

product ▶ heat ▶ fuel ▶ process

Fallbacks only where no product benchmark fits.



## THE NUMBERS THAT APPLY

### The two benchmarks applied here

#### PRODUCT BENCHMARK

##### High-alloy steel from EAF

**0.268** <sub>EUA / t steel</sub>

Activity = tonnes of qualifying high-alloy steel. Electricity ↔ fuel interchangeability applies, so an **exchangeability factor** scales the result.

#### FUEL BENCHMARK (fallback)

##### Downstream gas-fired heat

**42.6** <sub>EUA / TJ fuel</sub>

Activity = net energy of fuel burned (TJ). A single EU-wide value applied to all fuel with no product benchmark of its own.



## KEEPING ALLOCATION CURRENT

# HAL, ALC & the annual adjustment

HAL

### Historical activity level

Baseline median. Sets the preliminary allocation.



ALC

### Annual level of activity

Reported each year. Two-year rolling average compared to HAL.



ADJUST?

### Both thresholds together

relative change > 15% AND absolute  $\geq 100$  EUA

THIS PLANT — LATEST YEAR

### No adjustment triggered

Steel activity vs HAL

**$\approx +4\%$**

under the 15% band

Fuel activity vs HAL

**$\approx +10\%$**

under the 15% band

Allocation

**unchanged**

stays at HAL basis



## Preliminary free allocation

rounded & anonymised

### ① PRODUCT BENCHMARK

$\text{HAL } 1,154,600 \text{ t} \times \text{BM } 0.268 = 309,400 \times$   
 $\text{ElExch } 0.313 \times \text{CLEF } 1.0$

≈

**96,997 EUA**

### ② FUEL BENCHMARK

$\text{HAL } 1,924 \text{ TJ} \times \text{BM } 42.6 \times \text{CLEF } 1.0$   
(fallback benchmark)

≈

**81,962 EUA**

### TOTAL PRELIMINARY ALLOCATION

**178,959**

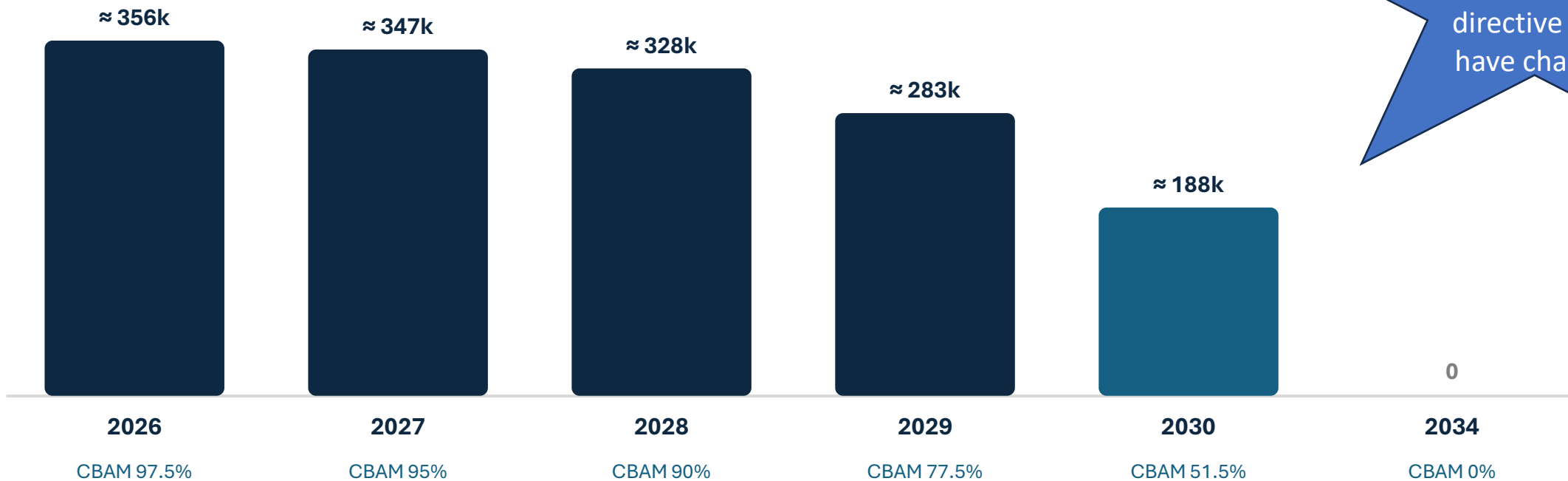
free allowances / year

96,997 (product) + 81,962 (fuel) . Adjusted  
yearly against the ALC.



WORKED EXAMPLE · EAF high alloy steel plant

## The CBAM phase-down — free allocation 2026 → 2034



After the revision of the directive this have change

The CBAM factor is the share of free allocation still granted — it reaches 0% in 2034, when CBAM fully replaces free allocation. As free allocation falls, the import-side CBAM obligation rises by the mirror amount.



WORKED EXAMPLE · EAF high alloy steel plant

## Emissions vs. free allocation — the 2025 gap

**≈ 236,000**

t CO<sub>2</sub>e — verified emissions (to surrender)

**≈ 179,000**

EUA — free allocation (≈ 76% of emissions)

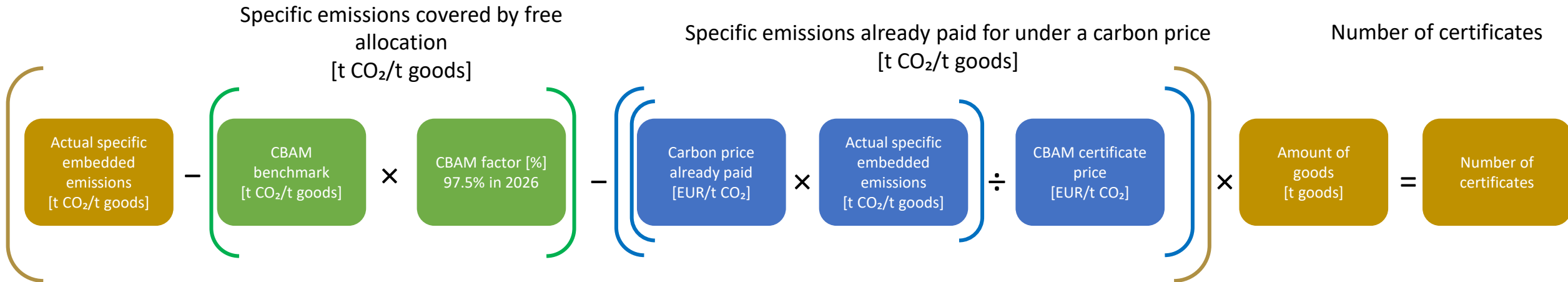
**≈ 57,000 allowances to purchase** — the gap the operator must cover on the market.

- Free allocation covers ≈ 76% of this plant's emissions; the balance must be bought.
- From 2026 the CBAM factor phases down free allocation for CBAM goods — the gap widens (see earlier slides).
- One dataset — emissions, activity levels, sub-installations — feeds both surrender and free allocation.



WORKED EXAMPLE · EAF high alloy steel plant – CBAM

## How CBAM certificates are calculated





WORKED EXAMPLE · EAF high alloy steel plant - CBAM

## The CBAM side, by route — CN 7224 10 (alloy-steel ingots)

(F) Low alloy  
Steel based on  
BF/BOF

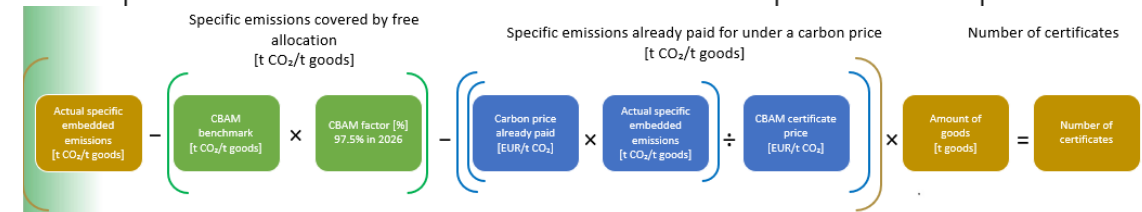
| Türkiye         |                                                                                                                                                         |                                     |                                          |                                    |                                                 |                                                 |                                                                |                                                          |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|------------------------------------------|------------------------------------|-------------------------------------------------|-------------------------------------------------|----------------------------------------------------------------|----------------------------------------------------------|
| Product CN Code | Description                                                                                                                                             | Default Value<br>(direct emissions) | Default Value<br>(indirect<br>emissions) | Default Value<br>(total emissions) | 2026<br>Default Value<br>(including<br>mark-up) | 2027<br>Default Value<br>(including<br>mark-up) | 2028 and<br>onwards<br>Default Value<br>(including<br>mark-up) | Underlying<br>production route<br>determining CBAM<br>BM |
| 7224 10         | Steel, alloy, other than stainless, in ingots or other primary forms (excl. waste and scrap in ingot form, and products obtained by continuous casting) | 6,950                               | N/A                                      | 6,950                              | 7,645                                           | 8,340                                           | 9,035                                                          | (F)                                                      |

| CN code    | CN Description                                                                                                                                                        | Column A<br>BMg* [tCO <sub>2</sub> e/t]          | Column B<br>BMg [tCO <sub>2</sub> e/t]                                                                                       |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| 7224 10 90 | Steel, alloy, other than stainless, in ingots or other primary forms (excl. of tool steel, waste and scrap in ingot form and products obtained by continuous casting) | 0,453 (F)<br>0,330 (G)<br>0,330 (H)<br>0,358 (J) | 1,807 (F)(1)<br>0,982 (G)(1)<br>0,640 (H)(1)<br>1,180 (J)(1)<br>1,640 (F)(2)<br>0,969 (G)(2)<br>0,628 (H)(2)<br>1,148 (J)(2) |

### CBAM cost per tonne for this product (2026):

[ 7.645 – (1.807 × 0.975) – emissions already paid under a carbon price ] × €75.36 ≈ **€443 / t**





WORKED EXAMPLE · EAF high alloy steel plant

## The CBAM side, by route — CN 7224 10 (alloy-steel ingots)

- When emissions are properly calculated, the applicable benchmark is lower; however, in most cases, the reported emissions are also correspondingly lower.
- Where an ETS is in place in the country of origin, it will also influence the CBAM-adjusted border price. A key advantage is that the carbon cost remains within the country of origin, rather than being fully transferred abroad.



## DAY 2

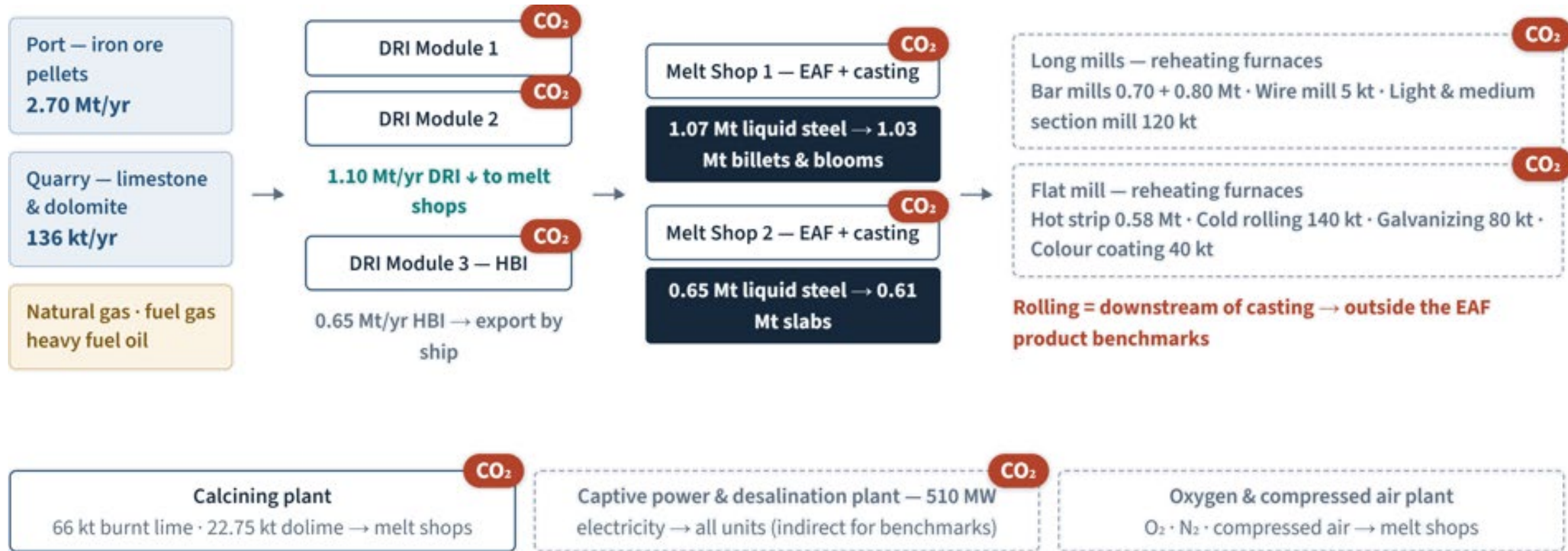
# Agenda for the day

|   |                                                                                       |                                |
|---|---------------------------------------------------------------------------------------|--------------------------------|
| 1 | Introduction: Routes and benchmark map (EU ETS ↔ CBAM)                                |                                |
| 2 | How emissions are counted (MRV & mass balance)                                        |                                |
| 3 | The production routes in technical detail & the benchmark curve                       | Detailed sector:<br>Iron&steel |
| 4 | System boundaries and relation between EU ETS benchmarks and CBAM                     |                                |
| 5 | Full worked calculation EAF – high alloy steel (Emissions + allocation + CBAM factor) | Case study:<br>Iron&steel      |
| 6 | Example of a full integrated plant (Emissions + allocation) - <i>overview</i>         |                                |
| 7 | Q&A                                                                                   |                                |



CASE STUDY · INTEGRATED DRI-EAF

## Example





CASE STUDY · INTEGRATED DRI-EAF

## First steps to

### 9 goods

one 2025 annual report — separate SEE per good

### 6 processes

defined for attributing emissions to goods

**DRI → EAF → casting → rolling** — plus captive power, calcining and oxygen plants; fuels: natural gas & heavy fuel oil.

- Precursors: iron ore supplier data is partial — actual values used where available, EU default values elsewhere; alloy additions (FeMn, SiMn) on defaults;



CASE STUDY · INTEGRATED DRI-EAF

## An integrated DRI-EAF works — the natural-gas route

- **Precursors arrive from prot**— natural-gas reduces into DRI on shaft furnaces ( $\approx 1.10$  Mt DRI +  $0.65$  Mt HBI/yr) feeding two EAF melt shops ( $\approx 1.72$  Mt liquid steel/yr).
- **Products:** billets & blooms ( $\approx 1.03$  Mt), slabs ( $\approx 0.61$  Mt), rolled long products, hot-rolled coils — plus HBI shipped for export.
- **Inside the boundary:** captive power plant ( $\approx 500$  MW), calcining plant (burnt lime & dolime), oxygen plant, own quarry — fuels: natural gas & heavy fuel oil.
- **Why it matters:** gas-based DRI sits between BF/BOF and scrap-EAF — the case the dedicated CBAM DRI benchmark targets.

$\approx 1.75$  Mt

DRI + HBI produced per year (CN 7203 10 00)

9

CBAM goods in scope — monitoring year 2025



CASE STUDY · INTEGRATED DRI-EAF

## Mapping the works — production processes, goods, CN codes

| Production process                     | Output / CBAM good                                                 | CN code                                            |
|----------------------------------------|--------------------------------------------------------------------|----------------------------------------------------|
| DRI plants — two shaft-furnace modules | DRI — $\approx 1.10$ Mt/yr                                         | 7203 10 00                                         |
| HBI plant — one module                 | HBI — $\approx 0.65$ Mt/yr, largely exported                       | 7203 10 00                                         |
| EAF melt shops 1 & 2 (crude steel)     | Billets & blooms $\approx 1.03$ Mt · slabs $\approx 0.61$ Mt       | 7207 11 11 · 7207 12 10                            |
| Rolling mills (reheating furnaces)     | Bars · wire rod · sections · hot-rolled coils                      | 7214 20 00 · 7213 10 00<br>7216 10 00 · 7208 10 00 |
| Auxiliaries                            | Captive power plant, calcining (burnt lime & dolime), oxygen plant | inputs — not CBAM goods                            |

**KEY LINK** — the plant's DRI and HBI fall under CN 7203 10 00 — exactly the code carrying the new dedicated CBAM benchmark for natural-gas DRI (0.295 col. A / 0.397 col. B, Reg. (EU) 2025/2620). Precursors declared: iron ore, FeMn, SiMn, scrap.



CASE STUDY · INTEGRATED DRI-EAF

BF/BOF vs DRI-EAF vs scrap-EAF — what the route means

| Per tonne of crude steel          | Integrated BF/BOF           | NG DRI-EAF (this case)                           | Scrap-EAF                    |
|-----------------------------------|-----------------------------|--------------------------------------------------|------------------------------|
| Direct emission intensity         | ≈ 1.83 t CO <sub>2</sub> /t | ≈ 0.7–1.0 t CO <sub>2</sub> /t                   | ≈ 0.21 t CO <sub>2</sub> /t  |
| EU ETS benchmark applied          | Hot metal — 1.288 EUA/t     | Hot metal (DRI included — no separate ETS value) | EAF high-alloy — 0.268 EUA/t |
| Covered by free allocation (2025) | ≈ 77%                       | — (non-EU exporter: CBAM side)                   | ≈ 76%                        |
| CBAM default benchmark (col. B)   | ≈ 1.288 (BF/BOF)            | 0.397 — dedicated DRI benchmark                  | ≈ 0.027 (scrap/EAF)          |

**TAKEAWAY** — route, not output, drives the carbon cost. Our anonymised case sits in the middle: the dedicated CBAM DRI benchmark (slide on Reg. 2025/2620) keeps its obligations below BF/BOF steel but above scrap-EAF. Türkiye makes ≈ 70% of its steel via scrap-EAF → among the lowest CBAM exposure; gas-based DRI exporters face a moderate, growing obligation as free allocation phases out.

Sources: JRC 2023 (Türkiye); applied 2021–25 EU benchmarks; Reg. (EU) 2025/2620 Annex (col. B). Anonymised pre-verification data, 2025. [ETS+CBAM/]



## DAY 2

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CLOSE

## Iron and steel – Day 2

Questions and discussion · Next: Day 3 — cement, lime and aluminium

### Primary sources cited in this storyboard

- EU ETS Directive 2003/87/EC (consolidated 01.03.2024) — Art. 10a [ETS/]
- Free Allocation Regulation (EU) 2019/331 (cons. 01.01.2024) — Annex I, Annex IV [ETS/]
- Free Allocation Guidance GD9 — sector-specific guidance, iron & steel §2-7 [ETS/]
- Supporting guidance: GD3, GD4, GD5, GD6, GD8 [ETS/]
- CBAM Implementing Reg (EU) 2025/2620 — benchmark Annex (codes C-J; DRI; pig iron; iron ore) [CBAM/]
- CBAM Reg (EU) 2023/956 and 2025/2621 (default values) [CBAM/]
- Accreditation & Verification Reg (EU) 2018/2067 (AVR) [MRV/]
- Continuity reference: Presentations 2024 / Day 2



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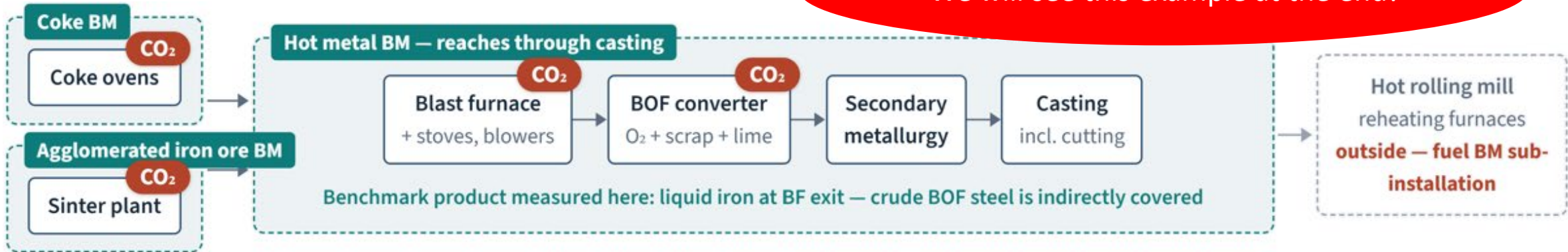
# Back-up slides



## PRODUCTION ROUTES — TECHNICAL DETAIL

### Integrated plant

We will see this example at the end!



**COG · BFG · BOFG** Waste gases → on-site power plant: combustion emissions attributed to electricity production, excluded from free allocation (GD 8)

#### WORKED EXAMPLE illustrative figures

**Given:** the coke plant discharges 800 kt dry coke: 740 kt charged to the blast furnace, 60 kt coke breeze consumed at the sinter strand.

**Rule & result:** allocation for coke production =  $\text{BM}_{\text{coke}} \times 800 \text{ kt}$  (full production). In emissions monitoring, the 740 kt is a source stream of the **hot metal** sub-installation and the 60 kt of the **sinter** sub-installation — consumption follows the consuming boundary.



## PRODUCTION ROUTES — TECHNICAL DETAIL

### Example

