

WHITE PAPER 06 · CAMEROON STEEL

LOWER-CARBON STEEL FROM CAMEROON: IT COULD REACH A THIRD OF THE WORLD'S CARBON INTENSITY

An electric-arc steelworks on Cameroon's hydro-dominated grid could make steel at about 0.3 t CO₂ per tonne within Scopes 1 and 2 (direct emissions and purchased electricity) and about 0.6 t including imported iron units, on our estimates. Carbon border measures can turn that estimated advantage, once measured and verified, into a competitive asset against ore-based steel, and Central Africa's ore and hydropower give it a long-term green-iron option.

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This paper sets out evidence and illustrative calculations. Project figures are planning values from the Cameroon Steel reference configuration RC-1 (planning estimate), labelled planned, indicative, derived or assumed; they are estimates, not measured results, guarantees or commitments. Carbon prices, rules and standards are quoted as published on or before 10 October 2026 and will change.

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EXECUTIVE SUMMARY: A LOW-CARBON START THAT ONLY MEASUREMENT CAN TURN INTO AN ASSET

An electric-arc steelworks at Mboro, drawing power from Cameroon's hydro-dominated grid, could make billets, wire rod and reinforcing bar at roughly a third of the world's average carbon intensity. Our illustrative estimate for the first phase of the reference configuration (RC-1) is about 0.32 tonnes of CO₂ per tonne of product within Scopes 1 and 2 (direct emissions on site and purchased electricity) and about 0.58 tonnes once the emissions of imported direct-reduced iron are included, against a 2024 world average of 1.92 tonnes. These are estimates, not measurements. That advantage is real but conditional: it depends on firm low-carbon power, on the carbon content of the iron units the furnace melts, and on measurement good enough to be verified. Carbon border measures, led by the European Union's mechanism in its definitive phase since 1 January 2026, are turning verified low intensity into a price advantage over ore-based steel, and Central Africa's iron ore and hydropower give Cameroon a long-term option to make low-carbon iron itself.

0.32 t/t

Scopes 1+2 per t product, RC-1 Phase 1 (derived, illustrative)

0.58 t/t

Including imported DRI/HBI upstream (derived, illustrative)

1.92 t/t

World average, all routes, 2024 data (worldsteel)

226 g/kWh

Cameroon grid average, 2024 (Ember)

€82 /t CO₂

EU CBAM certificate price, Q3 2026 (€82.32)

Twelve findings

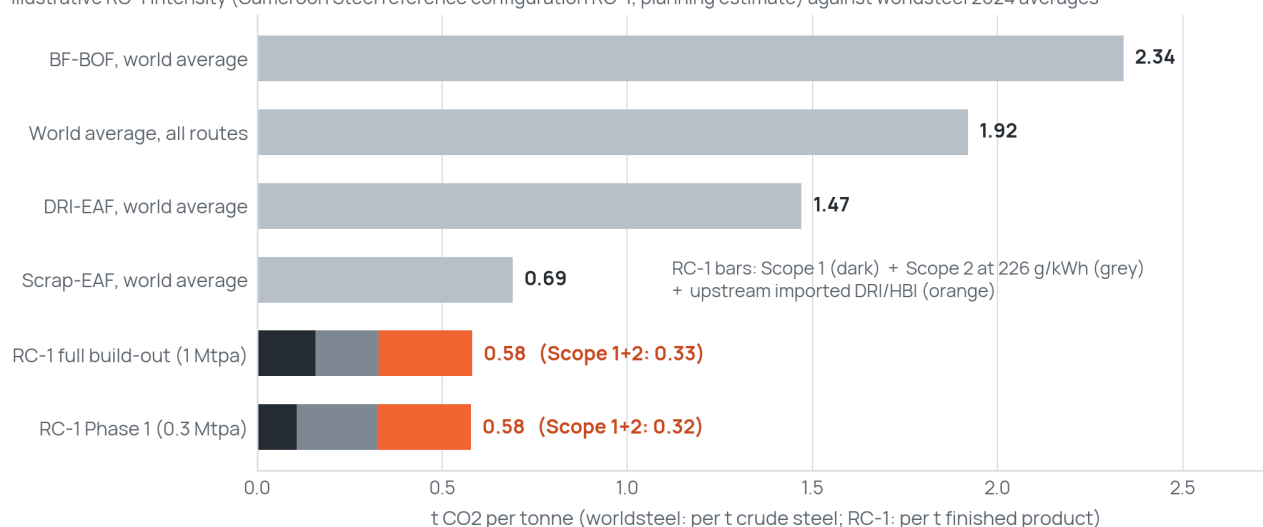
- 01 Route choice, not effort at the margin, sets the carbon intensity of steel.** Steel accounts for about 7% to 8% of global greenhouse gas emissions [S02]. On worldsteel's 2024 data, the blast-furnace route emits 2.34 t CO₂ per tonne of crude steel, gas-based direct reduction with an electric furnace 1.47 t and scrap-based electric furnaces 0.69 t, for a world average of 1.92 t [S01]. Africa already makes 89% of its crude steel in electric furnaces [S03].
- 02 Cameroon's grid is about half as carbon-intensive as the world's.** The average intensity of Cameroon's electricity was about 226 g CO₂e/kWh in 2024, against 471 g for the world and 717 g for South Africa [S48]. Hydropower supplied about 72% of generation in 2024 on the Ember dataset and, on the regulator's dataset, about 90% in 2025 after the 420 MW Nachtigal plant was fully commissioned [S49][S50]; the two datasets differ in coverage. Applying the 2024 fossil emission rate to the 2025 mix suggests an average of about 74 to 96 g/kWh (derived, indicative). 226 g/kWh is therefore conservative against the average, but not against the marginal factor: until the Nachtigal evacuation line and the southern grid are reinforced,

new load at Kribi may be served at the margin by gas or oil plants at about 770 g/kWh, which would add up to about 0.5 t per tonne in the hours when thermal plants are on the margin (derived).

-
- 03 The illustrative footprint of the first phase is about 97,000 t of CO₂ a year within Scopes 1 and 2.** At its nameplate of 0.3 Mtpa, RC-1 Phase 1 would emit about 31,900 t directly on site (Scope 1) and about 65,300 t through purchased grid electricity, emitted at the power plants (Scope 2). Minor sources outside the model (diesel for mobile plant, LPG and SF6 in switchgear) would add about 3,000 to 7,000 t (assumed). Imported direct-reduced iron or hot-briquetted iron (DRI/HBI) adds about 76,200 t upstream. At the expected sustained output of 270,000 to 300,000 t a year, the annual totals are up to 10% lower and the intensities unchanged. At the 1 Mtpa design capacity the figures are about 328,000 t (Scopes 1+2) and 582,000 t including upstream iron units; intensity stays close to 0.33 and 0.58 t per tonne. With the furnace at the upper planning value of about 490 kWh per tonne for a charge with 30% DRI, rather than 450, each intensity rises by about 0.01 t (derived from the RC-1 reference configuration).
-
- 04 The iron units the furnace melts matter more than any other single choice.** Moving the imported DRI share of the charge from 30% to 50% adds about 0.18 t per tonne; cutting it to 20% saves about 0.09 t. The upstream intensity of that DRI (0.5 to 0.9 t per tonne of DRI) moves the result by about 0.07 t either way, and the grid factor (200 to 300 g/kWh) by -0.03 to +0.07 t. Taken one at a time, these ranges keep the Phase 1 intensity between about 0.49 and 0.75 t per tonne; at their joint extremes it spans about 0.42 to 0.95 t (derived).
-
- 05 The advantage belongs to the grid as much as to the furnace.** The same melt shop on a world-average grid would emit about 0.81 t per tonne including upstream iron units, and about 1.05 t on South Africa's grid. On this full-footprint basis it would lose its lead over the average scrap-based electric furnace at a grid factor of about 340 g/kWh (derived). Firm, contracted low-carbon power is therefore a carbon decision, not only an energy decision.
-
- 06 One plant can honestly report seven different numbers.** Depending on the perimeter, the same Phase 1 tonne carries about 0.11 t (Scope 1 only), 0.11 t (Scopes 1+2 with a market-based hydro supply contract), 0.20 t (Scopes 1+2 at the 2025 grid cross-check of 96 g/kWh), 0.32 t (Scopes 1+2 at the 2024 grid average), 0.36 t (EU CBAM basis, which for steel counts direct and precursor emissions but not purchased electricity), 0.54 t (per tonne of crude steel on the ISO 14404 and worldsteel basis) or 0.58 t (the same, per tonne of product). Credibility depends on stating the perimeter every time and on third-party verification.
-

Below every route average, and far below ore-based routes

Illustrative RC-1 intensity (Cameroon Steel reference configuration RC-1, planning estimate) against worldsteel 2024 averages



DERIVED **Figure ES.1.** Illustrative carbon intensity of the RC-1 steelworks against worldsteel route averages. RC-1 values are per tonne of finished product, which overstates them by about 6% against the per-tonne-of-crude-steel basis of the benchmarks; the comparison is therefore conservative. The bars split RC-1 into Scope 1 (dark), Scope 2 at 226 g/kWh (grey) and the upstream emissions of imported DRI/HBI (orange).

Source: worldsteel Sustainability Indicators 2025 (2024 data) [S01]; Cameroon Steel reference configuration RC-1 (planning estimate), edition 10 October 2026 [S90]; WP06 model (Annex A).

07 Carbon border measures reward verified low intensity against ore-based steel, and they price RC-1's imported iron, not its grid. The EU Carbon Border Adjustment Mechanism (CBAM) covers iron-ore pellets, DRI, billets, reinforcing bar and wire rod [S27]. For steel it counts direct emissions and the direct emissions embedded in precursors such as DRI, but not purchased electricity, so Cameroon's low-carbon grid earns no CBAM credit [S27]. The certificate price was €82.32/t CO₂ for the third quarter of 2026 [S26], and the free allocation that shields EU producers falls from 97.5% of the benchmark in 2026 to zero in 2034 [S28]. For illustration, at a constant 2026 price and with the hot-rolled-coil benchmark used as a proxy for long products, an EU-bound tonne of RC-1 Phase 1 product (0.36 t on the CBAM basis, about 70% of it from the imported DRI) would carry about €24 of CBAM cost in 2026, rising to €30 in 2034; by 2034 gas-based DRI-EAF steel would carry about €82 to €121 and blast-furnace steel about €99 to €193. An all-scrap furnace would pay less than RC-1, about €3 to €9, because scrap carries no precursor emissions. Exporters without verified data face default values with mark-ups of 10% in 2026, 20% in 2027 and 30% from 2028 [S31].

08 Green iron is a long-term option for Central Africa, not a near-term product. On Midrex plant statistics, Sub-Saharan Africa produced 0.09 Mt of DRI in 2025 out of a world total of 151 Mt, with the region's gas-based plants idle [S13]; worldsteel, whose figures include estimates for plants outside that survey, puts output in Uganda, Kenya and Tanzania at about 2.7 Mt [S03]. DR-grade ore is scarce (about 3% of seaborne trade exceeded 66% Fe in IEEFA's 2022 assessment [S75]), and the direct-shipping ore reported for Mbalam grades a little above 62% Fe [S72], which is blast-furnace grade. A domestic direct-reduction module would need concentration and pelletising, a gas contract and, for hydrogen, electricity on the scale of a large hydro plant: about 0.9 to 1.0 TWh a year for RC-1's own iron units and 2.4 to 2.8 TWh for a 1 Mt/yr module, against 3.6 TWh delivered by Nachtigal in twelve months (derived) [S52].

09 The plant platform is safe from the sea; the port interface and the drainage system are not. The site sits about 40 to 100 m above sea level (rounded; to be confirmed by survey) [S106] and about 3 to 4 km inland (White paper 07, Table D.1). The design issues are extreme rainfall (a 100-year one-day total of 264 mm at Kribi station [S60], which an uplift of about 7% per degree of warming [S59] would take to about

280 to 300 mm), heat and humidity for melt-shop workers, and a coastline that retreated by about 2 m a year on average between 2015 and 2020 [S62].

- 10** **Circularity starts with scrap, and Cameroon is short of it.** RC-1 Phase 1 needs about 254,000 t of scrap a year at nameplate; the only published estimate of domestic scrap arising is 53,000 to 62,000 t a year (2006 data) [S88], and existing mills already import much of their feed [S89]. RC-1 therefore plans on about 30,000 t a year of domestic scrap (range 0 to 60,000 t, assumed) and imports the balance, which brings Phase 1 port receipts of metallics and consumables to about 351,000 t a year (derived). The works would also produce about 45,000 t of slag, suitable for roads after testing, and about 4,800 t of hazardous furnace dust containing roughly 1,000 to 1,400 t of zinc a year (derived), which European practice recycles almost entirely [S69].
- 11** **Lenders will apply their strongest climate rules from the first phase.** At 226 g/kWh, Phase 1 process emissions and purchased electricity come to about 97,000 t a year; with diesel, LPG and SF6 the total is about 100,000 to 104,000 t. Phase 1 therefore sits at or about the 100,000 t threshold of the Equator Principles for Scopes 1+2, and later phases are well above it [S22]. Cameroon Steel should therefore plan for a climate change risk assessment, an alternatives analysis and annual public reporting from Phase 1. On ResponsibleSteel's sliding scale, the illustrative RC-1 intensity clears Progress Level 1 by a wide margin but is far from the IEA's near-zero threshold [S37][S06].
- 12** **Known levers cut the footprint by about 40%; green iron takes it further.** Efficiency, lower direct emissions, a grid at about 100 g/kWh, more scrap in the charge (domestic or imported) and certified lower-carbon DRI would bring the 1 Mtpa intensity from about 0.58 to about 0.35 t per tonne; hydrogen-based iron units would take it to about 0.26 t (illustrative). We recommend ten actions, led by a firm low-carbon power contract, a carbon specification for every cargo of iron units, verified reporting from the first heat and an early study of DR-grade concentrate.

HOW TO READ THE NUMBERS

Every exhibit carries a status chip. **Sourced** values are taken from a cited document. **Derived** values are calculated from sourced or assumed inputs with the method shown in Annex A. **Assumed** values are planning values within stated ranges. **Illustrative** values show an order of magnitude or a mechanism and are not forecasts. Intensities are in tonnes of CO₂ per tonne; RC-1 values are per tonne of finished product unless stated otherwise.

What this paper is, and what it is not

This is the sixth of ten public white papers in which Cameroon Steel sets out the evidence behind its project at Mboro, in the Kribi industrial-port zone. Its subject is carbon: how much a modern electric-arc long-products works in Cameroon would emit, how that should be measured and reported, what carbon border measures mean for it, how its exposure to a changing climate should be managed, and how the works could move, over two decades, towards very low-carbon steel.

The project figures in this paper come from the Cameroon Steel reference configuration RC-1, a planning estimate prepared for public and regulatory discussion. RC-1 describes a phased works with a design capacity of 1 Mtpa, as reported publicly in January 2025 [S73], starting with an electric-arc melt shop, a ladle furnace and a billet caster (Phase 1, nameplate 0.3 Mtpa, expected sustained output 270,000 to 300,000 t a year), followed by sections mills and additional melting capacity, with a reserve for a future direct-reduction module that could process Cameroonian ore. Works are targeted to start in the first quarter of 2029, with a first heat in the second

half of 2030 and ramp-up through 2031. Phase 1's melt shop makes billets, and its output can move between rolled products (wire rod and reinforcing bar) and merchant billets for existing re-rollers, which today import much of their charge [S89]. Its tonnage is aimed at replacing imported billets and wire rod and at CEMAC exports, not at the domestic reinforcing-bar market, where capacity already exceeds demand (White paper 04). The footprint is computed for fully rolled output by multiplying RC-1 volumes by published or assumed consumption benchmarks and emission factors, each with a range; a tonne sold as billet carries less (Chapter 4). It is an estimate made before front-end engineering, not a measurement or a guarantee.

How the paper is organised

Table ES.1 The questions each chapter answers

Chapter	Question	Main exhibits
1 Steel and climate	Why does the route matter more than anything else?	Route intensities; route shares; IEA anatomy of emissions
2 Accounting carbon in steel	What should be counted, and by which standard?	Framework matrix; one plant, seven numbers
3 The grid factor	How much of the advantage comes from Cameroon's power system?	Generation mix; grid intensities; sensitivity line
4 An illustrative footprint	What would RC-1 emit, phase by phase, and what moves the result?	Footprint by phase; waterfall; tornado; heat map
5 Carbon border measures	What would EU and UK border charges mean in practice?	Phase-in; gross and net exposure
6 Green iron	Can Central Africa make low-carbon iron, and on what conditions?	DRI output; route ladder; hydrogen power need; stepwise route
7 Climate risk and adaptation	What does a changing climate mean for a coastal steelworks?	Rainfall; extremes; sea level and shoreline
8 Circularity	What happens to scrap, slag and dust?	Residues; scrap need; scrap share
9 Finance and standards	What will lenders, buyers and certifiers ask for?	Lender thresholds; sliding scales
10 Pathway and recommendations	What should be done, by whom and when?	Pathway waterfall; trajectory; ten recommendations
11 Evidence gaps	What is not yet known, and how will it be resolved?	Gap register

Source: Cameroon Steel, this paper.

LOW CARBON IS NOT A LABEL A PLANT CHOOSES. IT IS A NUMBER A PLANT MEASURES, HAS VERIFIED AND PUBLISHES, YEAR AFTER YEAR.

Cameroon Steel, White paper 06

What Cameroon Steel intends to do with these findings

The findings point to a short list of decisions that fix the carbon performance of the works for decades, and that are best taken before the equipment is ordered. The first is power: an electric-arc works is only as clean as the electricity it draws, so a firm supply contract backed by identified low-carbon generation, and a connection that keeps the furnace on hydro power through the dry season, is the single most valuable carbon decision after the

choice of route. The second is iron units: every cargo of DRI or HBI should come with verified carbon data and a contractual intensity ceiling, since under CBAM the DRI, not the electricity, sets most of the charge on an EU-bound tonne; and the share of scrap in the charge should rise as domestic collection and import contracts allow. The third is measurement: the works should be instrumented and its inventory designed from the outset to report on the GHG Protocol, ISO 14404 and EU CBAM bases, verified by an accredited third party, so that buyers can use actual rather than default values. The fourth is optionality: the land, utilities and permits for a future direct-reduction module should be preserved, while the critical unknown, whether Cameroonian ore can be upgraded economically to DR-grade pellets, is studied early.

None of this makes Cameroonian steel "green" today. What it does is place a new works on the right side of the carbon divide from its first heat, with a credible and measurable route to go further as power, iron units and finance allow. Chapter 10 sets out the recommendations in detail, and Chapter 11 lists the evidence gaps that must close before any of the illustrative figures in this paper can become measured ones. Companion papers treat the power system (White paper 05), the route choice (White paper 03) and the market for Phase 1 output, including the cost of a Kribi billet against an imported one (White paper 04, Chapter 8).

Statement of interest. This paper is published by Cameroon Steel, which is developing a steelworks at Kribi. It is written to inform public debate; its analysis is independent of any commercial offer, and every figure is sourced or labelled with its status.

CHAPTER 1

STEEL AND CLIMATE: THE ROUTE DECIDES

Steel is one of the largest single sources of industrial carbon dioxide, and the production route decides most of a tonne's footprint before any operator makes a choice on the shop floor. On worldsteel's 2024 data, a tonne made in a blast furnace emits more than three times as much CO₂ as a tonne melted from scrap in an electric-arc furnace. A new works that chooses the electric route, and connects it to a low-carbon grid, starts on the right side of that divide.

1.1 Steel accounts for about 7% to 8% of global greenhouse gas emissions

The world made 1,849.4 Mt of crude steel in 2025, 2.0% less than the 1,886.8 Mt of 2024, in a third consecutive year of slightly falling output led by China [S04]. worldsteel estimates that the industry's average greenhouse gas intensity was 2.18 t of CO₂-equivalent per tonne in 2024 and that the sector accounts for about 7% to 8% of global anthropogenic greenhouse gas emissions [S01][S02]. Multiplying the 2024 output by that average gives roughly 4.1 Gt of CO₂e a year (derived). Earlier work by the Energy Transitions Commission, using a narrower energy-system boundary, put the sector at about 2.3 Gt of CO₂ a year and about 7% of energy-system emissions [S09]. The two figures differ because of what they count, a theme that runs through this paper, but they agree on the order of magnitude: steel is too large to leave out of any serious climate strategy.

Steel's emissions are also unusually hard to abate. In the dominant blast-furnace route, carbon is not only a fuel but the chemical agent that strips oxygen from iron ore. Coke, made from metallurgical coal, reduces the ore inside the furnace and leaves as carbon monoxide and dioxide. That chemistry cannot be electrified away by switching a burner; it requires a different reducing agent (natural gas, hydrogen), a different route (melting scrap rather than reducing ore) or capture of the CO₂ after it forms. The International Energy Agency's technology roadmap describes the sector as one of the hardest to decarbonise for exactly this reason [S05].

At the same time, demand for steel will keep growing where infrastructure is still being built. Africa used 45.0 Mt of finished steel in 2025, up 10.4% in a year, and worldsteel expects a further 3.8% in 2026 and 4.6% in 2027 [S92]. Yet Africa uses about 29 kg of steel per person against a world average of 209 kg [S03]. Meeting that demand from the most carbon-intensive routes would add materially to global emissions; meeting it from low-carbon routes is one of the more consequential industrial choices the continent faces.

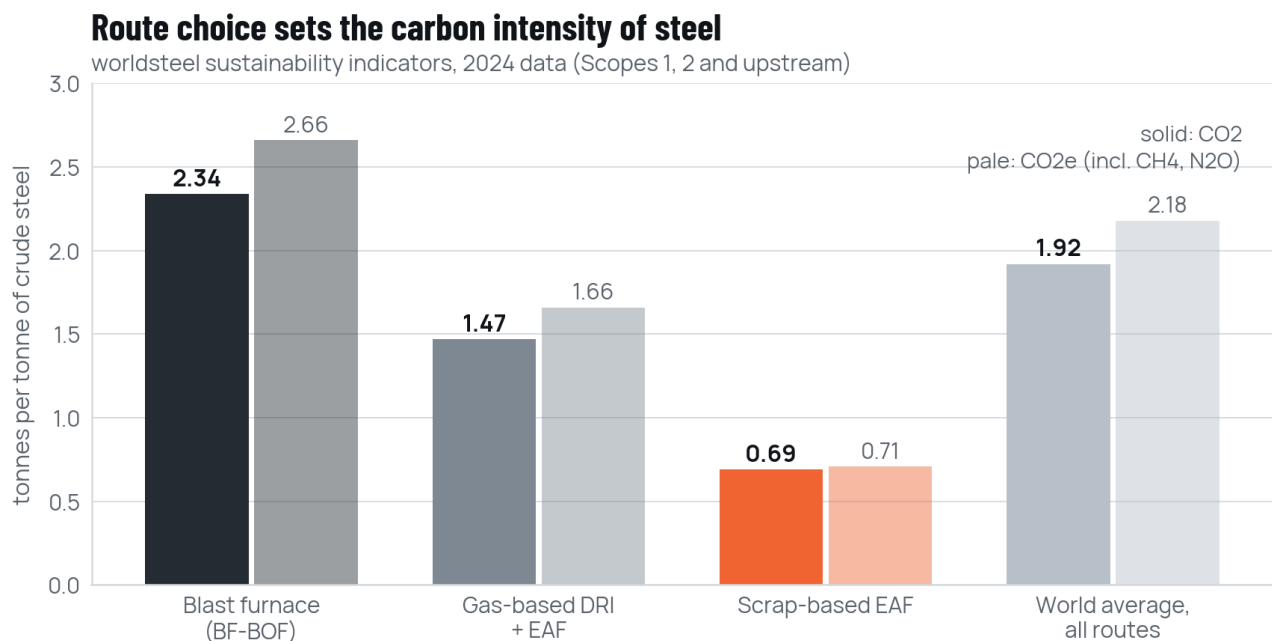
1.2 Three routes, three carbon profiles

Almost all of the world's steel is made by one of three routes. Figure 1.1 shows their carbon intensity on worldsteel's 2024 data, and Table 1.1 summarises how they work.

The blast furnace and basic oxygen furnace (BF-BOF). Iron ore, usually agglomerated as sinter or pellets, is reduced with coke in a blast furnace to make liquid pig iron containing about 4% carbon. A basic oxygen furnace then blows oxygen through the iron to burn off most of that carbon and make steel, with up to about a fifth of scrap added as coolant. The route emits 2.34 t CO₂ per tonne of crude steel on average, or 2.66 t CO₂e once methane from coal mining and other gases are added [S01]. It dominates world output because it is mature, works at very large scale and uses abundant ore and coal.

Direct reduction with an electric-arc furnace (DRI-EAF). Iron ore pellets are reduced in the solid state in a shaft furnace by a gas rich in hydrogen and carbon monoxide, usually made by reforming natural gas, to produce direct-reduced iron (DRI), a porous metallic product with about 90% to 94% metallic iron. DRI is then melted, often with scrap, in an electric-arc furnace. The worldsteel average for this route is 1.47 t CO₂ per tonne (1.66 t CO₂e) [S01]. The route is lower-carbon than the blast furnace because natural gas contains more hydrogen and less carbon than coal, and because the same shaft furnace can, in principle, run on an increasing share of hydrogen.

Scrap-based electric-arc furnaces (scrap-EAF). Steel scrap, which is already metallic iron, is melted by an electric arc between graphite electrodes and the charge. No ore is reduced, so the chemistry that makes ironmaking carbon-intensive is avoided. worldsteel's 2024 average is 0.69 t CO₂ per tonne (0.71 t CO₂e), most of it from electricity and the remainder from electrodes, charge carbon and lime [S01].



SOURCED **Figure 1.1.** Carbon intensity of the three main steelmaking routes and the world average, 2024 data. Solid bars show CO₂; pale bars show CO₂-equivalent, which adds methane and nitrous oxide. worldsteel's boundary covers direct emissions, purchased electricity and the upstream emissions of purchased intermediates such as coke, pellets and DRI.

Source: worldsteel, Sustainability Indicators 2025 report, route table added February 2026 [S01].

Table 1.1 The three main routes compared

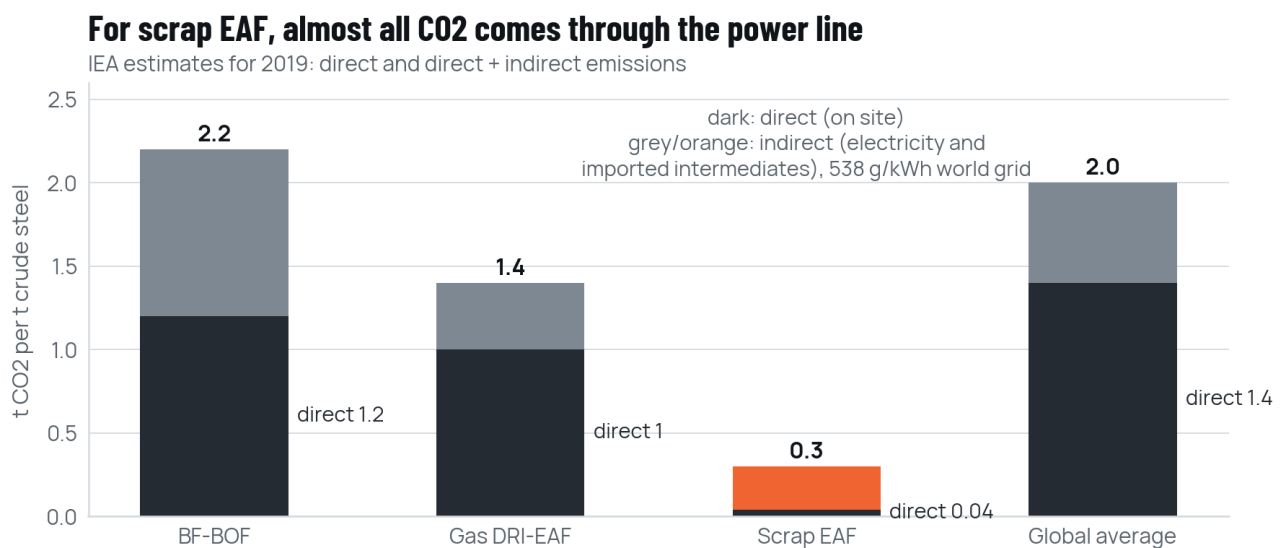
Route	What it melts or reduces	CO ₂ , t/t crude steel (2024)	CO ₂ e, t/t (2024)	Energy intensity, GJ/t (worldsteel)	Main carbon source
BF-BOF	Sinter, pellets, lump ore; coke; up to about 20% scrap	2.34	2.66	23.88	Coke and coal as reductant and fuel
DRI-EAF	DR-grade pellets reduced by reformed natural gas; scrap	1.47	1.66	23.30	Natural gas in the shaft furnace; electricity
Scrap-EAF	Scrap (more than 70% of charge); some DRI or pig iron	0.69	0.71	9.84	Electricity; electrodes, charge carbon, lime
World average	All routes	1.92	2.18	20.95	Dominated by BF-BOF

Source: worldsteel, Sustainability Indicators 2025 [S01]. worldsteel counts electricity as primary energy, so its energy intensities are higher than the final-energy figures of the IEA [S05].

Two qualifications matter. First, these are global averages. Individual plants range widely around them: a blast furnace with high scrap use and efficient energy recovery may be well below 2.34 t, and a DRI plant that uses coal rather than gas emits far more. The IEA estimates that coal-based DRI emits about three times as much direct CO₂ as gas-based DRI [S05], which matters because about 35% of the world's 151 Mt of DRI in 2025 was made with coal, mostly in Indian rotary kilns [S13]. Second, the electric routes are only as clean as the electricity they use. The scrap-EAF average of 0.69 t reflects a world grid emitting several hundred grams of CO₂ per kWh; the same furnace on a hydro grid would emit much less. Chapter 3 quantifies that effect for Cameroon.

1.3 Where the carbon comes from inside each route

Figure 1.2 uses IEA estimates to separate direct emissions, released on site, from indirect emissions, released where the electricity or purchased intermediates are made. The split matters for accounting (Chapter 2) and for policy: the EU carbon border mechanism, for example, counts direct and precursor emissions of steel but not the emissions of the electricity used to make it (Chapter 5).



SOURCED Figure 1.2. Direct and indirect CO₂ intensity by route, IEA estimates for 2019. Indirect emissions are calculated at a world-average grid of 538 g CO₂/kWh. For scrap-based electric furnaces almost the whole footprint arrives through the power line, which is why the grid factor matters so much for an electric works.

Source: IEA, Iron and Steel Technology Roadmap (2020) [S05].

For the blast-furnace route, most of the carbon is direct: the IEA puts direct emissions at about 1.2 t per tonne and the total, including electricity and imported coke and pellets, at about 2.2 t. Gas-based DRI-EAF has about 1.0 t direct and 1.4 t in total. For scrap-based electric furnaces the direct share is tiny, about 0.04 t, while the total reaches about 0.3 t at a 538 g/kWh grid [S05]. The figures differ slightly from worldsteel's because of vintage and boundary, but the structure is the same.

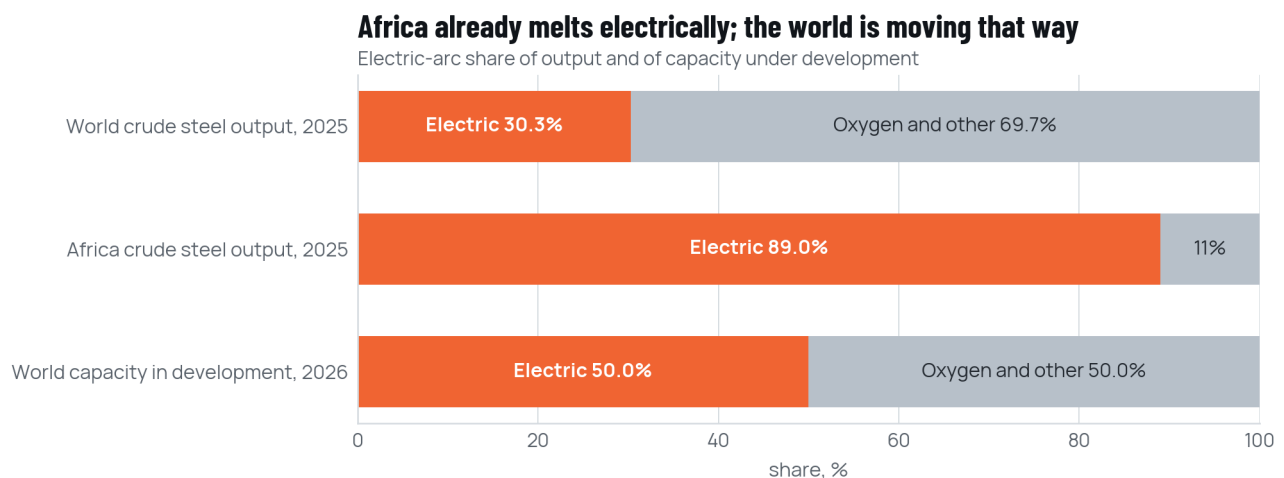
That structure has a practical consequence for a works like RC-1, whose charge combines scrap with purchased DRI or HBI. Its footprint has three parts of comparable size: a direct part from the furnace (electrodes, charge carbon and lime calcination, and later gas for reheating), an electricity part that depends on the grid, and an upstream part that depends on how the purchased iron units were made. Chapter 4 shows that the third part is the largest.

THE ELECTRIC ROUTE MOVES THE CARBON QUESTION UPSTREAM

In a blast furnace the carbon decision is made inside the plant. In an electric-arc works it is made largely outside: in the power system that supplies the furnace and in the plants that make the DRI or HBI it melts. Managing the carbon of an electric works is therefore as much a matter of contracts and suppliers as of furnace practice.

1.4 The world is shifting towards electric steel, and Africa is already there

Electric furnaces made 30.3% of the world's crude steel in 2025, up from 29.1% a year earlier; oxygen converters made 69.4% [S03]. The shift is slow in the installed base but faster in what is being built. Global Energy Monitor's 2026 survey of plants of 0.5 Mtpa and above found that electric furnaces account for about 34% of operating capacity but about half of the capacity in development and 71% of the projects under construction [S14].



SOURCED **Figure 1.3.** Share of electric-arc steelmaking in world and African output (2025) and in the world's capacity under development (2026). Africa's crude steel is already overwhelmingly electric, because its larger producers in Egypt and Algeria use gas-based direct reduction and its smaller ones melt scrap.

Source: worldsteel, World Steel in Figures 2026 [S03]; Global Energy Monitor, Pedal to the Metal 2026 [S14].

Africa is an outlier in the other direction: 89% of its 29.8 Mt of crude steel in 2025 came from electric furnaces [S03]. The reason is not climate policy. North African producers built gas-based direct reduction on cheap domestic gas, and smaller producers elsewhere melt scrap or imported billets because a blast furnace complex requires a scale, a coking-coal supply and a capital budget that few African markets can support. Algeria alone produced 6.70 Mt of DRI in 2025 and Egypt 6.06 Mt on Midrex plant statistics; on the same statistics Sub-Saharan Africa produced 0.09 Mt, with its gas-based plants idle [S13], while worldsteel, whose figures include estimates for plants outside that survey, puts output in Uganda, Kenya and Tanzania at about 2.7 Mt [S03]. Chapter 6 returns to what that gap means for Central Africa.

The practical implication is that an electric-arc works in Cameroon is not an exotic choice imposed by decarbonisation; it is the regional norm and the global direction of travel. What distinguishes a low-carbon electric works from an ordinary one is not the furnace but the power and the iron units.

1.5 Scrap is the cleanest input, and it is finite

Every tonne of scrap used in place of ore-based iron avoids about 1.5 t of CO₂, according to worldsteel [S02]. Around 630 Mt of scrap is used in global steelmaking each year, which the Bureau of International Recycling and worldsteel estimate avoids nearly 950 Mt of CO₂ [S68]. Scrap is therefore the most powerful decarbonisation lever the industry already has.

It is also limited. The amount of scrap available in any year depends on how much steel entered use decades earlier and is now reaching the end of its life. Countries that built their infrastructure long ago, such as the United States or the member states of the European Union, generate large volumes of old scrap; countries still building theirs generate little. In Cameroon, the only quantified study put scrap arising at 53,000 to 62,000 t a year using 2006 data [S88], and existing mills report that local scrap covers only about 40% of their needs [S89]. Global studies reach the same conclusion at world scale: even with much higher recycling, primary iron made from ore will remain necessary for decades, which is why the decarbonisation of ironmaking itself, through gas and then hydrogen-based direct reduction, sits at the centre of every credible net-zero pathway for steel [S08][S11].

Table 1.2 What drives a tonne of steel's footprint, and who controls it

Driver	Effect on intensity	Who controls it	Where discussed
Production route	Largest: about 0.7 to 2.3 t per tonne between averages	Investor, at the design stage	This chapter; Chapter 4
Grid emission factor	About 0.1 t per tonne for every 100 g/kWh at RC-1's use of about 960 kWh per tonne	Power system; supply contract	Chapter 3
Carbon content of purchased iron units	About 0.2 to 0.3 t per tonne at RC-1's 30% DRI share	Purchasing; suppliers	Chapters 4 and 6
Scrap share	About 0.09 t per tonne per 10 points of charge for RC-1	Scrap market; collection	Chapter 8
Furnace and mill practice	Typically a few hundredths of a tonne	Operations	Chapters 4 and 10

Source: worldsteel [S01]; IEA [S05]; WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]. Ranges are indicative.

1.6 What this means for a new works in Cameroon

Three points from this chapter frame the rest of the paper.

First, by choosing an electric-arc route and excluding a blast furnace, RC-1 avoids the largest source of carbon in steelmaking at the design stage. That decision, more than any later improvement, places its footprint in the lower part of the global distribution.

Second, an electric works exports its carbon question to two places: the grid and its suppliers of iron units. A works on a coal-heavy grid, melting coal-based DRI, can emit as much as an average integrated plant. A works on a hydro-dominated grid, melting scrap and gas-based DRI, can emit a third or less. The quality of the power supply contract and the carbon specification of purchased iron units are therefore climate instruments in their own right.

Third, because scrap is scarce in Cameroon and ore is abundant in the region, the long-term question for a Central African works is not only how to melt cleanly but how to make iron cleanly. That is the green-iron question, and it is the subject of Chapter 6.

AN ELECTRIC-ARC WORKS DOES NOT DECARBONISE STEEL BY ITSELF. IT MOVES THE CARBON DECISION TO THE GRID AND TO THE IRON UNITS IT BUYS.

Chapter 1 finding

The next chapter addresses a prior question: before comparing plants or routes, one must be clear about what is being counted. The same works can report numbers that differ by a factor of five depending on the perimeter, and most public confusion about "green steel" begins there.

CHAPTER 2

ACCOUNTING CARBON IN STEEL: STATE THE PERIMETER EVERY TIME

The carbon intensity of a tonne of steel is not a single fact about a plant; it is the result of a counting rule applied to that plant. The same RC-1 tonne can honestly be reported at seven different values, from about 0.11 to 0.58 t of CO₂, depending on which emissions are counted and per tonne of what. The standards that matter to Cameroon Steel's lenders, buyers and regulators are now well defined. The discipline that follows is simple: choose the standard that fits the purpose, state its perimeter, and have the figure verified.

2.1 The GHG Protocol sorts emissions into three scopes

Most corporate carbon accounting rests on the Greenhouse Gas Protocol, developed by the World Resources Institute and the World Business Council for Sustainable Development [S45]. It sorts emissions by who controls their source.

- **Scope 1** covers direct emissions from sources the company owns or controls. For an electric-arc works, these are the CO₂ from graphite electrodes and charge or injection carbon that oxidise in the furnace, from the carbonate share of fluxes such as lime and dolomite, and from any fuel burnt on site, such as natural gas in a reheating furnace.
- **Scope 2** covers the emissions from generating the electricity, steam or heat the company buys. For an electric-arc works this is usually the largest category within Scopes 1 and 2, although the emissions occur at the power plants rather than on site. The Protocol's 2015 guidance requires two figures: a location-based figure, which uses the average emission factor of the grid the plant draws from, and a market-based figure, which uses the emission factor of the electricity the company has contracted for, evidenced by contractual instruments [S45].
- **Scope 3** covers all other indirect emissions in the value chain, upstream (purchased goods, transport of inputs) and downstream (processing, use and end-of-life of products).

For steel, one Scope 3 category is so large that sector methods treat it separately: the upstream emissions of purchased iron-bearing intermediates such as coke, pellets, pig iron and DRI. A plant that buys DRI rather than making it moves the emissions of ironmaking out of its own Scope 1 and into someone else's. Comparing that plant's Scopes 1 and 2 with an integrated works that makes its own iron would flatter it unfairly. Sector methods therefore add the upstream emissions of purchased intermediates back in, so that plants with different degrees of integration can be compared on a like-for-like basis.

TWO SCOPE 2 FIGURES, AND WHY BOTH ARE REPORTED

The location-based figure answers "what does the grid emit to supply this plant?" and is the conservative basis used for lender thresholds in this paper. The market-based figure answers "what electricity has the company chosen to buy?" and rewards contracts with low-carbon generators. Reporting both, with the evidence behind the second, is what the GHG Protocol requires and what informed readers expect.

2.2 ISO 14404 and the worldsteel method compare sites on a common boundary

The ISO 14404 series, built on the CO₂ data collection methodology of the World Steel Association, gives the steel industry's standard method for calculating the CO₂ intensity of a steel site [S41][S42][S43]. Part 1 covers plants with a blast furnace and Part 2 plants with an electric-arc furnace, both in second editions published in 2024; Part 3 covers plants with an electric-arc furnace and a coal-based or gas-based direct-reduction facility (2024); Part 4 (2020) gives guidance on using the series, including a universal calculation sheet covering all routes.

The method has three features that matter for a works like RC-1:

1. **A fixed site boundary.** All processes from raw-material handling to hot rolling are inside it, with defined treatment of auxiliary units such as oxygen plants and lime kilns.
2. **Upstream emissions for purchased intermediates.** Purchased DRI, pig iron, pellets, coke, lime and oxygen carry standard or supplier-specific upstream emission factors, so that buying an intermediate does not reduce the reported intensity.
3. **Credits for exported by-products and energy.** Slag sent to cement making or exported electricity can earn a credit, because they displace emissions elsewhere.

The result is expressed per tonne of crude steel (cast steel), the denominator used by worldsteel in its route averages [S01]. worldsteel has collected site data on this basis from its members for many years, and the IEA reviewed the series alongside the worldsteel methods and the ResponsibleSteel standard in its 2023 report on emissions measurement for a net-zero steel industry, recommending convergence towards a common method [S07].

BUYING IRON INSTEAD OF MAKING IT MOVES EMISSIONS OFF A PLANT'S BOOKS. SECTOR METHODS PUT THEM BACK, SO THAT PLANTS CAN BE COMPARED.

Chapter 2 finding

2.3 Product footprints and environmental product declarations follow the product, not the site

Construction clients, specifiers and public buyers increasingly ask not for a site intensity but for the footprint of the product they buy, documented in an environmental product declaration (EPD). Product footprints follow ISO 14067 [S46]; EPDs for construction products follow ISO 14025 and, in Europe, the core rules of EN 15804+A2 [S47].

A cradle-to-gate EPD (modules A1 to A3) counts everything from raw-material extraction to the factory gate: the site's direct emissions, its electricity, the upstream emissions of every purchased input (iron units, ferroalloys, electrodes, lime, refractories, gases) and inbound transport. EN 15804 also requires a separate module D, which reports the benefit of recycling the steel at the end of its life. worldsteel's life cycle inventory, whose 2024 dataset was released in May 2026 with global and regional data for 16 products including reinforcing bar and sections, follows ISO 14040 and 14044 and is compatible with ISO 14067 and EN 15804 [S44].

Product footprints are larger than site intensities because they count more inputs, and they are expressed per tonne of the declared product rather than per tonne of crude steel. They are the figures a buyer will compare with competing products and enter into a building's embodied-carbon calculation.

2.4 Regulators and lenders each draw their own perimeter

Three regulatory or contractual perimeters matter most for RC-1.

The EU Carbon Border Adjustment Mechanism prices the "embedded emissions" of imported goods. For iron and steel, aluminium and hydrogen, Annex II of the CBAM Regulation provides that only direct emissions are taken into account, including the direct emissions embedded in precursors such as DRI or pig iron; the emissions of the electricity used are monitored and reported but not priced [S27]. A scrap-and-DRI electric works on a hydro grid therefore has a CBAM perimeter that excludes its purchased electricity, its largest category within Scopes 1 and 2, but includes the full direct emissions of the DRI it buys. The same rule explains why an all-scrap furnace carries a smaller CBAM charge than RC-1, even though RC-1's total footprint on Cameroon's grid is lower than that of the average scrap-based furnace (Chapter 5).

The Equator Principles (EP4) use Scopes 1 and 2 combined to set their climate requirements: a climate change risk assessment, including an alternatives analysis, for projects expected to emit more than 100,000 t CO₂e a year, and annual public reporting above the same threshold [S22]. **IFC Performance Standard 3** requires quantification above 25,000 t a year [S21].

Certification schemes and definitions for low-emission steel, such as the IEA's near-zero threshold, ResponsibleSteel's progress levels, the Global Steel Climate Council's standard and Germany's Low Emission Steel Standard, count Scopes 1 and 2 and upstream emissions of purchased intermediates, with differences in detail [S06][S37][S39][S40]. Chapter 9 discusses their thresholds.

Figure 2.1 summarises which emission sources each perimeter counts.

The same steelworks, eight different carbon perimeters

What each framework counts (simplified)

	EAF/LF carbon	On-site gas	Grid power	Imported iron units	Lime, alloys, electrodes	Inbound freight	Use and recycling
GHG Protocol Scope 1	●	●	●	●	●	●	●
GHG Protocol Scope 2	●	●	●	●	●	●	●
EP4 threshold (Scopes 1+2)	●	●	●	●	●	●	●
EU CBAM, iron and steel	●	●	●	●	●	●	●
ISO 14404 / worldsteel	●	●	●	●	○	●	●
ResponsibleSteel, IEA near-zero	●	●	●	●	○	●	●
Product footprint, cradle to gate	●	●	●	●	●	●	●
EPD incl. end-of-life (module D)	●	●	●	●	●	●	●

filled: counted open: partly counted dot: not counted. Orange: imported iron units, the largest block for RC-1.

SOURCED **Figure 2.1.** What each framework counts, simplified. Filled circles: counted; open circles: partly counted (some purchased inputs such as lime or oxygen); dots: not counted. The imported iron units (orange) are counted by every perimeter except Scopes 1 and 2 and the EP4 threshold, and they are the largest block of RC-1's footprint.

Source: GHG Protocol [S45]; Equator Principles EP4 [S22]; Regulation (EU) 2023/956, Annex II [S27]; ISO 14404 series [S41][S43]; ResponsibleSteel [S37]; IEA [S06]; ISO 14067 [S46]; EN 15804+A2 [S47]. Simplification by Cameroon Steel.

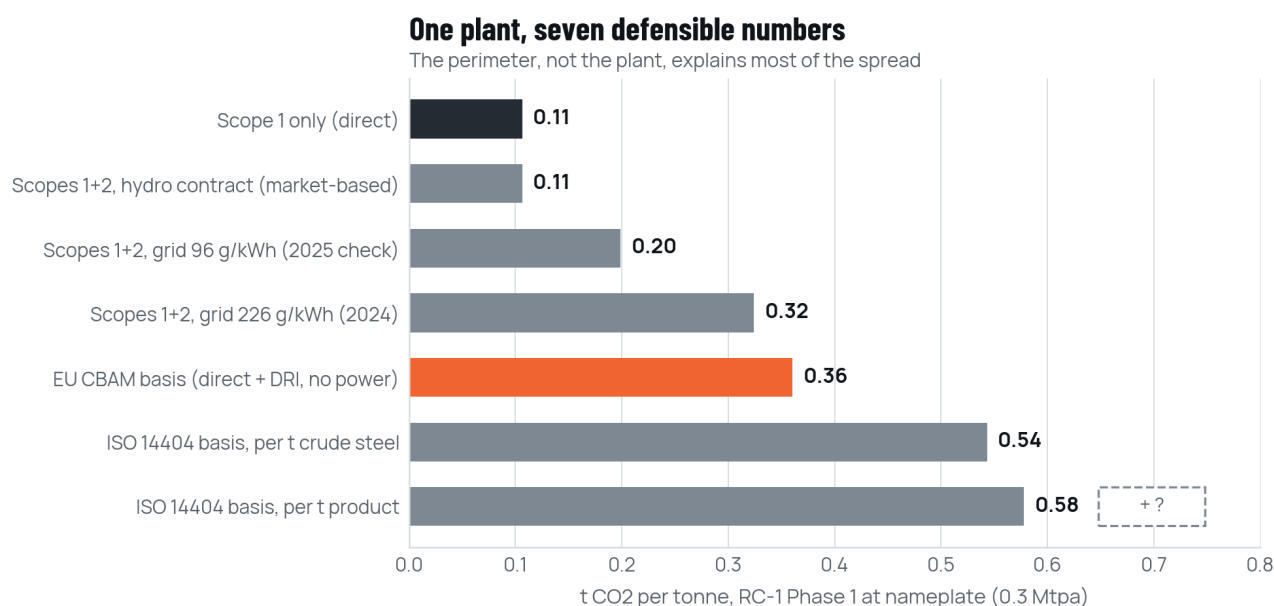
Table 2.1 The main standards and perimeters compared

Framework	Purpose	Boundary	Denominator	Electricity	Purchased iron units	Status for RC-1
GHG Protocol, Scopes 1 and 2	Corporate inventory	Operational or financial control	Absolute, t CO ₂ e per year	Scope 2, location- and market-based	Scope 3	Inventory from first heat
Equator Principles EP4	Lender due diligence	Scopes 1 and 2	Absolute, above 100 kt	Included	Excluded	Applies from Phase 1
IFC Performance Standard 3	Lender standard	Project	Absolute, above 25 kt	Included	Excluded	Applies
ISO 14404 / worldsteel	Site intensity, benchmarking	Site, with upstream and credits	Per t crude steel	Included	Included (upstream)	Primary reporting basis
EU CBAM (iron and steel)	Border charge	Installation, with precursors	Per t of good	Reported, not priced	Included (direct of precursor)	For any EU-bound tonne
ISO 14067 / EPD (EN 15804+A2)	Product claims, procurement	Cradle to gate (A1 to A3), module D separate	Per t declared product	Included	Included, with all other inputs	For construction buyers
IEA near-zero, ResponsibleSteel, GSCC, LESS	Definitions, certification	Scopes 1 and 2 with upstream	Per t crude steel or product	Included	Included	Benchmark for progress

Source: as for Figure 2.1; GSCC [S39]; LESS [S40]; IEA [S07].

2.5 One plant, seven defensible numbers

Figure 2.2 applies these perimeters to the illustrative RC-1 Phase 1 footprint developed in Chapter 4. None of the numbers is wrong; each answers a different question.



DERIVED **Figure 2.2.** Seven perimeters applied to the same RC-1 Phase 1 tonne at nameplate output. The dashed box marks inputs not yet quantified (ferroalloys, electrodes, lime and refractories made elsewhere, and inbound freight), which a cradle-to-gate product footprint would add. The market-based figure assumes a supply contract backed by hydro generation with a zero combustion emission factor.

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; grid factors from Ember via Our World in Data [S48] and ARSEL [S50]; CBAM perimeter from Regulation (EU) 2023/956 [S27].

Reading from the smallest:

- **About 0.11 t (Scope 1 only).** The furnace's own emissions: electrodes, charge carbon and lime. This is what the plant emits through its stacks in Phase 1, when billets are reheated by induction rather than gas.
- **About 0.11 t (Scopes 1 and 2, market-based, hydro contract).** If Cameroon Steel buys electricity under a contract backed by identified hydro generation, the GHG Protocol allows a market-based Scope 2 at the contracted source's emission factor, which is zero on a combustion basis. This figure is only as credible as the contract and the evidence behind it (Chapter 3).
- **About 0.20 t (Scopes 1 and 2 at 96 g/kWh).** The location-based figure if the grid factor falls to the level suggested by the 2025 generation mix (derived, indicative; Chapter 3).
- **About 0.32 t (Scopes 1 and 2 at 226 g/kWh).** The location-based figure at the published 2024 grid average. This is the conservative planning value used throughout this paper.
- **About 0.36 t (EU CBAM basis).** Direct emissions plus the direct emissions of the purchased DRI, without electricity; the DRI's full upstream factor is used as its embedded direct emissions, a conservative simplification. It exceeds the Scopes 1 and 2 figure because the DRI it adds weighs more than the electricity it removes.
- **About 0.54 t (ISO 14404 basis, per tonne of crude steel).** Scopes 1 and 2 plus the upstream emissions of the purchased DRI, per tonne of liquid steel cast. This is the figure to compare with worldsteel route averages.
- **About 0.58 t (same, per tonne of finished product).** The same emissions divided by the smaller tonnage of rolled product, since about 6% of the liquid steel is lost as crop ends, scale and rejects between the caster and the finished bundle.

2.6 Per tonne of what? The denominator matters

The last two numbers illustrate a frequent source of confusion. worldsteel route averages, the IEA near-zero threshold and ResponsibleSteel's progress levels are expressed per tonne of crude steel. CBAM embedded emissions and EPDs are expressed per tonne of the declared good. For a long-products works the difference is the yield from caster to finished product, about 0.94 in RC-1 [S90]. Table 2.2 sets out the RC-1 figures on both bases.

Table 2.2 RC-1 illustrative intensities on the two denominators (t CO₂ per tonne)

Perimeter	Phase 1, per t crude steel	Phase 1, per t product	1 Mtpa, per t crude steel	1 Mtpa, per t product	Status
Scope 1	0.100	0.106	0.148	0.157	derived
Scope 2 at 226 g/kWh	0.205	0.218	0.160	0.170	derived
Scopes 1 and 2	0.305	0.324	0.308	0.328	derived
Upstream imported DRI/HBI	0.239	0.254	0.239	0.254	derived
Scopes 1 and 2 plus upstream DRI	0.543	0.578	0.547	0.582	derived
EU CBAM basis (direct and precursor)	0.339	0.360	0.387	0.411	illustrative

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90] (Annex A). The 1 Mtpa Scope 1 is higher because Phases 2 and 3 reheat billets with natural gas; its Scope 2 per tonne is lower for the same reason.

In this paper, RC-1 figures are per tonne of finished product unless stated otherwise, and comparisons with crude-steel benchmarks are flagged. Using the product basis against crude-steel benchmarks overstates RC-1 by about 6%, so the comparisons are conservative.

2.7 Market-based electricity claims need evidence, especially on a hydro grid

The difference between the location-based and market-based Scope 2 figures (0.32 against 0.11 t in Figure 2.2) is large enough to deserve caution. On a grid where most electricity is already hydro, a contract that "allocates" hydro output to one customer does not by itself reduce the grid's emissions; it can simply move low-carbon electricity on paper from other customers. The GHG Protocol's quality criteria require that contractual instruments be unique, traceable, matched in time and drawn from the same market [S45], and buyers and certifiers increasingly look for evidence that the contracted supply is additional or at least that it is not double-counted. We have not identified a national registry of electricity attribute certificates in Cameroon for this paper, and Cameroon has no mandatory industrial greenhouse gas reporting regime of which we are aware. Its updated nationally determined contribution targets a 35% reduction in emissions below business as usual by 2030, 12% unconditionally [S80], and its Plan National Climat was approved in July 2025 [S81].

Cameroon Steel's position is therefore to report the location-based figure as the primary Scope 2 number, to report a market-based figure only where a bilateral contract with an identified plant and metered delivery supports it, and to show both. A supply contract that brings new low-carbon capacity onto the grid, or that ties the works to a specific plant through the dry season, would strengthen both figures.

REPORTING DESIGN FOR RC-1

The RC-1 inventory should be designed from the first heat to produce, from a single metered dataset, (1) a GHG Protocol corporate inventory with location- and market-based Scope 2; (2) an ISO 14404 site intensity per tonne of crude steel; (3) CBAM embedded emissions per product and per installation; and (4) cradle-to-gate EPDs for billets, wire rod and reinforcing bar. Each should be verified by an accredited third party. Building this in at design stage costs little; retrofitting it costs a great deal, and buyers will not wait.

2.8 Why this matters commercially

Accounting rules may seem a technical matter, but for an exporting steelworks they translate directly into money and market access. Under CBAM, an importer that cannot document actual embedded emissions must use default values, which for many origins assume blast-furnace-like intensities and carry mark-ups that rise to 30% from 2028 (Chapter 5). Public buyers in several markets now award points or set ceilings on embodied carbon, which they assess from EPDs. Lenders apply thresholds to Scopes 1 and 2. A works that can produce verified numbers on every perimeter will be able to sell its low intensity; one that cannot will be assumed to be average, or worse.

The next chapter turns to the parameter that most affects Scope 2, and therefore the Scopes 1 and 2 numbers, for an electric works in Cameroon: the emission factor of the grid.

CHAPTER 3

THE GRID FACTOR: CAMEROON'S HYDROPOWER IS THE ELECTRIC WORKS' LARGEST ADVANTAGE

Cameroon's electricity is among the lower-carbon supplies in Africa because most of it comes from hydropower. At the 2024 average of about 226 g CO₂e/kWh, grid electricity adds about 0.22 t of CO₂ to each tonne of RC-1 Phase 1 product; on the world-average grid the same furnace and mills would add about 0.45 t, and on South Africa's grid about 0.69 t. The 2025 generation mix, with Nachtigal fully online, points to an even lower average. The advantage is real, but it is an average: it holds only if the works can draw firm power through the dry season without pulling thermal plants onto the margin.

3.1 An electric works is mostly an electricity consumer

RC-1 Phase 1 would use about 289 GWh of electricity a year at nameplate output, or about 960 kWh per tonne of finished product (derived from the RC-1 reference configuration [S90]). Of this, the electric-arc furnace, ladle furnace and melt-shop auxiliaries take about 166 GWh (57%), induction heating of billets before rolling about 90 GWh (31%) and the rolling mills about 33 GWh (11%). The furnace planning value of 450 kWh per tonne of liquid steel sits inside the range of 347 to 500 kWh/t given by the IFC's guidelines for steel mills [S20]; European melt shops report 404 to 748 kWh/t depending on charge and practice [S19]. Because DRI needs more energy to melt than scrap, about 14.5 kWh/t more for every 10 points of DRI in the charge [S15], about 490 kWh/t is the upper planning value for a charge with 30% DRI or HBI. At that value Phase 1 would use about 302 GWh a year and draw about 38 MW on average, and its Scopes 1 and 2 would rise by about 0.01 t per tonne (derived).

At full build-out to 1 Mtpa the annual demand would rise to about 753 GWh. Because Phases 2 and 3 are planned with gas-fired reheating, electricity use per tonne would fall to about 750 kWh, and part of the energy demand would move to natural gas (Chapter 4). In capacity terms, Phase 1 would draw an average of about 36 MW and the full works about 94 MW, with peaks well above these averages: an electric-arc furnace of the 40 t class, with a furnace transformer of the 30 to 33 MVA class, draws far more than the average while it melts [S90]. Because melting can be timed around system peaks, the furnace offers schedulable load, not interruptible load: it needs firm supply in the hours it melts.

Those volumes are material for Cameroon's power system, which White paper 05 (Chapters 2 and 3) describes in full; this chapter keeps only what the carbon estimate needs. Total generation was 8,120 GWh in 2025, installed capacity 2,033 MW and peak demand 1,278 MW [S50]. RC-1 Phase 1 would therefore consume about 3.6% of 2025 generation, and the full works about 9% (derived). That is why the carbon content of the grid, and the firmness of supply, are central to any honest estimate of the works' footprint.

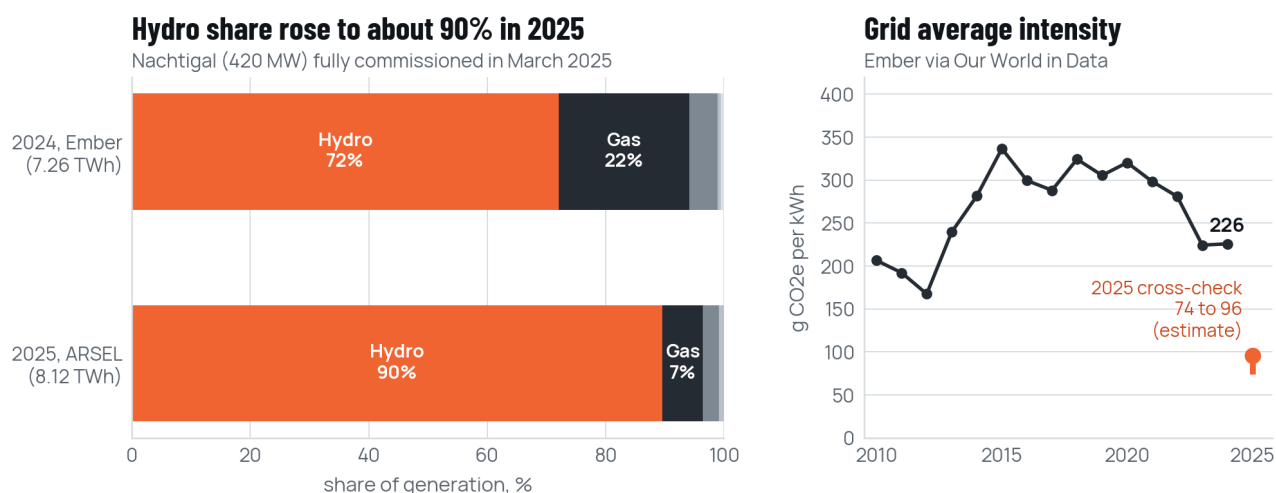
Table 3.1 Cameroon's power system and the RC-1 demand in context

Item	Value	Year	Status	Source
Installed capacity	2,033 MW, of which hydro 69.5%	2025	sourced	[S50]
Generation	8,119.9 GWh, of which hydro 7,272.4 GWh	2025	sourced	[S50]
Peak demand	1,278 MW	2025	sourced	[S50]
Nachtigal hydro	420 MW, fully commissioned March 2025; 3.6 TWh injected in the 12 months to May 2026	2025 to 2026	sourced	[S91] [S52]
Industrial demand unmet pending the Nachtigal 400 kV evacuation line	150 MW; line due November 2026	October 2026	sourced	[S51]
225 kV supply to the Kribi port platform	100 MW initially, 330 to 400 MW later	2025 to 2026	sourced	[S55] [S56]
Hydro potential	about 115 TWh a year, about 4% developed	2026	sourced	[S53]
RC-1 Phase 1 electricity	about 289 GWh/yr; about 36 MW average	at nameplate	derived	[S90]
RC-1 full build-out electricity	about 753 GWh/yr; about 94 MW average	at nameplate	derived	[S90]

Source: as listed. RC-1 averages assume 8,000 operating hours a year.

3.2 The grid average fell sharply as Nachtigal came online

Figure 3.1 shows Cameroon's generation mix and average carbon intensity. On the Ember dataset published through Our World in Data, hydro supplied about 5.23 TWh of 7.26 TWh in 2024 (72%), gas 1.60 TWh, oil 0.35 TWh and solar and bioenergy small amounts; the average intensity was 225.9 g CO₂e/kWh, close to 224 g in 2023 and down from 281 g in 2022 [S48][S49]. The regulator ARSEL's 2025 report shows a very different mix: 8.12 TWh generated, of which 7.27 TWh (about 90%) was hydro and only about 0.78 TWh came from gas and oil [S50]. The difference reflects the full commissioning of the 420 MW Nachtigal plant in March 2025, which delivered about 2.07 TWh in 2025 despite hydrology below plan [S50].



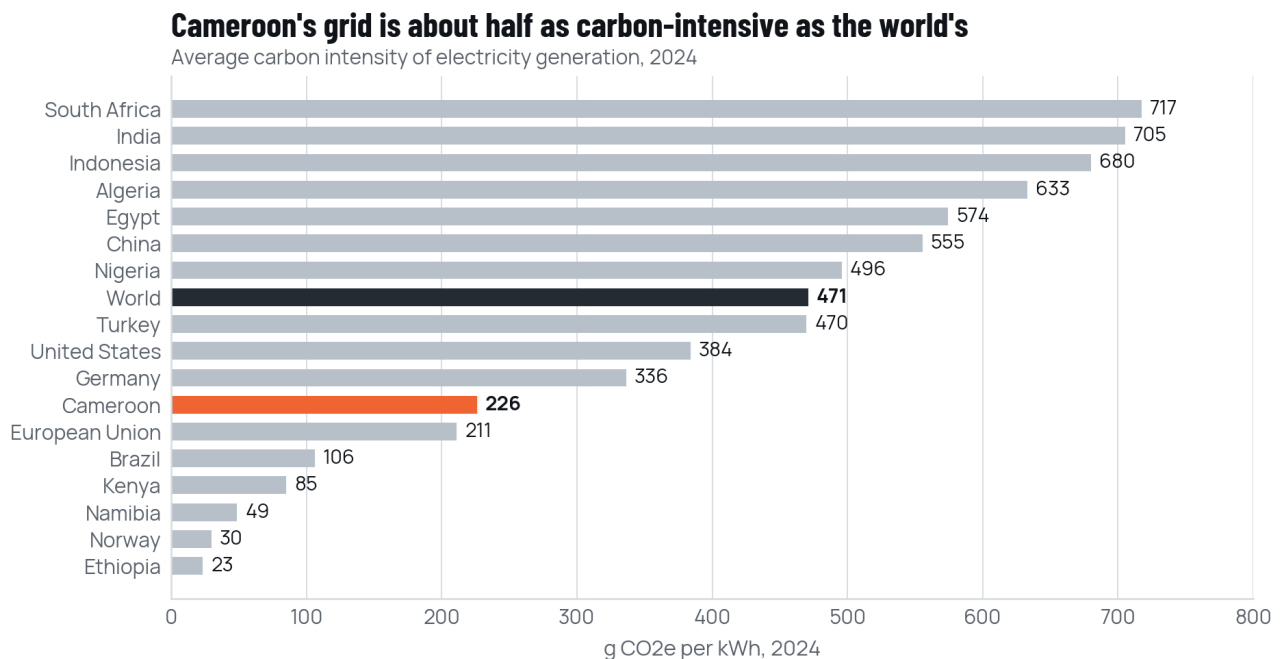
DERIVED **Figure 3.1.** Cameroon's generation mix in 2024 (Ember) and 2025 (ARSEL), and the grid's average carbon intensity since 2010. The orange marker shows a 2025 cross-check, an estimate derived by applying the fossil emission rate implied by the 2024 data to the 2025 mix: about 74 g/kWh on a combustion basis and about 96 g/kWh if renewable sources carry life-cycle factors. Source: Ember via Our World in Data, carbon intensity and generation by source [S48][S49]; ARSEL, Rapport d'activités 2025 [S50]; life-cycle factors for hydro (24 g), solar (48 g) and bioenergy (230 g) from IPCC AR5 Annex III [S58]. 2025 cross-check derived by Cameroon Steel (Annex A).

No 2025 value has yet been published on the Ember basis. To gauge where it might fall, we derived the average emission rate of fossil generation implied by the 2024 data (about 770 g CO₂e/kWh, consistent with gas engines and oil-fired plants) and applied it to the 2025 fossil generation reported by ARSEL. The result, an estimate of about 74 to 96 g/kWh depending on whether hydro and solar are counted at zero or at their life-cycle values, is

less than half the 2024 average. We treat it as an indicative cross-check, not a replacement: the two datasets have different coverage, 2025 hydrology was not exceptional, and a single year does not make a trend. The planning value in this paper remains the published 226 g/kWh, which is therefore conservative against the average. It is not conservative against the marginal factor discussed below.

3.3 Cameroon's grid is about half as carbon-intensive as the world's

Figure 3.2 places Cameroon among other electricity systems. Its 2024 average of 226 g/kWh is close to the European Union's 211 g and well below the world's 471 g, China's 555 g, India's 705 g and South Africa's 717 g [S48]. Several African systems with large hydro or geothermal shares, such as Ethiopia, Kenya and Namibia, are lower still.



SOURCED Figure 3.2. Average carbon intensity of electricity generation, selected countries and regions, 2024. Cameroon (orange) sits close to the European Union and at about half the world average (dark).

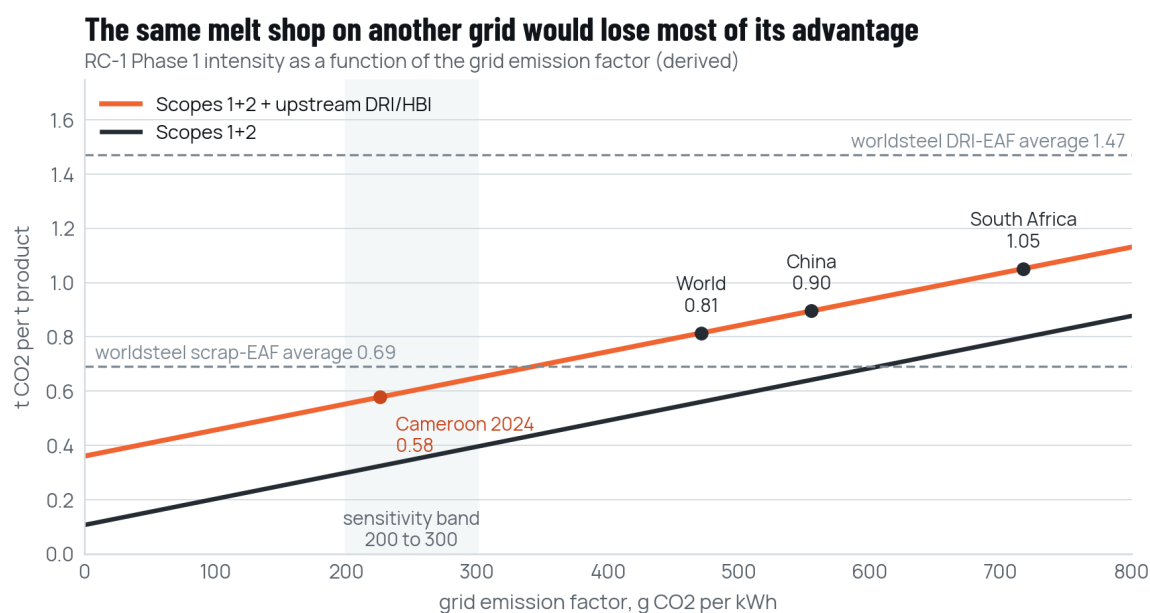
Source: Ember via Our World in Data, carbon intensity of electricity generation, accessed 10 October 2026 [S48].

For a steel melt shop this ranking translates directly into carbon per tonne. The largest steel-producing countries run their electric furnaces on grids of 400 to 700 g/kWh, which is one reason why the world scrap-EAF average of 0.69 t per tonne is far above what the same technology achieves on hydro or nuclear grids.

3.4 The same melt shop on another grid would lose most of its advantage

Figure 3.3 holds everything about RC-1 Phase 1 constant except the grid factor. At 226 g/kWh, Scopes 1 and 2 come to about 0.32 t per tonne of product and the total including imported DRI to about 0.58 t. At the world average of 471 g/kWh these become about 0.56 and 0.81 t; on China's grid about 0.64 and 0.90 t; on South Africa's about 0.80 and 1.05 t (derived). The RC-1 total would match the world scrap-EAF average of 0.69 t at a grid factor of about 343 g/kWh.

Each 100 g/kWh of grid factor is worth about 0.096 t of CO₂ per tonne of Phase 1 product, because the works uses about 960 kWh per tonne. That slope is the quantitative case for treating power as a climate decision. A 100 g/kWh difference in the average carbon intensity of supplied electricity is worth more than every furnace-efficiency measure in Chapter 10 combined.



DERIVED **Figure 3.3.** RC-1 Phase 1 carbon intensity as a function of the grid emission factor, all other parameters at their RC-1 values. The shaded band is the 200 to 300 g/kWh sensitivity range used in this paper. Points mark the 2024 averages of Cameroon, the world, China and South Africa.
Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; grid factors from Ember via Our World in Data [S48]; worldsteel route averages [S01].

Table 3.2 Grid factor cases for the RC-1 footprint (t CO₂ per tonne of product)

Case	Grid factor, g/kWh	Phase 1, Scopes 1+2	Phase 1, incl. upstream DRI	1 Mtpa, Scopes 1+2	1 Mtpa, incl. upstream DRI	Status
Market-based, hydro contract (combustion basis)	0	0.106	0.360	0.157	0.411	illustrative
Hydro life-cycle factor (IPCC AR5 median)	24	0.129	0.383	0.176	0.429	illustrative
2025 mix cross-check	74 to 96	0.178 to 0.199	0.432 to 0.453	0.213 to 0.230	0.467 to 0.484	derived
Low sensitivity	200	0.299	0.553	0.308	0.562	assumed
Planning value, 2024 average	226	0.324	0.578	0.328	0.582	derived
High sensitivity	300	0.395	0.649	0.383	0.637	assumed
World average, 2024	471	0.560	0.814	0.512	0.766	illustrative
Fossil generation rate implied by 2024 data	about 770	0.849	1.103	0.738	0.992	illustrative

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; Ember via Our World in Data [S48]; ARSEL [S50]; IPCC AR5 Annex III [S58].

3.5 Average, marginal and contracted factors answer different questions

The grid average is the right factor for a location-based Scope 2 inventory under the GHG Protocol [S45], and it is the factor used in this paper's central estimate. It is not the only relevant one.

The marginal factor. A new 36 to 94 MW load does not draw an average slice of the grid; it is served by whichever plant adjusts to meet it. In a hydro-dominated system with spare water, that is hydro and the marginal emissions are close to zero. In the dry season, or when transmission constraints bind, it may be the Kribi gas plant or oil-fired units, and the marginal factor approaches the fossil rate of about 770 g/kWh implied by the

2024 data. The 225 kV line that will supply the Kribi port platform runs from the Kribi gas plant's substation [S55], and Business in Cameroon reported on 9 October 2026 that 150 MW of industrial demand was unmet pending the 400 kV evacuation line from Nachtigal [S51]. Until that line and the wider southern grid are reinforced, there is a real risk that new industrial load in Kribi is served at the margin by gas. In the hours when it is, Phase 1 would carry about 0.5 t more CO₂ per tonne than at the 226 g/kWh average (derived), more than its whole Scope 2 at the average. Multilateral lenders often use a "combined margin" factor that blends the average and marginal views for project accounting; the harmonised factor for Cameroon could not be verified for this paper and is listed as an evidence gap (Chapter 11).

The contracted factor. A bilateral supply contract with an identified hydro plant, metered and matched in time, would support a market-based Scope 2 close to zero. On a grid that is already mostly hydro, such a claim is credible only if it does not simply reassign existing low-carbon output from other customers. The strongest form is a contract that brings new capacity onto the system, for example by underwriting part of a new hydro project or a firming arrangement, so that the works' demand is matched by additional low-carbon supply.

The seasonal factor. Cameroon's southern grid depends on rivers whose flows vary by season and year. Nachtigal delivered about 28% less than planned in 2025 because of hydrology [S50]. A steelworks that runs continuously will draw power in the dry months too. Reporting the grid factor monthly, and contracting for firmness, is therefore more informative than an annual average.

THE GRID FACTOR IS A STRATEGIC DECISION

For RC-1, every 100 g/kWh of grid factor is worth about 0.1 t of CO₂ per tonne of product, and the difference between a hydro-matched and a thermal-margin supply is worth about 0.7 t. Securing firm, identified low-carbon supply, and the transmission that delivers it, is the most valuable carbon decision after the choice of route. It also matters for reliability: an arc furnace that loses power mid-heat wastes energy and time.

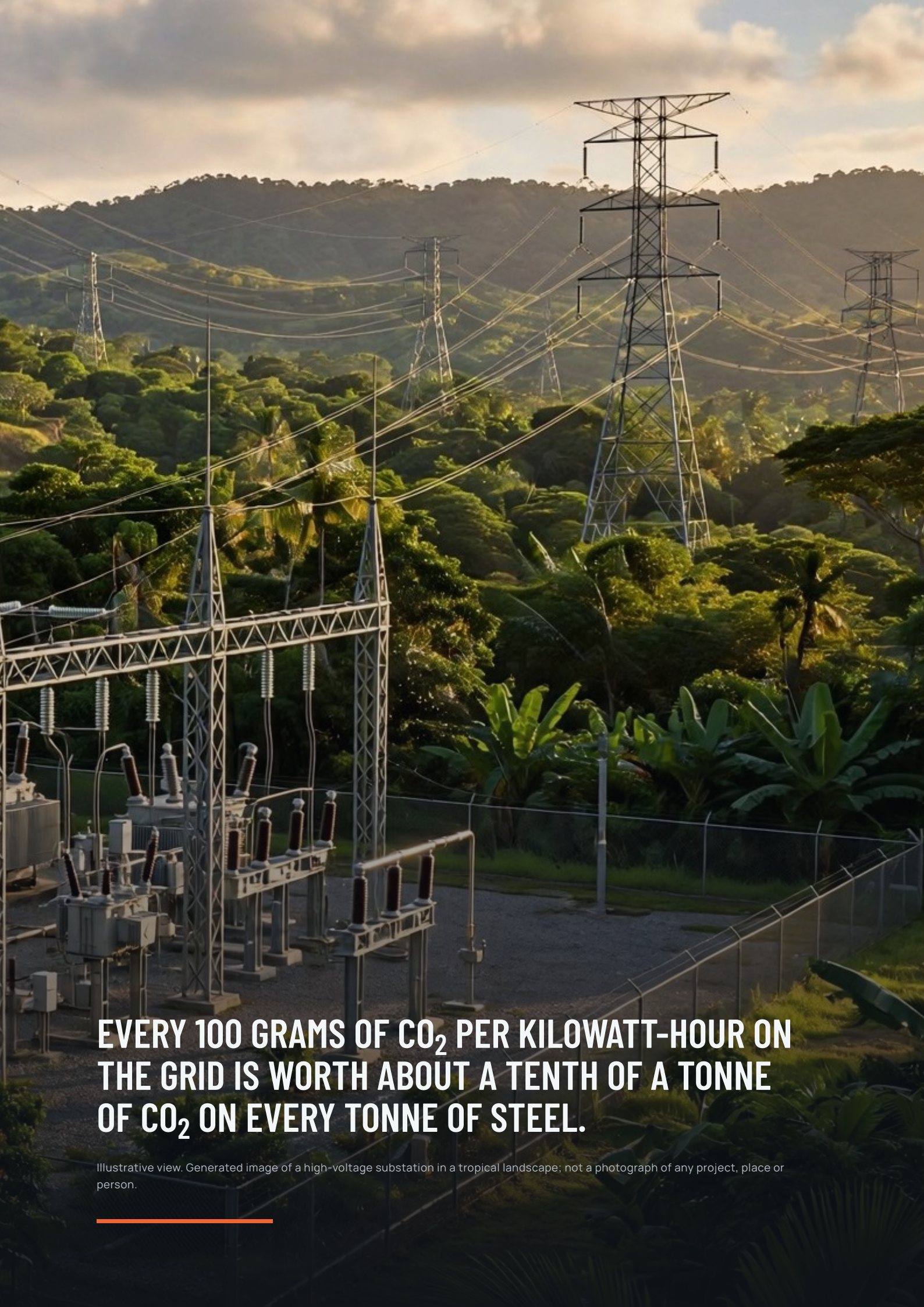
3.6 Firmness and cost shape what is achievable

Low-carbon power is valuable to a steelworks only if it is firm and affordable. White paper 05 (Chapter 3) analyses tariffs and contracting for large users; two points matter for carbon. There is no regulated tariff above 10 MW, so a works of RC-1's size would contract bilaterally; legacy high-voltage contracts averaged about 18.4 FCFA/kWh in 2025, while the regulator estimates the cost-reflective average across all customers at about 105 FCFA/kWh [S50][S54]. Where a new steelworks lands in that range will affect both its competitiveness and the carbon content of the electricity it can secure, since cheaper supply is often older hydro whose output is already committed.

These constraints are not reasons to abandon the hydro advantage; they are reasons to plan for it deliberately. Chapter 10 recommends a power strategy built on four elements: a firm bilateral contract with identified low-carbon generation; support for the transmission reinforcements that bring hydro to Kribi; on-site measures (power-factor correction, flicker compensation, melting scheduled around system peaks and flexibility in the rolling mills) that make the works a good grid citizen; and monthly reporting of location- and market-based Scope 2.

3.7 What the grid factor cannot do

Even a perfectly clean grid would not make RC-1's steel near-zero. At a grid factor of zero, Phase 1 would still emit about 0.11 t per tonne directly and carry about 0.25 t of upstream emissions from the imported DRI in its charge, for a total of about 0.36 t. That is lower than any route average, but well above the IEA's near-zero threshold for a plant with about 70% scrap, which is about 0.16 t per tonne of crude steel [S06]. Beyond the grid, the next gains must come from the iron units and from direct emissions in the furnace. Chapter 4 sets out the full footprint and shows which of these matters most.



EVERY 100 GRAMS OF CO₂ PER KILOWATT-HOUR ON THE GRID IS WORTH ABOUT A TENTH OF A TONNE OF CO₂ ON EVERY TONNE OF STEEL.

Illustrative view. Generated image of a high-voltage substation in a tropical landscape; not a photograph of any project, place or person.

CHAPTER 4

AN ILLUSTRATIVE FOOTPRINT: ABOUT 0.3 T WITHIN SCOPES 1 AND 2, ABOUT 0.6 T WITH IMPORTED IRON

On the RC-1 planning basis, the first phase of the Mboro works would emit about 97,000 t of CO₂ a year within Scopes 1 and 2 at nameplate output, from direct emissions on site and purchased electricity, or about 0.32 t per tonne of rolled product; minor fuels and SF₆ would add a few thousand tonnes. Imported DRI or HBI would add about 76,000 t upstream, taking the total to about 0.58 t per tonne. At the 1 Mtpa design capacity the annual totals roughly triple while the intensity barely moves. The single largest uncertainty is not the grid but the iron units: their share of the charge and how they were made.

4.1 The reference configuration

The Cameroon Steel reference configuration RC-1 is the planning estimate that Cameroon Steel uses for public and regulatory discussion of the project. It is not a frozen design. It describes an electric-arc long-products works in three phases, with a reserve for a direct-reduction module, as summarised in Table 4.1. The project's design capacity of 1 Mtpa, and the focus of its first phase on long products for construction, are on the public record [S73][S72].

Phase 1's melt shop makes billets. Its output can move between rolled products (wire rod and reinforcing bar) and merchant billets sold to Cameroon's existing re-rollers, which report that local scrap covers only about 40% of their needs and that the balance comes from imported billets [S89]. The tonnage is aimed at replacing imported billets and wire rod and at exports to the CEMAC region; the domestic reinforcing-bar market already has more rolling capacity than demand, so new rebar capacity alone would not close a gap (White paper 04). Phase 1 has a nameplate of 300,000 t a year; with a single furnace, the expected sustained output is 270,000 to 300,000 t, depending on utilisation. The footprint below is computed at nameplate for fully rolled output; the footprint section below also shows what a tonne sold as billet would carry.

Table 4.1 The RC-1 reference configuration (indicative)

Phase	Main units	Finished output	Reheating before rolling	Timing (indicative)	Status
Phase 1	Electric-arc furnace of the 40 t class, ladle furnace, billet caster, induction billet heating, reinforcing-bar mill, high-speed wire-rod mill	300,000 t/yr nameplate (270,000 to 300,000 t expected sustained); billets for rolling or merchant sale	Electric induction, partly hot-charged	Works from Q1 2029; first heat H2 2030; ramp-up 2031	planned
Phase 2	Second melt line (EAF, LF, caster), light and medium sections mill	+200,000 t/yr	Natural-gas walking-beam furnace	2032 to 2034, subject to market and financing	indicative

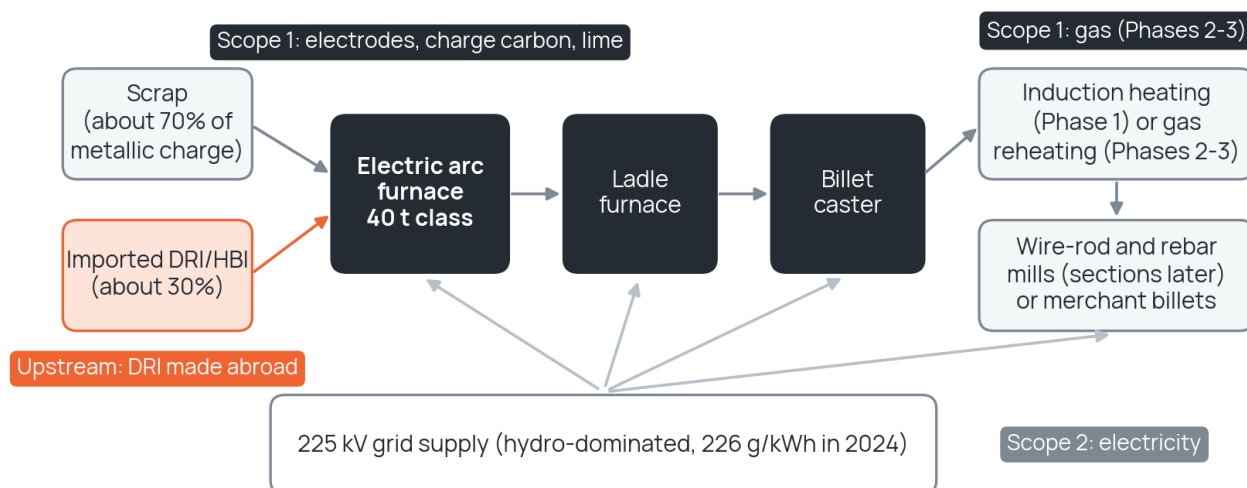
Phase	Main units	Finished output	Reheating before rolling	Timing (indicative)	Status
Phase 3	Melt-shop expansion, heavy sections and H-beam mill	+500,000 t/yr, to 1,000,000 t/yr	Natural-gas walking-beam furnace	After 2034, subject to market and financing	indicative
Reserve	Direct-reduction module for Cameroonian ore	Not in the footprint	Not applicable	Later, subject to ore quality, gas supply and approvals	indicative

Source: Cameroon Steel reference configuration RC-1 (planning estimate), edition 10 October 2026 [S90].

The metallic charge in every phase is assumed to be about 70% scrap and 30% imported DRI or HBI, the planning value in the RC-1 reference configuration, with a range of 20% to 50% DRI. Scrap would be bought domestically as far as collection allows, about 30,000 t a year in the planning case (range 0 to 60,000 t), and imported for the balance (Chapter 8). Figure 4.1 shows the process chain and where emissions enter it.

Where the carbon enters an EAF long-products works

RC-1 Phase 1 process chain and emission points (simplified)



ILLUSTRATIVE Figure 4.1. The RC-1 Phase 1 process chain and its emission points. Direct emissions arise in the furnace (electrodes, charge carbon, lime) and, from Phase 2, in gas-fired reheating; electricity enters at every unit; the upstream emissions of DRI made abroad enter with the charge.

Source: Cameroon Steel reference configuration RC-1 (planning estimate) [S90]. Simplified diagram.

4.2 The method: volumes times benchmarks, with every range stated

The footprint is a gate-to-gate inventory extended upstream to the imported iron units. It follows the boundary logic of the GHG Protocol and ISO 14404 described in Chapter 2 and uses four relationships, set out in full in Annex A:

- **Liquid steel** equals finished product divided by the cast-and-roll yield (0.94); **metallic charge** equals liquid steel divided by the metallic yield (0.88).
- **Scope 1** equals liquid steel times a direct factor of 0.10 t CO₂ per tonne (electrodes, charge and injection carbon, the carbonate share of fluxes), plus natural gas burnt for reheating times 0.0561 t CO₂ per GJ, the IPCC default for natural gas [S57].
- **Scope 2** equals electricity times the grid factor (226 g/kWh), where electricity is liquid steel times 520 kWh/t (450 for the furnace, the planning value within the IFC range of 347 to 500 [S20], plus 70 for auxiliaries; about

490 is the upper planning value for a 30% DRI charge), plus finished product times 110 kWh/t for rolling (IFC range 70 to 140 [S20]), plus, in Phase 1, 300 kWh/t for induction heating.

- **Upstream DRI/HBI** equals metallic charge times the DRI share (30%) times 0.70 t CO₂ per tonne of DRI, a planning value for gas-based shaft-furnace iron with a range of 0.5 to 0.9.

Table 4.2 gives the resulting activity data. All values are at nameplate output for a full year; ramp-up years would be lower in absolute terms and, typically, higher in intensity.

Table 4.2 Activity data by phase (RC-1 balances at nameplate output)

Quantity	Unit	Phase 1	Phases 1+2	Full build-out	Status
Finished product	t/yr	300,000	500,000	1,000,000	planned
Liquid (crude) steel	t/yr	319,149	531,915	1,063,830	derived
Metallic charge	t/yr	362,669	604,449	1,208,897	derived
of which imported DRI/HBI	t/yr	108,801	181,335	362,669	derived
of which scrap	t/yr	253,868	423,114	846,228	derived
Electricity	MWh/yr	288,957	421,596	753,191	derived
Average electrical load (8,000 h)	MW	36.1	52.7	94.1	derived
Natural gas for reheating	GJ/yr	0	260,000	910,000	derived

Source: Cameroon Steel reference configuration RC-1 (planning estimate), balances for Phase 1, Phases 1+2 and full build-out [S90].

4.3 The footprint by phase

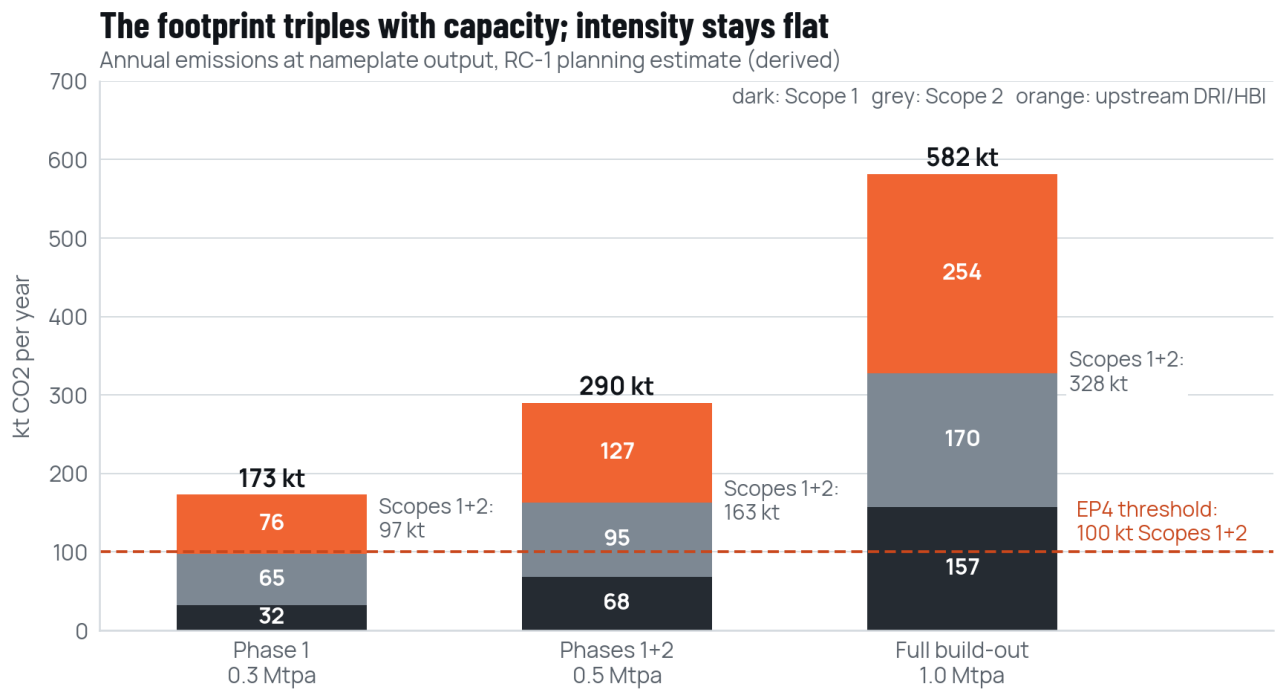
Table 4.3 and Figure 4.2 give the resulting annual footprint. Scopes 1 and 2 rise from about 97,000 t in Phase 1 to about 163,000 t with Phase 2 and about 328,000 t at 1 Mtpa. Upstream iron units add 76,000 to 254,000 t.

Because every phase uses the same charge mix and similar benchmarks, the intensity stays almost constant at about 0.32 to 0.33 t per tonne for Scopes 1 and 2 and 0.58 t including upstream.

Table 4.3 Annual footprint by phase at nameplate output (t CO₂ per year)

Component	Phase 1 (0.3 Mtpa)	Phases 1+2 (0.5 Mtpa)	Full build-out (1 Mtpa)	Status
Scope 1, furnace and ladle (electrodes, carbon, lime)	31,915	53,191	106,383	derived
Scope 1, natural-gas reheating	0	14,586	51,051	derived
Scope 1 total	31,915	67,777	157,434	derived
Scope 2, grid electricity at 226 g/kWh	65,304	95,281	170,221	derived
Scopes 1+2	97,219	163,058	327,655	derived
Upstream imported DRI/HBI	76,161	126,934	253,868	derived
Total including upstream DRI	173,380	289,992	581,524	derived
Scopes 1+2 per t product	0.324	0.326	0.328	derived
Total per t product	0.578	0.580	0.582	derived

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; values agree with the RC-1 balances to the tonne.



DERIVED **Figure 4.2.** Annual footprint by phase at nameplate output. In Phase 1, Scopes 1 and 2 (dark and grey) come to about 97,000 t from process emissions and purchased electricity, at or about the Equator Principles threshold of 100,000 t once minor fuels and SF6 are added; later phases are well above it. Upstream DRI/HBI (orange) is the largest single block in every phase.

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; Equator Principles EP4 [S22].

The composition shifts as the works grows. In Phase 1, with induction heating, grid electricity is about two-thirds of Scopes 1 and 2. In Phases 2 and 3, gas-fired reheating moves part of the energy use from Scope 2 to Scope 1, so that at 1 Mtpa the two scopes are of similar size. The choice between induction and gas reheating is therefore partly a carbon choice: on Cameroon's grid at 226 g/kWh, 300 kWh of induction heating emits about 0.068 t per tonne, while 1.3 GJ of gas emits about 0.073 t, so the two are close; on a cleaner grid, induction wins clearly.

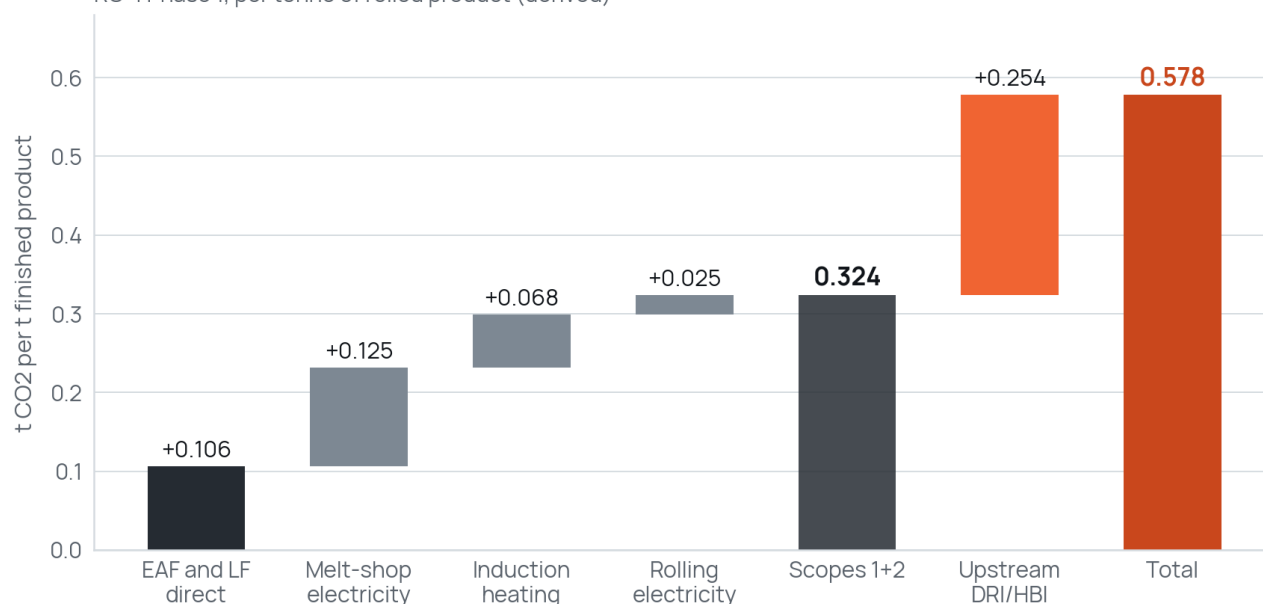
A tonne sold as merchant billet leaves the works before reheating and rolling. Per tonne of cast steel, a Phase 1 billet would carry about 0.10 t of direct emissions and about 0.12 t from melt-shop electricity, or about 0.22 t within Scopes 1 and 2, and about 0.46 t including the upstream DRI; on the CBAM basis it would carry about 0.34 t (derived). Selling billets rather than rolled products therefore lowers the works' own Scopes 1 and 2, but the reheating and rolling emissions move to the buyer's mill rather than disappear.

4.4 Inside a Phase 1 tonne

Figure 4.3 breaks a tonne of Phase 1 product into its components. Melt-shop electricity (furnace, ladle furnace and auxiliaries) is the largest item within Scopes 1 and 2 at about 0.125 t, followed by the furnace's direct emissions at about 0.106 t, induction heating at about 0.068 t and rolling electricity at about 0.025 t. The upstream emissions of the DRI in the charge, at about 0.254 t, exceed any single item within Scopes 1 and 2.

Electricity is two-thirds of Scopes 1 and 2; imported iron is the largest block

RC-1 Phase 1, per tonne of rolled product (derived)



DERIVED Figure 4.3. A tonne of RC-1 Phase 1 product, built up from its emission sources. Purchased electricity accounts for about two-thirds of Scopes 1 and 2; the imported iron units are the largest single block.

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90] (Annex A).

Table 4.4 Electricity use and Scope 2 emissions by consumer

Consumer	Basis	Phase 1, MWh/yr	Phase 1, t CO ₂	Full build-out, MWh/yr	Full build-out, t CO ₂
Electric-arc furnace, ladle furnace, auxiliaries	520 kWh/t liquid	165,957	37,506	553,191	125,021
Rolling mills	110 kWh/t product	33,000	7,458	110,000	24,860
Induction billet heating	300 kWh/t, Phase 1 only	90,000	20,340	90,000	20,340
Total		288,957	65,304	753,191	170,221

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; benchmarks from IFC [S20] and the RC-1 reference configuration.

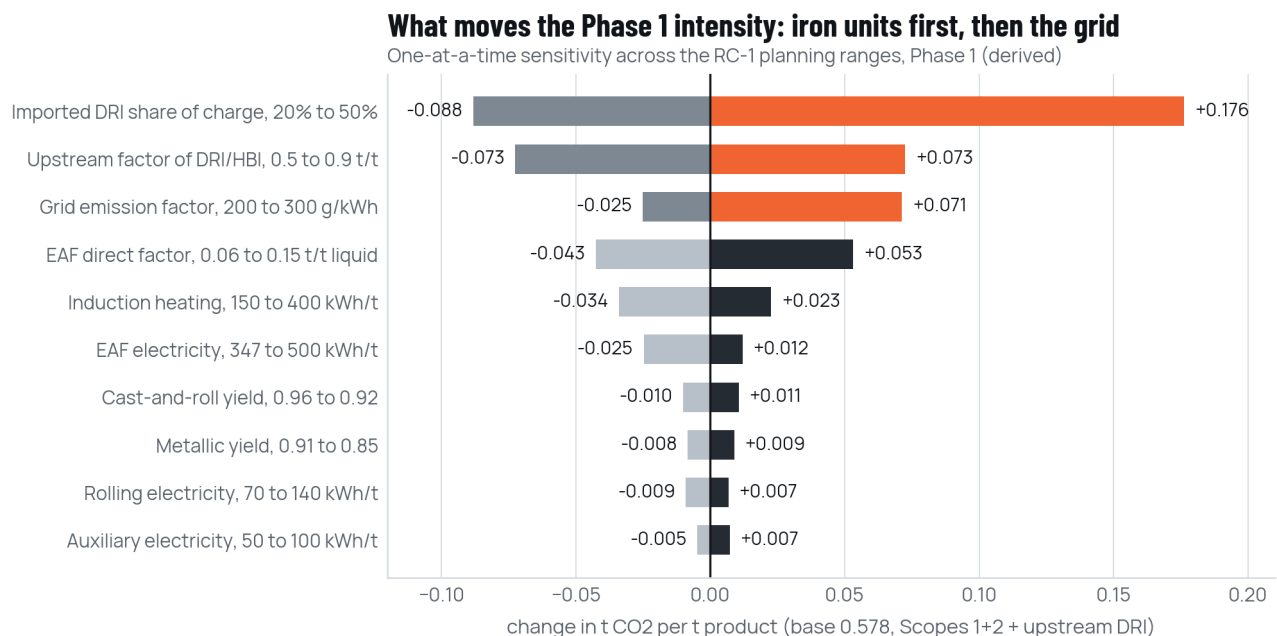
Three practical conclusions follow for the design. First, furnace efficiency matters more than any other electricity measure, because the melt shop takes 57% of Phase 1 electricity and 73% at full build-out; scrap preparation, foamy-slag practice, oxy-fuel assistance, hot-heel operation and continuous scrap charging (which reported 321 kWh/t at one Asian plant [S94]) are all relevant. Second, hot charging of billets straight from the caster reduces the induction load, and the 300 kWh/t planning value already assumes partial hot charging. Third, the direct factor of 0.10 t per tonne is a planning value that should be replaced by measured carbon and electrode balances from the first campaigns.



ILLUSTRATIVE Illustrative view. Generated image of a molten steel surface; not a photograph of any project, place or person.

4.5 What moves the result: iron units first, then the grid

Figure 4.4 tests the Phase 1 intensity, including upstream iron units, against the range of every parameter in the RC-1 reference configuration, one at a time. The ranges come from published benchmarks where they exist (IFC for furnace and rolling electricity [S20]) and from planning assumptions where they do not.



DERIVED **Figure 4.4.** One-at-a-time sensitivity of the RC-1 Phase 1 intensity (Scopes 1 and 2 plus upstream DRI, t CO₂ per tonne of product). Orange and steel-grey bars mark the three parameters this paper treats as decisive: the DRI share of the charge (including the extra furnace electricity that DRI requires), the upstream intensity of the DRI and the grid factor.

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; DRI power penalty of about 14.5 kWh/t per 10 points of DRI in the charge from the EC Innovation Centre for Industrial Transformation [S15].

Table 4.5 Sensitivity of the Phase 1 intensity to the three decisive parameters and to the upper furnace planning value (t CO₂ per tonne of product)

Parameter	Range tested	Change in Scopes 1+2	Change in total incl. upstream	Resulting total
Imported DRI share of charge	20% to 50%	-0.004 to +0.007	-0.088 to +0.176	0.49 to 0.75
Upstream intensity of DRI/HBI	0.5 to 0.9 t/t DRI	none	-0.073 to +0.073	0.51 to 0.65
Grid emission factor	200 to 300 g/kWh	-0.025 to +0.071	-0.025 to +0.071	0.55 to 0.65
Furnace electricity at the upper planning value (490 instead of 450 kWh/t)	490 kWh/t	+0.010	+0.010	0.59
All three decisive parameters at their joint extremes		-0.028 to +0.081	-0.161 to +0.371	0.42 to 0.95

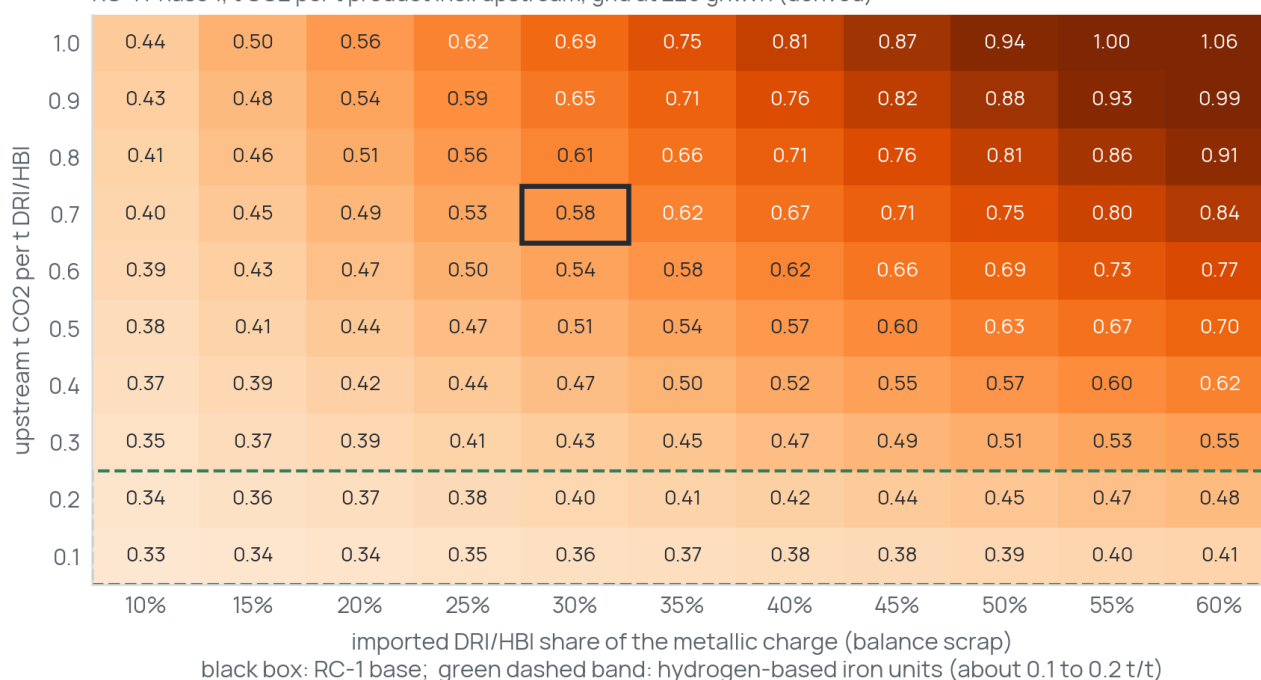
Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]. Base: Scopes 1+2 0.324; total 0.578. The DRI share changes Scopes 1+2 slightly because DRI needs more furnace electricity than scrap.

The DRI share dominates because it acts on the largest block. Each 10 points of DRI added to the charge, in place of scrap, adds about 0.09 t per tonne at 0.7 t per tonne of DRI. The upstream intensity of the DRI is the next lever: buying DRI made at 0.5 rather than 0.9 t per tonne is worth about 0.15 t per tonne of steel at a 30% share. The grid factor follows, with an asymmetric range because the planning value of 226 g/kWh sits near the lower end of the band. The furnace's direct factor (0.06 to 0.15 t per tonne of liquid steel) is the largest uncertainty in direct emissions on site, and the only one of these parameters that is mostly in the operator's hands. The furnace's electricity matters less: moving from the planning value of 450 kWh/t to the upper planning value of about 490 kWh/t for a 30% DRI charge adds about 0.01 t per tonne.

Figure 4.5 shows how the first two levers interact. The RC-1 base case sits in the middle of the map. Halving the DRI share at the same upstream intensity has about the same effect as halving the upstream intensity at the same share; doing both, or replacing gas-based DRI with hydrogen-based iron units at about 0.1 to 0.2 t per tonne, takes the total to about 0.4 t per tonne or below even at today's grid factor.

Cleaner iron units cut more carbon than any grid scenario

RC-1 Phase 1, t CO₂ per t product incl. upstream, grid at 226 g/kWh (derived)



DERIVED Figure 4.5. RC-1 Phase 1 intensity including upstream iron units, for combinations of DRI share (columns) and upstream DRI intensity (rows), grid at 226 g/kWh. The black box is the RC-1 base case; the dashed band shows the range expected for hydrogen-based iron units.

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; DRI power penalty from [S15]; hydrogen-based iron range discussed in Chapter 6.

IRON UNITS ARE THE CARBON LEVER THAT PURCHASING CONTROLS

For RC-1, the carbon content and share of purchased iron units move the footprint more than the grid factor, furnace practice and every efficiency measure combined. That makes the purchasing specification for DRI and HBI (a verified carbon intensity, a contractual ceiling and a preference for lower-carbon suppliers) the most important climate instrument after the power contract.

4.6 How RC-1 compares with route averages

On the ISO 14404 and worldsteel basis, per tonne of crude steel, the illustrative RC-1 intensity including upstream iron units is about 0.54 t in Phase 1 and 0.55 t at full build-out. That is about 21% below the world average for scrap-based electric furnaces (0.69 t), about 63% below gas-based DRI-EAF (1.47 t), about 72% below the world average for all routes (1.92 t) and about 77% below the blast-furnace route (2.34 t) [S01]. On a per-tonne-of-product basis, which is how this paper reports RC-1 and which slightly overstates it, the total of about 0.58 t is about 30% of the world average.

These comparisons need three cautions. RC-1 is an estimate, not a measurement; route averages describe real plants. RC-1's boundary does not yet count every purchased input that worldsteel includes (ferroalloys, lime, electrodes made elsewhere), which would add a few hundredths of a tonne; Cameroon Steel's monitoring plan would close that gap from the first year of operation. And the comparison with the scrap-EAF average flatters no one: RC-1 melts a lower share of scrap than a typical scrap-based plant, but runs on a cleaner grid, and the two effects roughly offset.

4.7 What the footprint excludes, and why it matters

Five categories are outside the estimate. They are listed so that the direction of any bias is clear.

1. **Other purchased inputs.** Ferroalloys, lime, electrodes and refractories made elsewhere, and any oxygen or industrial gases bought in rather than made on site with grid electricity. These would raise a cradle-to-gate product footprint by an amount to be measured.
2. **Transport.** Sea freight of imported scrap and DRI to Kribi, and transport of finished products. These belong in Scope 3 and will be reported.
3. **Construction and land-use change.** The embodied emissions of buildings and equipment, and any carbon released by clearing vegetation on the site, will be quantified in the environmental and social impact assessment once the vegetation survey and construction plan are available.
4. **Methane and nitrous oxide.** These are minor for the electric route: worldsteel's CO₂e intensity for scrap-EAF is only 0.02 t above its CO₂ intensity [S01].
5. **Minor fuels and SF6.** Diesel for mobile plant and standby generators, liquefied petroleum gas (LPG) for ladle and tundish preheating, and leakage of sulphur hexafluoride (SF6) from high-voltage switchgear are direct emissions that the RC-1 balances do not model. We estimate them at 0.01 to 0.02 t CO₂ per tonne of liquid steel for the fuels, and at 0.5% a year of a 0.5 to 2 t SF6 inventory at a global warming potential of 23,500 [S105]: about 3,000 to 7,000 t CO₂e a year in Phase 1 (assumed). They are small per tonne, about 0.01 to 0.02 t, but they take Phase 1 Scopes 1 and 2 to about 100,000 to 104,000 t, which matters for the lender threshold (Chapter 9).

The estimate also assumes nameplate operation. At the expected sustained output of 270,000 to 300,000 t, Phase 1's annual emissions would be up to 10% lower at the same intensity. During ramp-up, furnaces run below their best energy performance and yields are lower, so intensity is typically higher in the first year or two. Cameroon Steel would report actual figures from the first heat, so that the trajectory is visible.

4.8 From estimate to measurement

The numbers in this chapter are only as good as the benchmarks behind them. The next step, at front-end engineering, is to replace the planning values with the technology supplier's guaranteed consumptions, the power utility's contracted supply and the carbon data of named suppliers of DRI and HBI. After commissioning, measured data take over. Chapter 10 sets out the monitoring, reporting and verification plan that makes that transition auditable; Chapter 5 shows why it is worth money.

CHAPTER 5

CARBON BORDER MEASURES: VERIFIED LOW INTENSITY BECOMES A PRICE ADVANTAGE

The European Union's Carbon Border Adjustment Mechanism (CBAM) has charged for the carbon embedded in imported steel since 1 January 2026, and the United Kingdom's follows on 1 January 2027. Both cover every product an electric-arc works in Cameroon could export: iron-ore pellets, DRI and HBI, billets, reinforcing bar, wire rod and sections. For steel, the EU mechanism counts direct emissions and the direct emissions embedded in precursors such as DRI, but not the emissions of purchased electricity. At the third-quarter 2026 certificate price of €82.32 per tonne of CO₂, RC-1 product would carry about €30 per tonne once the protection of EU producers has been phased out, about 70% of it from the imported DRI, against about €82 to €121 for gas-based DRI-EAF steel and €99 to €193 for blast-furnace steel. An all-scrap furnace would pay less than RC-1, and Cameroon's low-carbon grid earns no credit. The advantage is real against ore-based steel, and it is available only to exporters that can prove their numbers.

5.1 How the EU mechanism works

CBAM applies to imports into the EU of goods in six sectors: iron and steel, aluminium, cement, fertilisers, hydrogen and electricity [S27]. After a transitional period of reporting only, which began in October 2023, the definitive regime has applied since 1 January 2026 [S25]. Importers must be authorised CBAM declarants, buy CBAM certificates corresponding to the embedded emissions of the goods they import, and surrender them once a year.

The simplification regulation adopted in October 2025, Regulation (EU) 2025/2083, made several changes that matter to exporters [S29]:

- a single de minimis threshold of 50 t a year per importer across iron and steel, aluminium, fertilisers and cement, below which no obligation arises;
- applications for declarant authorisation by 31 March 2026, certificate sales from 1 February 2027 and the first annual declaration and surrender, covering 2026 imports, by 30 September 2027;
- a quarterly holding requirement reduced from 80% to 50% of the estimated annual obligation.

The certificate price follows the EU Emissions Trading System. In 2026 it is set quarterly from average auction prices: €75.36 for the first quarter, €75.28 for the second and €82.32 for the third, published on 5 October 2026; from 2027 it will be set weekly [S26]. For context, the EU ETS average auction price in 2025 was €73.43 per tonne [S82].

Table 5.1 The CBAM regime as it applies to steel, at 10 October 2026

Element	Provision	Source
Legal basis	Regulation (EU) 2023/956, as amended by Regulation (EU) 2025/2083	[S27] [S29]
Definitive regime	From 1 January 2026; first declaration and surrender of certificates for 2026 imports by 30 September 2027	[S25] [S29]
Goods covered (iron and steel)	CN chapter 72 except listed ferroalloys and ferrous scrap (7204), including DRI and HBI (7203), semi-finished products (7206, 7207), wire rod (7213), bars and rods (7214, 7215), sections (7216); articles in 7301 to 7311, 7318 and 7326; agglomerated iron ore, including pellets (2601 12 00)	[S27]
Emissions counted for steel	Direct emissions, including those embedded in precursors (for example DRI, pig iron); electricity emissions reported but not priced (Annex II)	[S27]
Certificate price	Quarterly in 2026: €75.36, €75.28, €82.32 per t CO ₂ (Q1 to Q3); weekly from 2027	[S26]
De minimis	50 t per importer per year, across covered sectors	[S29]
Free-allocation adjustment	Certificates reduced by a CBAM benchmark times a CBAM factor that falls from 97.5% (2026) to 0% (2034)	[S28] [S31]
Default values	Country-specific, with mark-ups of 10% (2026), 20% (2027) and 30% (from 2028); where no reliable country data exist, the average of the ten exporting countries with the highest emission intensities	[S31] [S30]
Carbon price paid at origin	Deductible, if effectively paid and documented	[S27]
Proposed extension	About 180 downstream steel- and aluminium-intensive goods, plus anti-circumvention rules, from 1 January 2028 (proposal COM(2025) 989)	[S33] [S32]

Source: as listed.

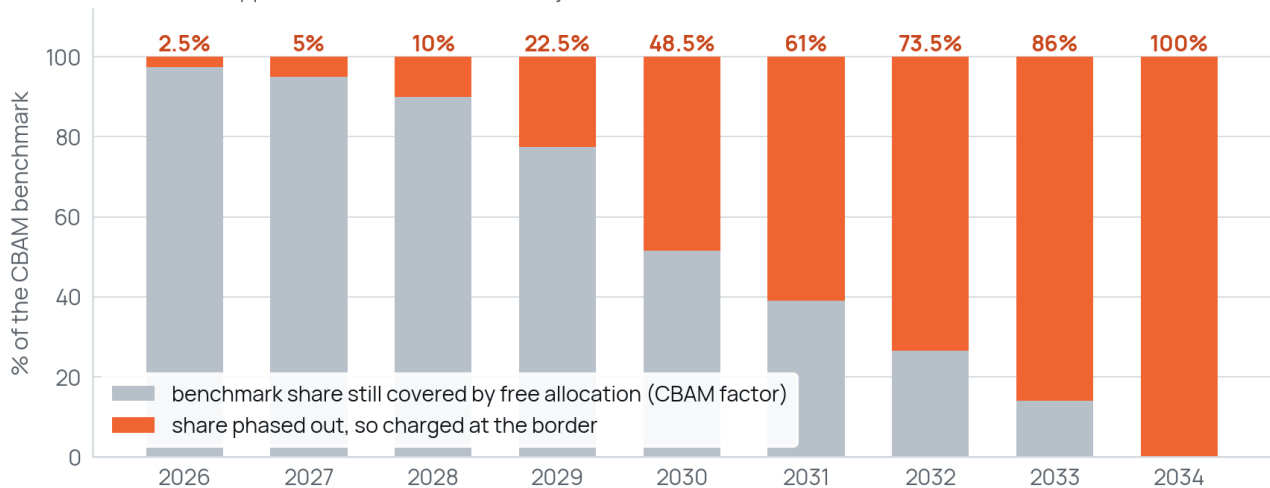
5.2 The free-allocation shield falls to zero by 2034

EU steelmakers have long received most of their emission allowances free of charge, to limit "carbon leakage" to countries without carbon pricing. CBAM replaces that protection gradually. Each year, the number of certificates an importer must surrender is reduced by an amount reflecting the free allocation EU producers of the same good still receive: a CBAM benchmark, multiplied by a CBAM factor that follows the phase-out of free allocation in the revised EU ETS Directive [S28] [S31]. Figure 5.1 shows that schedule.

The benchmarks matter as much as the factor. Implementing Regulation (EU) 2025/2620, adopted in December 2025, sets route-specific benchmark values for steel products [S104]. We have not extracted its values for wire rod and bars (CN 7213 and 7214). As reported by the trade press for hot-rolled coil, the values are 1.370 t CO₂e per tonne for the blast-furnace route, 0.481 t for DRI-EAF and 0.072 t for scrap-based EAF, with a dedicated benchmark for gas-based DRI so that its imports are not adjusted below zero [S31] [S32]. This paper uses those hot-rolled-coil values as a proxy for long products. The proxy affects only the free-allocation adjustment: for RC-1 it is worth about €6 per tonne in 2026 and nothing from 2034. The benchmark that applies to a given import depends on its production route; according to a published compliance guide, a product whose crude steel comes more than half from scrap is classified as scrap-EAF [S93]. With about 70% scrap in its charge, RC-1 product would fall in the scrap-EAF category, where the benchmark, and therefore the adjustment, is small. In practice, RC-1 product would carry almost its full embedded emissions as a CBAM liability from the start. At about 0.36 t, those emissions are low against ore-based routes but more than three times those of an all-scrap furnace, because the DRI precursor counts in full.

The free-allocation shield falls from 97.5% in 2026 to zero in 2034

CBAM factor applied to the free-allocation adjustment, EU ETS Directive as amended in 2023

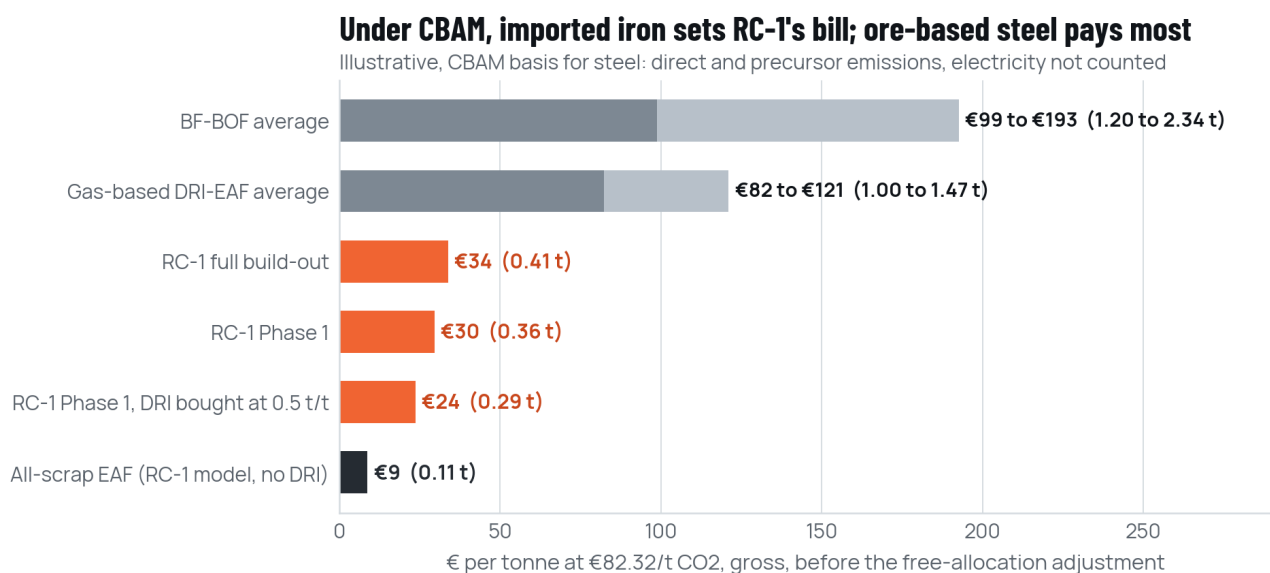


SOURCED Figure 5.1. The CBAM factor applied in the free-allocation adjustment. The share of the benchmark still covered (grey) falls from 97.5% in 2026 to 51.5% in 2030 and zero in 2034; the share phased out (orange) is charged at the border in full.

Source: Directive (EU) 2023/959 amending the EU ETS Directive, free-allocation phase-out schedule [S28]; CBAM implementing rules [S31].

5.3 Illustrative exposure: what a tonne would pay

Figure 5.2 shows the gross exposure, before the free-allocation adjustment, of a tonne of product at the third-quarter 2026 price. Every bar is on the CBAM basis for steel: direct emissions plus the direct emissions of precursors, without purchased electricity [S27]. For RC-1 and for an all-scrap furnace, the values come from the WP06 model; the all-scrap case is RC-1 with no DRI in its charge. Published averages for the ore-based routes are not reported on the CBAM basis, so the figure shows them as ranges. The lower end is the IEA's estimate of direct emissions by route, which leaves out the precursors a plant buys in [S05]; the upper end is worldsteel's 2024 route average, which also counts electricity and other upstream inputs [S01]. The CBAM-relevant emissions of an average ore-based plant lie between the two.



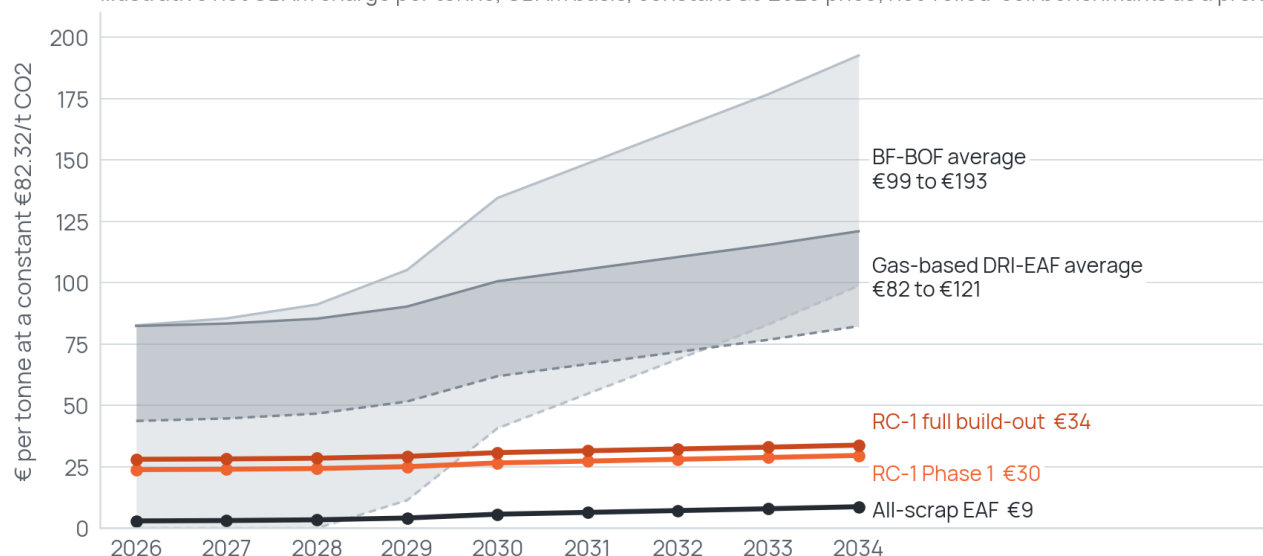
ILLUSTRATIVE Figure 5.2. Illustrative gross CBAM charge per tonne of product at €82.32/t CO₂, before the free-allocation adjustment, on the CBAM basis for steel (direct and precursor emissions, no electricity). Ranges for the ore-based routes run from the IEA's direct-emission estimate (solid) to worldsteel's all-scope average (pale); RC-1 and the all-scrap furnace use the WP06 model.

Source: European Commission, price of CBAM certificates [S26]; Regulation (EU) 2023/956, Annex II [S27]; IEA [S05]; worldsteel [S01]; WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90].

On the CBAM basis, a tonne of RC-1 Phase 1 product embeds about 0.36 t of CO₂ (0.11 t direct and 0.25 t in the purchased DRI), which at €82.32 is about €30 gross. At full build-out, gas-fired reheating raises the direct share and the figure to about 0.41 t and €34. Each 10 points of DRI in the charge add about 0.085 t, or about €7 gross (derived). An all-scrap furnace would embed only its direct emissions, about 0.11 t, or €9: under CBAM, RC-1 product would pay more than scrap-based steel, not less. Applying the free-allocation adjustment at the scrap-EAF benchmark reduces the 2026 charge to about €24 for Phase 1, €28 for the full works and €3 for an all-scrap furnace, rising to the gross figures by 2034 (Figure 5.3 and Table 5.2).

As free allocation ends, the gap with ore-based steel widens

Illustrative net CBAM charge per tonne, CBAM basis, constant Q3 2026 price; hot-rolled-coil benchmarks as a proxy



ILLUSTRATIVE Figure 5.3. Illustrative net CBAM charge per tonne, 2026 to 2034, at a constant €82.32/t CO₂, on the CBAM basis. Each series applies its route's benchmark (hot-rolled-coil values used as a proxy for long products: 1.370, 0.481 and 0.072 t/t for BF-BOF, DRI-EAF and scrap-EAF) and the CBAM factor for each year. Bands for the ore-based routes span the ranges of Figure 5.2; prices will change.

Source: as Figure 5.2; benchmarks as reported for hot-rolled coil, used as a proxy for long products [S31][S104]; CBAM factor [S28].

Table 5.2 Illustrative CBAM arithmetic per tonne of product on the CBAM basis for steel (constant €82.32/t CO₂)

Product	Embedded emissions used, t CO ₂ /t	Benchmark applied, t/t (hot-rolled-coil proxy)	Net charge 2026, €/t	Net charge 2030, €/t	Net charge 2034, €/t	Status
All-scrap EAF (WP06 model, no DRI)	0.11	0.072 (scrap-EAF)	3	6	9	illustrative
RC-1 Phase 1, DRI bought at 0.5 t/t	0.29	0.072 (scrap-EAF)	18	21	24	illustrative
RC-1 Phase 1 (DRI at 0.7 t/t)	0.36	0.072 (scrap-EAF)	24	27	30	illustrative
RC-1 full build-out	0.41	0.072 (scrap-EAF)	28	31	34	illustrative
Gas-based DRI-EAF (IEA direct to worldsteel all-scope)	1.00 to 1.47	0.481 (DRI-EAF)	44 to 82	62 to 101	82 to 121	illustrative
BF-BOF (IEA direct to worldsteel all-scope)	1.20 to 2.34	1.370 (BF-BOF)	0 to 83	41 to 135	99 to 193	illustrative

Source: WP06 model (Annex A); price [S26]; CBAM basis [S27]; benchmarks as reported for hot-rolled coil [S31]; CBAM factor [S28]; IEA [S05]; worldsteel [S01]. Net charge = (embedded emissions – benchmark × CBAM factor) × price, floored at zero. Not a forecast: prices, the long-product benchmarks of Implementing Regulation (EU) 2025/2620 [S104] and the route classification must be checked before any EU sale.

Three observations follow. First, RC-1's CBAM advantage is against ore-based steel. By 2034, at today's price, an average blast-furnace product would pay about €70 to €160 more per tonne than RC-1 product, and an average gas-based DRI-EAF product about €50 to €90 more. Against export reinforcing-bar prices of about US\$620 to US\$630 per tonne FOB Türkiye in early October 2026 [S96], those are large numbers. Second, an all-scrap furnace would pay about €21 per tonne less than RC-1 by 2034. CBAM prices the DRI precursor in full and ignores the electricity in which Cameroon's grid gives RC-1 its lower total footprint, so the clean grid earns nothing at the EU border. RC-1's CBAM lever is the carbon content of its DRI: each 0.1 t CO₂ per tonne of DRI is worth about €3 per tonne of product, and DRI bought at 0.5 rather than 0.7 t would save about €6. Third, the free-allocation adjustment protects high-carbon routes most in the early years, so the competitive effect of CBAM against ore-based steel grows steadily to 2034.

5.4 Default values punish the unmeasured

An importer that cannot document actual embedded emissions, verified under the CBAM rules, must use default values. These are set per country and product where reliable data exist, with mark-ups that rise from 10% in 2026 to 20% in 2027 and 30% from 2028 [S31]. Where no reliable data exist for a country, the default is the average emission intensity of the ten exporting countries with the highest emission intensities for that type of good [S30]. For a country with little steel export history, such as Cameroon, that rule could assign a product made in a clean electric works an intensity typical of the world's most carbon-intensive producers.

The arithmetic is unforgiving. At €82.32, each tonne of CO₂ per tonne of steel by which a default exceeds the verified actual value costs about €82 per tonne of product. A producer whose verified embedded emissions are 0.36 t, but whose buyer must use a default of, say, 2 t, would hand that buyer a cost difference of more than €130 per tonne. Measurement is therefore not a reporting chore; it is the condition for monetising the plant's low intensity.

VERIFIED DATA ARE THE ASSET

Under CBAM, an exporter's low carbon intensity is worth money only if an accredited verifier has confirmed it and the importer can declare it. Cameroon Steel should design its monitoring to the CBAM rules from the first heat, so that every EU-bound tonne can carry verified actual embedded emissions, and should expect buyers to make that a contract condition.

5.5 Other carbon border measures are following

The EU is not alone. The United Kingdom's CBAM applies from 1 January 2027 to imports of iron and steel, among other goods, with a registration threshold of GBP 50,000 of covered imports a year [S34]. Australia's carbon leakage review, whose final report was released in February 2026, identified a border carbon adjustment as the preferred response for certain high-risk commodities and recommended a staged introduction starting with cement and clinker and extending later to other goods including steel [S35]. Other jurisdictions are considering similar instruments or product carbon standards. Table 5.3 summarises the measures relevant to a Cameroonian exporter.

Table 5.3 Carbon border measures relevant to Cameroonian steel, at 10 October 2026

Jurisdiction	Instrument	Status	Steel covered	Relevance for Cameroon Steel
European Union	CBAM, Regulation (EU) 2023/956	Definitive since 1 January 2026; certificates on sale from February 2027	Yes, including DRI/HBI, semis, bars, wire rod, pellets	Applies to any EU-bound tonne; verified actual data decisive
European Union	Proposed extension to downstream goods, COM(2025) 989	Proposal; intended from 1 January 2028	Fabricated steel products	Would extend coverage to mesh, fabricated reinforcement and structures
United Kingdom	UK CBAM	From 1 January 2027	Yes	Similar logic; separate registration and reporting
Australia	Border carbon adjustment recommended by the carbon leakage review	Recommendation; staged, cement first	Later stage	Signal of a wider trend
CEMAC and West Africa	None	No border carbon measure identified	No	RC-1's main markets carry no carbon charge

Source: [S27][S33][S34][S35]. Market access to the EU is also limited by the steel tariff-rate quota that replaced the EU safeguard from 1 July 2026, with a 50% out-of-quota duty [S95].

5.6 What CBAM means, and does not mean, for RC-1

It would be easy to overstate the importance of CBAM for a works whose planned markets are mainly domestic and regional. Cameroon's own demand for steel is supplied largely by imports of iron units and finished products, and the CEMAC region applies no carbon charge. RC-1 does not depend on European sales, and EU market access for steel is constrained by quotas as much as by carbon [S95].

CBAM nevertheless matters for three reasons. First, it creates an option: semi-finished products, sections or, later, HBI from a low-carbon Cameroonian works would be competitive in a market where ore-based competitors pay more, and that option is worth preserving. Second, it sets the template that buyers, lenders and other governments are adopting: the CBAM monitoring rules are becoming the de facto international standard for installation-level embedded emissions, and complying with them is the cheapest way to answer every other request. Third, it applies to iron-ore pellets and DRI, so any future export of Cameroonian iron units to Europe, discussed in Chapter 6, will be priced on its carbon content from the outset.

WHAT IS NOT YET KNOWN

The benchmark values for long products and their application to RC-1's product mix; the default values that would apply to Cameroon for each CN code; the future CBAM price path; and whether Cameroon will introduce any domestic carbon price that could be deducted. Chapter 11 lists these gaps and how they will be closed.

The next chapter looks further ahead: if verified low-carbon iron is becoming valuable, can Central Africa make it?

CHAPTER 6

GREEN IRON: A LONG-TERM OPTION FOR CENTRAL AFRICA, GATED BY ORE, POWER AND GAS

The deepest cuts in steel's emissions will come from making iron without coal: first with natural gas in direct-reduction shaft furnaces, then with an increasing share of hydrogen made from low-carbon electricity. Regions that combine iron ore with abundant clean energy could make that iron and ship it as hot-briquetted iron (HBI) to steelmakers elsewhere. Central Africa has ore and large undeveloped hydropower. It does not yet have the DR-grade concentrate, the contracted gas or the low-cost firm electricity that green iron requires. For RC-1, green iron is therefore a reserved option, to be earned step by step, not a near-term product.

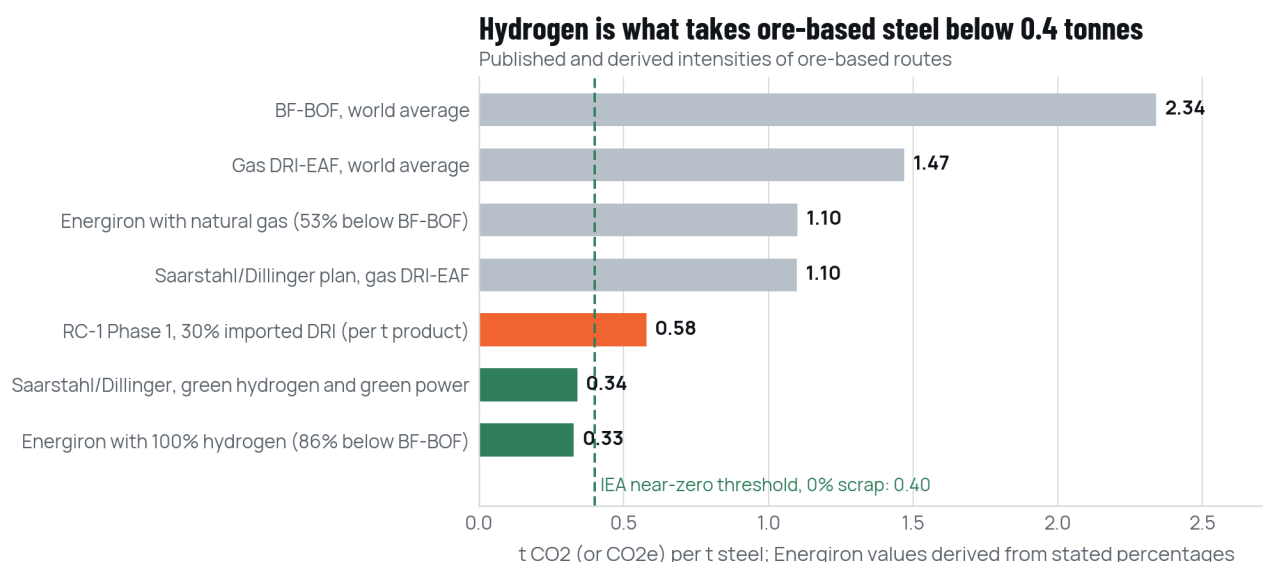
6.1 Why ironmaking is where the carbon is

In the blast-furnace route, almost all of steel's CO₂ comes from turning ore into iron; converting iron into steel and rolling it add comparatively little. In an electric works that buys DRI, the same carbon appears upstream, in the supplier's shaft furnace. Chapter 4 showed that the imported iron units are the largest block in RC-1's footprint. Lowering the carbon content of iron, wherever it is made, is therefore the central task of steel decarbonisation.

Two technologies dominate the pipeline. Gas-based direct reduction, using the MIDREX or Energiron processes, already produces about two-thirds of the world's DRI; the rest is made mostly in coal-fired rotary kilns in India [S13]. The same shaft furnaces can be designed to run on a rising share of hydrogen, up to 100%, because the reducing gas they use from natural gas is already a mixture of hydrogen and carbon monoxide [S15][S17]. Hydrogen reduces iron oxide to iron and water vapour instead of CO₂.

6.2 Gas first, then hydrogen

Figure 6.1 places published intensities for ore-based routes on one scale. The worldsteel average for gas-based DRI-EAF is 1.47 t CO₂ per tonne [S01]. Energiron reports that its process with natural gas emits about 53% less than the blast-furnace route and, with 100% hydrogen, about 86% less [S15]; applied to the worldsteel blast-furnace average, those percentages correspond to about 1.10 t and 0.33 t per tonne (derived). The Saarlouis and Dillinger project in Germany expects its gas-based DRI-EAF route to emit 1.098 t CO₂e per tonne and, with green hydrogen and green power, 0.339 t [S18].



DERIVED **Figure 6.1.** Published and derived carbon intensities of ore-based steelmaking routes. Only hydrogen-based routes approach the IEA's near-zero threshold for primary steel of 0.40 t CO₂e per tonne. The RC-1 Phase 1 figure (per tonne of product) is shown for comparison; it is lower than ore-based routes because about 70% of its charge is scrap.

Source: worldsteel [S01]; EC Innovation Centre for Industrial Transformation, Energiron and POWER4STEEL pages [S15][S18]; IEA near-zero threshold [S06]; WP06 model [S90]. Energiron values derived by applying the stated percentages to the worldsteel blast-furnace average.

The energy and material requirements are well documented:

- **Natural gas.** A modern shaft furnace uses about 9.2 to 10 GJ of natural gas per tonne of DRI; Egypt's Suez Steel reported a sustained 9.2 GJ per tonne in 2026 [S16][S15]. A 1 Mt/yr DRI module would therefore need about 9.2 to 10 PJ of gas a year, about 11% to 12% of Cameroon's 2025 gas production of 75.5 billion cubic feet (derived) [S83].
- **Hydrogen.** Full hydrogen reduction needs about 54 kg of hydrogen per tonne of DRI [S17]. At electrolyser efficiencies of about 45 to 52 MWh per tonne of hydrogen [S05], that is about 2.4 to 2.8 MWh of electricity per tonne of DRI for the hydrogen alone (derived).
- **Ore.** Both gas and hydrogen shaft furnaces need DR-grade pellets: high in iron and low in silica and alumina, because unlike a blast furnace the shaft furnace does not remove gangue as slag before melting; the gangue goes into the electric furnace and raises its energy use and slag volume.

The cost of the hydrogen route depends above all on electricity. The IEA estimates that hydrogen-based DRI needs power below about US\$35 per MWh to compete with gas-based DRI fitted with carbon capture [S05]. The Energy Transitions Commission's earlier analysis found that electricity below about US\$40 per MWh is needed for hydrogen-based DRI to beat carbon capture on a new blast furnace, and that full decarbonisation of steel costs about US\$60 per tonne of CO₂, or about US\$115 per tonne of steel, falling to about US\$25 per tonne of CO₂ and US\$50 per tonne of steel where very cheap renewable electricity is available [S09].

6.3 The ore-quality question

DR-grade iron ore is scarce. The Institute for Energy Economics and Financial Analysis (IEEFA) noted in 2022 that DR-grade ore ideally contains 67% iron or more, and that only about 3% of seaborne iron ore trade had an iron content above 66% [S75]. Agora Industry warned in 2023 that, unless urgent action is taken, demand for DR-grade ore will significantly outstrip supply by 2030 [S11]. IEEFA's 2026 assessment expects the high-grade market to grow, as new mines and beneficiation plants come on stream [S76], but the scarcity is a structural feature of the transition: the iron ore most of the world mines today was chosen for blast furnaces, which tolerate more gangue.

Cameroon is a significant prospective ore producer. Global Energy Monitor counts 64 Mtpa of iron-ore mine capacity in development in Cameroon, about 9% of the world total [S14]. The Mbalam deposit, whose exploitation permit is held by Cameroon Steel's sister company Cameroon Mining Company, was reported at the foundation-stone ceremony of the Kribi steel complex as holding more than 2 billion tonnes of ore, including 517 Mt of direct-shipping ore above 62.3% iron [S72]; the reserve statement published under the JORC Code in 2015 gives 62.2% iron for the same 517 Mt (White paper 03, Chapter 4). That is a respectable grade for blast-furnace and sinter feed. It is not DR grade. The much larger lower-grade banded iron formations (itabirites) that make up most of such resources would have to be ground, concentrated and pelletised to reach DR specification.

Table 6.1 Iron-ore quality and the direct-reduction route

Feed	Typical iron content	Route it suits	What it would take for direct reduction	Source
DR-grade pellets	67% Fe or more, low silica and alumina	Gas or hydrogen shaft furnace	Already DR grade; scarce in seaborne trade	[S75]
Seaborne high-grade (above 66% Fe)	above 66% Fe	Shaft furnace after pelletising, or premium blast-furnace feed	About 3% of seaborne trade in 2022	[S75]
Direct-shipping ore reported for Mbalam	above 62.3% Fe as reported; 62.2% in the 2015 JORC reserve statement	Blast furnace, sinter	Not DR grade as mined; would need beneficiation and pelletising	[S72]
Itabirite (banded iron formation)	low as mined; upgradeable	After concentration: pellet feed	Grinding, concentration (magnetic or flotation), pelletising; not yet demonstrated at commercial scale in Cameroon	[S72] [S75]

Source: as listed. Concentration processes are generic descriptions, not a project design.

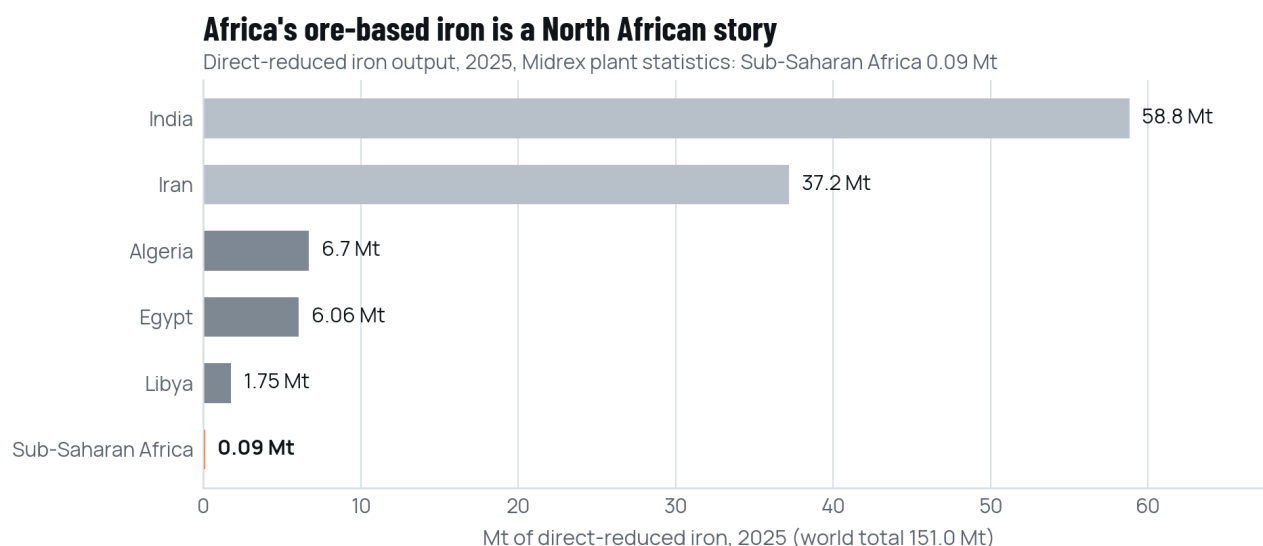
This is the single most important unknown in the green-iron option. If Cameroonian ore can be upgraded economically to DR-grade concentrate and pelletised, the country could one day supply its own steelworks and export iron units with a low carbon content. If it cannot, a Cameroonian direct-reduction module would depend on imported DR-grade pellets, competing for a scarce product. Chapter 10 recommends an early concentrate and pelletising study to settle the question before land, gas or power are committed to the reserve module.



ILLUSTRATIVE Illustrative view. Generated image of iron-ore pellets; not a photograph of any project, place or person, nor of Cameroonian ore.

6.4 Africa's direct-reduced iron is a North African story so far

Africa produced about 16 Mt of DRI in 2025, most of it in North Africa: Algeria 6.70 Mt, Egypt 6.06 Mt and Libya 1.75 Mt on Midrex plant statistics, all gas-based [S13][S03]. On the same statistics Sub-Saharan Africa produced 0.09 Mt, and its gas-based plants, including Nigeria's 1.02 Mt/yr Delta Steel and South Africa's 0.80 Mt/yr Saldanha unit, were idle at the end of 2025 [S13]. worldsteel, whose figures include estimates for plants outside that survey, puts output in Uganda, Kenya and Tanzania at about 2.7 Mt [S03]; the two series differ in coverage, and neither shows an operating gas-based plant south of the Sahara. Figure 6.2 shows the contrast.



SOURCED **Figure 6.2.** Direct-reduced iron output in 2025, selected producers. North Africa built gas-based direct reduction on domestic gas, and Algeria became a net steel exporter; on Midrex plant statistics, Sub-Saharan Africa made 0.09 Mt of DRI out of a world total of 151.0 Mt; worldsteel's estimates add about 2.7 Mt in East Africa that the survey does not cover.

Source: Midrex Technologies, 2025 World Direct Reduction Statistics [S13]; East African estimate from worldsteel, World Steel in Figures 2026 [S03].

The first African green-iron plant is in Namibia. The Hylron Oshivela project, inaugurated in April 2025 with European support, combines solar power, batteries and an electrolyser to make DRI with hydrogen in a pilot of about 15,000 t a year, with plans to scale up in stages [S77][S78]. It is small, but it shows that the technology can be deployed on the continent and that European partners are prepared to co-finance it.

6.5 What the studies say about Africa's green-iron opportunity

A body of recent analysis argues that ironmaking will partly relocate to places where ore and cheap clean energy coincide. Table 6.2 summarises the studies most relevant to Central Africa.

Table 6.2 Selected studies on green iron and the steel transition

Study	Main finding relevant to Central Africa	Source
RMI and Green Hydrogen Catapult, Green Iron Corridors (2024)	Restructuring half of primary steelmaking around green iron could save more than US\$25 billion a year across the ten largest importers, about US\$80 to US\$125 per tonne of steel; fast-tracking corridors could abate about 30 Mt of CO ₂ a year by 2030; lowest-cost exporters include South Africa and Mauritania	[S10]
Agora Industry, 15 Insights on the Global Steel Transformation (2023)	Net-zero steel is feasible by the early 2040s; green iron trade benefits exporters and importers; DR-grade ore demand will outstrip supply by 2030 unless urgent action is taken	[S11]
Agora Industry and Cambridge Econometrics, Green Iron, Shared Gains (October 2026)	Green iron trade raises GDP and employment in both exporting and importing countries; South Africa is modelled to gain about 161,000 jobs by 2050	[S12]

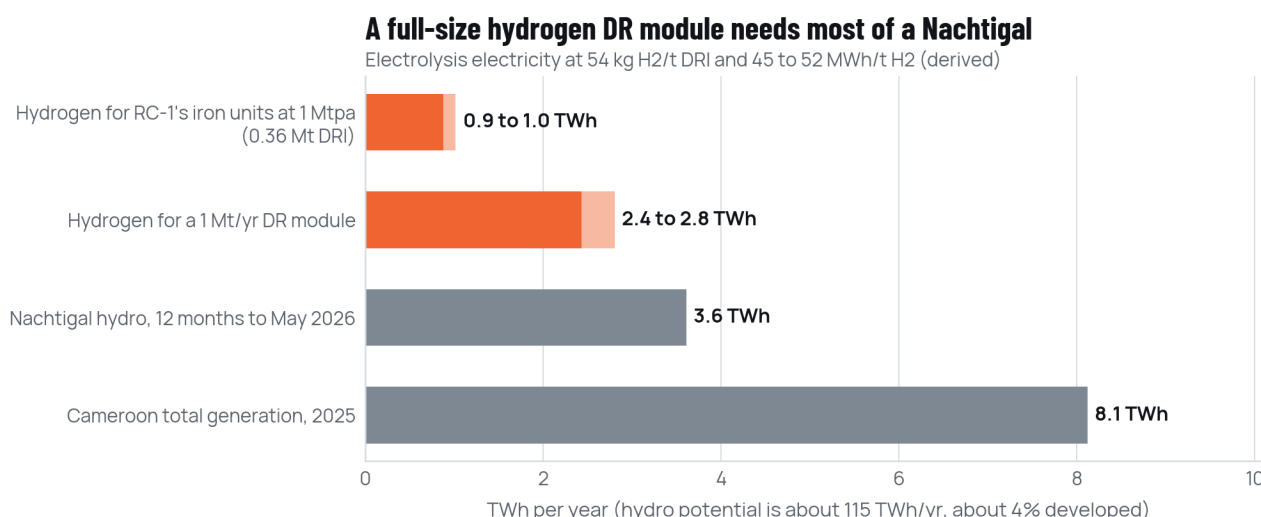
Study	Main finding relevant to Central Africa	Source
Energy Transitions Commission, Mission Possible: steel (2018 to 2019)	Full decarbonisation of steel costs about US\$60/t CO ₂ (about US\$115/t steel), falling to about US\$25/t CO ₂ with very cheap clean power; hydrogen DRI needs electricity below about US\$40/MWh to beat carbon capture	[S09]
Mission Possible Partnership, Making Net-Zero Steel Possible (2022)	A near-zero primary steel premium of about US\$175/t (about 40%) versus blast-furnace steel around 2030, adding about 2% to the price of a building	[S08]
IEA, Iron and Steel Technology Roadmap (2020) and Global Hydrogen Review (2025)	Hydrogen DRI needs power below about US\$35/MWh to compete with gas DRI plus carbon capture; more than 200 low-emission hydrogen projects have reached investment decisions since 2020	[S05] [S79]
IEEFA (2022, 2026)	DR-grade ore is a bottleneck: about 3% of seaborne trade above 66% Fe in 2022; the high-grade market is expected to grow	[S75] [S76]

Source: as listed.

Read together, the studies support three conclusions for Central Africa. The opportunity is real: importers will pay for iron with a low carbon content, and they will pay more as carbon prices and border measures bite. The winners will be locations that combine DR-grade ore, low-cost firm clean electricity and port access, not merely one of the three. And the timeline is long: most studies place large-scale green iron trade in the 2030s and 2040s.

6.6 How much power would hydrogen need in Cameroon?

Figure 6.3 sets the electricity needed for hydrogen-based reduction against Cameroon's power system. Supplying RC-1's own iron units at full build-out, about 0.36 Mt of DRI a year, with hydrogen would take about 0.9 to 1.0 TWh of electricity a year for electrolysis alone. A full-size 1 Mt/yr module would take about 2.4 to 2.8 TWh. For comparison, Nachtigal, Cameroon's largest hydro plant, injected 3.6 TWh in the twelve months to May 2026 [S52], and the whole country generated 8.12 TWh in 2025 [S50].



DERIVED Figure 6.3. Electricity for hydrogen-based direct reduction compared with Cameroon's supply. Ranges reflect electrolyser efficiencies of 45 to 52 MWh per tonne of hydrogen at 54 kg of hydrogen per tonne of DRI; the DR plant's own electricity is excluded.

Source: hydrogen requirement [S17]; electrolyser efficiency [S05]; Nachtigal output [S52]; national generation [S50]; hydro potential [S53]. Derived by Cameroon Steel (Annex A).

The resource exists: Cameroon's hydro potential is estimated at about 115 TWh a year, of which only about 4% is developed [S53]. The constraint is cost and firmness. At the purchase price of about 43.93 FCFA per kWh reported for the Memve'ele plant [S50][S103], about US\$73 per MWh at a planning rate of 600 FCFA to the dollar (derived), new hydro is well above the US\$35 to US\$40 per MWh that the IEA and the ETC identify as competitive

for hydrogen-based iron [S05][S09]. Older hydro sold under legacy contracts is cheaper, but its output is committed. Hydrogen-based iron in Cameroon would therefore need either very low-cost new hydro, a carbon price or premium that closes the gap, or both.

6.7 Gas: the bridge whose availability has just changed

A gas-based direct-reduction module, designed to accept hydrogen later, is the natural first step for ore-based iron in Central Africa, as it was in North Africa. Cameroon's gas is produced mainly from the Sanaga Sud field near Kribi. In 2025, about 95% of national gas output was sold as feed to the floating liquefaction vessel Hilli Episeyo [S83]; the vessel's charter ended and it left Cameroon in July 2026 [S84]. That frees gas in the near term, but the field is mature and its remaining reserves are not publicly certified, and the larger Yoyo-Yolanda resource has no final investment decision [S85]. A direct-reduction module would need a long-term supply contract backed by a reserve audit before it could be designed.

THE THREE GATES OF GREEN IRON IN CAMEROON

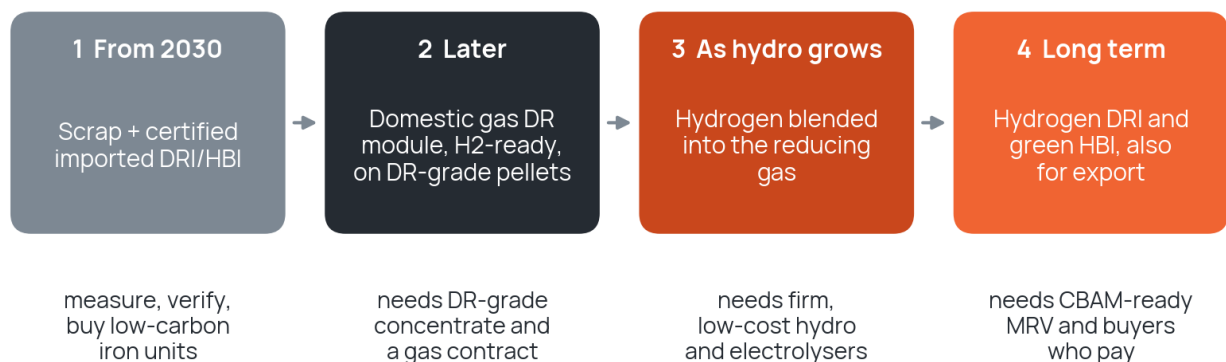
A Cameroonian direct-reduction module, and later a hydrogen-based one, would need to pass three gates: (1) DR-grade concentrate from Cameroonian ore, demonstrated at pilot scale and priced; (2) a long-term natural-gas contract backed by audited reserves, with a shaft furnace designed for hydrogen blending; and (3) firm low-carbon electricity at a cost compatible with hydrogen, from new hydro or a firming arrangement. None is in place today; all three can be studied now.

6.8 A stepwise, gated route

Figure 6.4 sets out how RC-1's iron units could evolve. Each step is optional and conditional; none is a commitment of this paper.

A stepwise route from imported iron units to green iron

Illustrative sequence for the RC-1 reserve direct-reduction module



ILLUSTRATIVE Figure 6.4. An illustrative stepwise route from imported iron units to green iron for the RC-1 reserve direct-reduction module. Each step depends on the gate shown beneath it.

Source: Cameroon Steel reference configuration RC-1 (planning estimate), reserve module [S90]; analysis in this chapter.

1. **From the first heat (targeted for the second half of 2030): imported scrap and certified DRI/HBI.** Phase 1 melts scrap and buys DRI or HBI on the international market, with a verified carbon intensity and a contractual ceiling for each cargo. This is where the largest near-term savings are (Chapter 4).

2. **Later, after the main phases: a domestic gas-based module.** If DR-grade concentrate and a gas contract are secured, a shaft furnace sized to RC-1's needs (about 0.36 Mt of DRI a year at 1 Mtpa) or larger would replace imports. The RC-1 master plan reserves land for a direct-reduction module and pellet yard. On gas, its emissions would move from upstream into Cameroon Steel's own Scope 1, at an intensity similar to the imported DRI it replaces; the gain is in value added and supply security, not yet in carbon.
3. **As hydro grows: hydrogen blending.** Shaft furnaces can accept a rising share of hydrogen in the reducing gas. Each step would require electrolyzers and firm power, and would lower the module's emissions in proportion.
4. **Long term: hydrogen DRI and green HBI.** At high hydrogen shares, the module could make iron at a few tenths of a tonne of CO₂ per tonne, for RC-1's own furnaces and for export as HBI into markets where CBAM and buyers reward low carbon. Under CBAM, DRI and HBI are covered goods, priced on their direct emissions from the outset (Chapter 5).

Table 6.3 Evidence needed before each step

Step	Decision	Evidence required	Indicative timing
1	Carbon specification for purchased DRI/HBI	Supplier carbon data, verified to CBAM or ISO 14404 rules; market survey of low-carbon suppliers	Before Phase 1 procurement
2	Domestic gas-based DR module	Concentrate and pelletising study on Cameroonian ore; gas reserve audit and supply contract; module sizing; permits	Studies from 2027; decision after 2034
3	Hydrogen blending	Firm low-carbon power at a competitive price; electrolyser supply; safety case	With new hydro capacity
4	Hydrogen DRI and HBI exports	Long-term offtake with a low-carbon premium; CBAM-ready monitoring; port bulk handling	Long term

Source: Cameroon Steel analysis. Timings are indicative.

The KPIZ development plan already lists steelmaking linked to mineral exports among the zone's clusters [S74], and Cameroon's 2023 Mining Code provides for the local transformation of part of mine output [S86]. A stepwise green-iron route would align with both, while keeping each investment conditional on the evidence that justifies it.

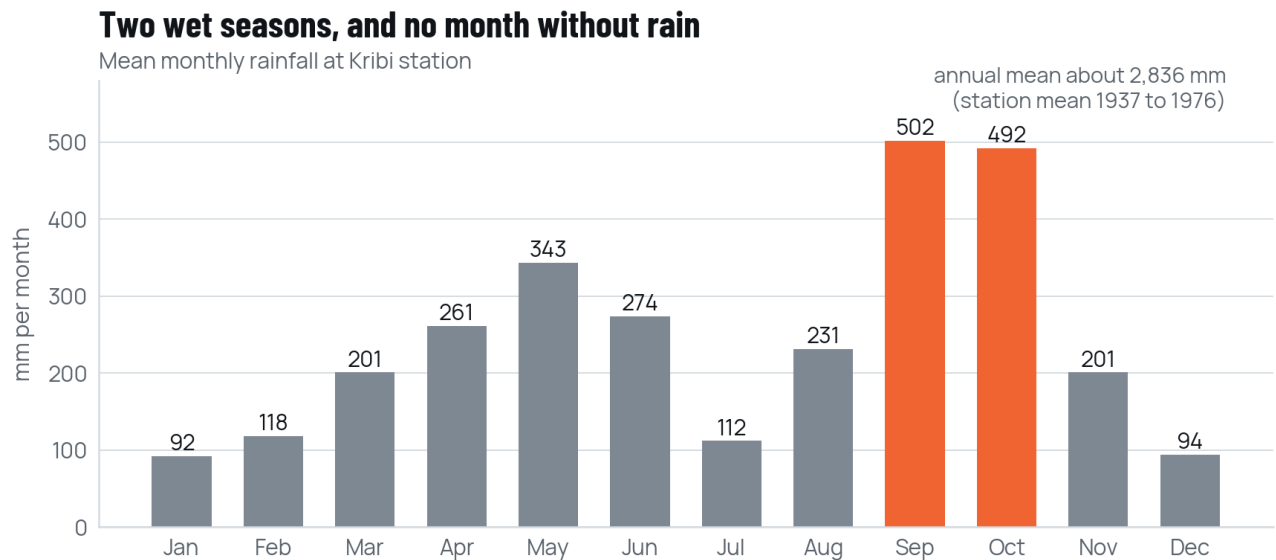
CHAPTER 7

CLIMATE RISK AND ADAPTATION: A PLATEAU SITE WITH A WET, WARMING CLIMATE AND AN ERODING PORT COAST

A steelworks built around 2030 will operate into the 2070s, in a climate that will be warmer and, at Kribi, wetter in its extremes than the records on which engineers usually design. The Mboro site sits on a plateau about 40 to 100 m above sea level and about 3 to 4 km inland, so it is not exposed to coastal flooding. Its material risks are elsewhere: extreme rainfall on large paved and roofed areas, heat and humidity for workers in front of an arc furnace, lightning, the reliability of hydro-based power in dry years, and a port interface on a coastline that has been retreating since the deep-water port was built. All of these can be managed by design if they are designed for now.

7.1 The site and its climate

The Kribi coast has an equatorial climate with two wet seasons and no truly dry month: even the driest months receive about 90 mm of rain [S60]. The homogenised record of Kribi station gives a mean annual rainfall of about 2,836 mm for 1937 to 1976, with the main wet season in September and October at about 500 mm a month and a relatively drier spell in July [S60]. Other sources give similar means, between about 2,800 and 2,900 mm [S60] [S64]. On the ERA5 reanalysis for the Kribi grid cell, mean daily maximum temperatures range from about 26 °C in August to about 30 °C in March, and minimum temperatures from about 23 to 25 °C (1991 to 2020) [S64]; reanalysis tends to understate coastal maxima, which site measurements will confirm (Chapter 11); relative humidity ranges from about 70% to 78% in the afternoon to 92% to 96% at night [S60]. Squall lines bring short, violent gusts of up to about 20 m/s [S60][S62]. The US Geological Survey catalogue records no earthquake of magnitude 4.6 or more within about 170 km of Kribi since 1900 [S97]; a site-specific seismic hazard assessment is part of the geotechnical studies.



SOURCED **Figure 7.1.** Mean monthly rainfall at Kribi station. September and October each bring about 500 mm; even the driest months receive about 90 mm.

Source: Olivry, Monographie du Nyong et des fleuves côtiers, ORSTOM (1979), homogenised Kribi station record, 1937 to 1976 [S60].

The RC-1 site lies on the coastal plateau; satellite surface models give roughly 50 to 120 m across the wider area, and allowing for the forest canopy they include puts the ground at about 40 to 100 m above sea level (rounded; to be confirmed by survey) [S106]. The site is about 3 to 4 km from the coastline at the port frontage, measured from the centre of the indicative area (White paper 07, Table D.1). No river or marine flooding can reach the plant platforms at that elevation. The flood question on site is therefore one of stormwater: how much rain falls on the roofs, roads and stockyards of a large works, and where it goes.

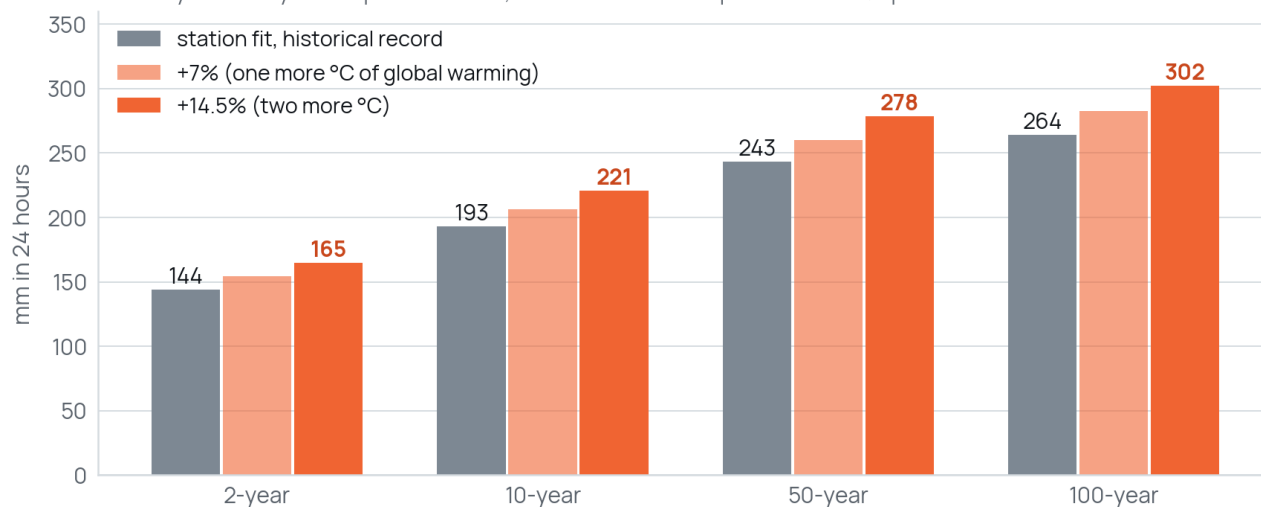
7.2 Extreme rainfall is the main physical design load

The station record gives one-day rainfall totals of about 144 mm with a two-year return period, 193 mm at ten years, 243 mm at fifty years and 264 mm at one hundred years, from a Pearson type III fit to 33 years of data; the largest observed one-day total was 205.3 mm [S60]. Reanalysis datasets such as ERA5 smooth these extremes heavily (their mean annual maximum is about 76 mm [S64]) and should not be used for drainage design.

A warming climate intensifies heavy rainfall. The IPCC's Sixth Assessment Report concludes that extreme daily precipitation events intensify by about 7% for each additional 1 °C of global warming [S59]. Applying that rate to the station values gives an illustrative allowance: about 283 mm for the 100-year day with one more degree of warming and about 302 mm with two (Figure 7.2). The station fit itself rests on mid-twentieth-century data, so part of that uplift may already have occurred.

Drainage should be sized for a wetter climate than the record shows

One-day rainfall by return period at Kribi, with an illustrative uplift of about 7% per °C



ILLUSTRATIVE Figure 7.2. One-day rainfall at Kribi by return period, from the station record, with an illustrative uplift of about 7% per additional degree of global warming. The uplift is a design allowance, not a regional projection.

Source: Kribi station Pearson III fit [S60]; IPCC AR6 WGI, scaling of extreme daily precipitation with warming [S59]. Uplift applied by Cameroon Steel.

For a steelworks, the consequences of under-designed drainage are not only nuisance flooding. Water entering a melt shop can cause steam explosions on contact with liquid steel or slag; flooded cable trenches and substations stop production; wet scrap raises furnace energy use and, if it carries trapped water into the furnace, is a safety hazard; and runoff from stockyards and slag areas must be collected and treated before discharge. Short-duration intensity-duration-frequency curves for Kribi, which govern the sizing of roof drainage and channels, are not available in the public record and are an evidence gap (Chapter 11).

7.3 Heat and humidity: a worker-safety issue first

Steelworks expose workers to radiant heat from liquid steel, slag and hot product, in addition to the ambient climate. In Kribi's hot, humid conditions the body's ability to cool by sweating is limited, so the combination is more demanding than either alone. The International Labour Organization estimated in 2019 that heat stress would cost 2.2% of total working hours worldwide by 2030, about 5% in western Africa, with central Africa among the most affected regions [S65]. Heat-stress management for RC-1 should be based on the wet-bulb globe temperature index defined in ISO 7243 [S66], with work-rest regimes, cooled refuges and pulpits, hydration, acclimatisation and monitoring, and with equipment specified for ambient conditions that include margins for warming.

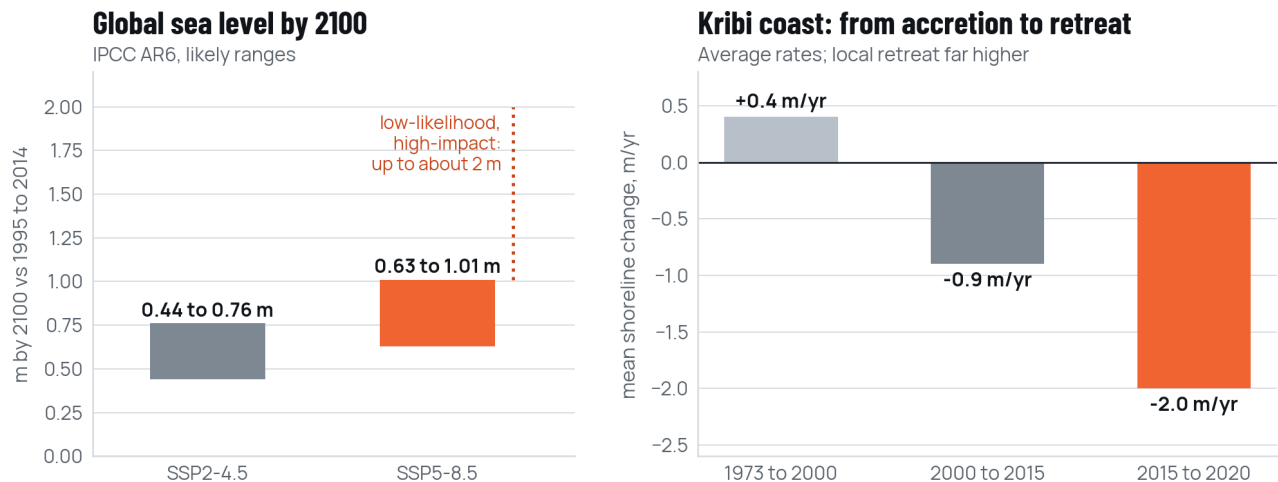
Heat also affects equipment. Transformer, motor and drive ratings, the capacity of cooling towers (which depends on the wet-bulb temperature), and the performance of air-conditioned control rooms and electrical rooms should all be specified for hotter and more humid conditions than today's averages.

7.4 Sea-level rise and shoreline retreat at the port interface

Globally, the IPCC projects sea-level rise by 2100, relative to 1995 to 2014, of about 0.44 to 0.76 m under an intermediate emissions scenario (SSP2-4.5) and 0.63 to 1.01 m under a very high one (SSP5-8.5), with a low-likelihood, high-impact outcome of up to about 2 m that cannot be ruled out [S59]. Kribi-specific projections were not obtained for this paper.

On the Kribi coast, sea-level rise adds to a more immediate process. Shoreline studies show that the coast was accreting by about 0.4 m a year on average between 1973 and 2000, retreated by about 0.9 m a year between 2000 and 2015 and by about 2 m a year between 2015 and 2020, with local rates far higher: about 32 m a year at

the Lobé falls in 2015 to 2020 and 45 to 70 m a year near Lolabé in 2013 to 2017, while more than 15 m a year accumulated updrift of the port breakwater [S62]. A 2025 assessment rated 68.3% of the 31.5 km Kribi coast as highly vulnerable and linked part of the change to sediment trapping by the breakwater [S63].



SOURCED **Figure 7.3.** Global sea-level rise by 2100 under two scenarios (left) and mean shoreline change on the Kribi coast (right). The plant platform is not exposed; the port interface, through which imported iron units and exports would pass, is. Source: IPCC AR6 WGI Summary for Policymakers [S59]; Fendoung, Tchindjang and Hubert-Ferrari (2022) [S62].

RC-1 depends on the port in both directions. In Phase 1 the works would bring in about 351,000 t a year of imported metallics and consumables and ship up to 300,000 t of products, rising to about 1.24 Mt and 1 Mt at full build-out [S90]. Port infrastructure is the port authority's responsibility. A mineral terminal at Kribi was the subject of a memorandum of understanding signed on 4 November 2025, and the port's Director General said in March 2026 that it should be completed within five to six years [S87][S61][S74]; until then, iron units would pass through the existing terminals (White paper 02). Cameroon Steel's own exposure lies in any jetty, conveyor or pipeline landfall it might build, in access roads near the coast and in the storage of imported iron units.

DRI deserves particular care. Freshly made DRI reacts with water and air, releasing heat and hydrogen; it is regulated as a hazardous bulk cargo under the International Maritime Solid Bulk Cargoes Code, which sets strict conditions for its carriage [S99]. HBI, compacted while hot, is more stable but must still be kept dry. In a climate with about 2,836 mm of rain a year, covered storage for DRI and HBI, both at the port and on site, is a safety requirement as well as a quality one. The RC-1 layout reserves a covered DRI/HBI store in the metallics yard [S90].

7.5 Climate risk to the power supply is also a carbon risk

Physical climate risk reaches the works through its power supply. Cameroon's southern grid is about 90% hydro, and hydro output varies with rainfall: Nachtigal delivered about 28% less than planned in 2025 because of hydrology [S50]. Drier years, or longer dry seasons, would push more thermal generation onto the margin, raising both the cost and the carbon content of electricity at the time the works needs it (Chapter 3). Conversely, wetter extremes raise flood and sediment risks at hydro plants and along transmission corridors. For an electric-arc works, the climate resilience of the power system is therefore part of its own adaptation case, and a reason to contract for firmness rather than for energy alone.

7.6 Transition risks: the other half of a climate risk assessment

A climate change risk assessment under the Equator Principles covers transition risks as well as physical ones: the policy, legal, technology, market and reputational changes that a shift to a low-carbon economy brings [S22]. For an electric-arc works on a hydro-dominated grid, most of these are smaller than for a conventional steel plant, and several are opportunities. They are not negligible, however, and they belong in the same register as the physical hazards.

The policy channel runs mainly through export markets. Carbon border measures in the EU and the United Kingdom already price embedded emissions (Chapter 5), and buyers' procurement rules increasingly do the same through product declarations. At home, Cameroon's updated nationally determined contribution and its Plan National Climat set the direction of national policy [S80][S81]; a future domestic reporting obligation or carbon price cannot be excluded over a forty-year asset life. The technology channel concerns iron units: if ironmaking moves towards hydrogen and DR-grade ore stays scarce, the price and availability of the DRI and HBI that RC-1 buys could change materially [S11]. The market channel cuts both ways: low-carbon steel may earn a premium in some markets, but competing imports will also advertise low-carbon credentials, and unverifiable claims will not survive scrutiny.

Table 7.1 Transition risk screening for the RC-1 works

Driver	Channel	Effect on RC-1	Horizon	Response
Carbon border measures (EU, UK, possibly others)	Cost of exports; buyer requirements	Opportunity if verified; risk if default values apply	Now to 2034	CBAM-grade monitoring from the first heat (Chapter 5)
Domestic climate policy	Reporting duties; possible carbon price	Moderate risk; low intensity limits exposure	Medium term	Voluntary verified reporting ahead of any obligation
Lender and investor standards	Access to and cost of finance	Requirements apply from Phase 1	Now	EP4-grade assessment and annual reporting (Chapter 9)
Shift of ironmaking to hydrogen; DR-grade ore scarcity	Price and carbon content of purchased DRI/HBI	Risk to cost; opportunity for a Cameroonian green-iron option	2030s	Diversified iron-unit sourcing; ore and gas studies (Chapter 6)
Buyer demand for low-carbon products	Price premium; market access	Opportunity, conditional on EPDs and certification	Now to 2040	EPDs and site certification (Chapters 2 and 9)
Credibility of claims	Reputation	Risk if claims outrun evidence	Continuous	State perimeters; verify; publish (Chapter 2)

Source: Cameroon Steel screening; requirement from Equator Principles EP4 [S22].

7.7 A hazard screening for the Mboro works

Table 7.2 summarises the hazards, their relevance to the plant platform and the port interface, and the design responses that follow. It is a screening, not the full climate change risk assessment required by the Equator Principles for a project of this size [S22], which will be completed within the environmental and social impact assessment with site-specific data.

Table 7.2 Physical climate hazard screening (desk level)

Hazard	Plant platform	Port interface and access	Trend with warming	Design response
Extreme rainfall and flash flooding	High: large impermeable areas, melt-shop water hazard	High	Increasing (about 7% per °C for daily extremes)	Size drainage and retention to the 100-year day plus an uplift; keep water away from liquid metal areas; covered scrap and DRI/HBI storage

Hazard	Plant platform	Port interface and access	Trend with warming	Design response
Heat and humidity	High for workers; moderate for equipment	Moderate	Increasing	WBGT-based heat-stress plan; cooled refuges and pulpits; equipment rated with margins
Sea-level rise and coastal erosion	None at about 40 to 100 m elevation	High near the shoreline	Increasing	No critical assets near the shore; coastal setbacks for any jetty or conveyor landfall
Squall-line winds	Moderate (cladding, cranes, stacks)	Moderate (ship-to-shore operations)	Uncertain	Wind loads with margins; crane wind interlocks
Lightning	High but unquantified	High	Uncertain	Lightning protection and earthing designed to the IEC 62305 series
Drought in the hydro catchments	Indirect: power reliability and carbon	Not applicable	Uncertain	Firm power contract; melting scheduled around system peaks; on-site power quality
Earthquakes	Not rated at desk level: no event of magnitude 4.6 or more within about 170 km since 1900 (USGS catalogue) [S97]	Not rated	Not applicable	Site-specific seismic hazard assessment in the geotechnical studies; design to its result and the applicable code

Source: Kribi station data [S60]; IPCC AR6 [S59]; shoreline studies [S62][S63]; USGS catalogue [S97]; ILO [S65]; ISO 7243 [S66]; IEC 62305 [S98]. Screening by Cameroon Steel.

7.8 Adaptation is cheapest at the design stage

Most adaptation measures for a new works cost little if they are built into the design and a great deal if they are retrofitted. The main principles for RC-1 are:

- **Design to the future climate, not the record.** Use the station extremes with an explicit warming allowance for drainage, retention and roof design, and specify cooling systems and electrical equipment for hotter and more humid conditions.
- **Keep water away from liquid metal.** Melt-shop floors, pits and slag areas need positive drainage, raised thresholds and dry storage of charge materials.
- **Separate clean and contaminated runoff.** Roof water can be harvested for cooling-water make-up; runoff from scrap, slag and stockyards must be collected and treated.
- **Protect people first.** Heat-stress management, lightning protection and emergency plans for extreme weather should be in place before the first heat.
- **Contract for firm power.** The climate resilience of the grid is part of the plant's own.
- **Monitor and revise.** A weather station on site from the start of construction, and a review of design assumptions at each phase, will keep the adaptation case current.

WHAT IS NOT YET KNOWN

Short-duration rainfall intensities for Kribi; site-specific heat-stress statistics; lightning flash density; Kribi-specific sea-level projections; and the hydrology-driven variability of the southern grid's emission factor. Chapter 11 explains how each will be resolved.

Physical risk and decarbonisation meet at one more point: the materials the works consumes and produces. The next chapter turns to circularity.



THE PLANT PLATFORM IS SAFE FROM THE SEA. THE DRAINAGE, THE WORKERS AND THE PORT INTERFACE ARE WHERE A CHANGING CLIMATE WILL BE FELT.

Illustrative view. Generated image of a mangrove estuary on an Atlantic coast; not a photograph of any project, place or person.

CHAPTER 8

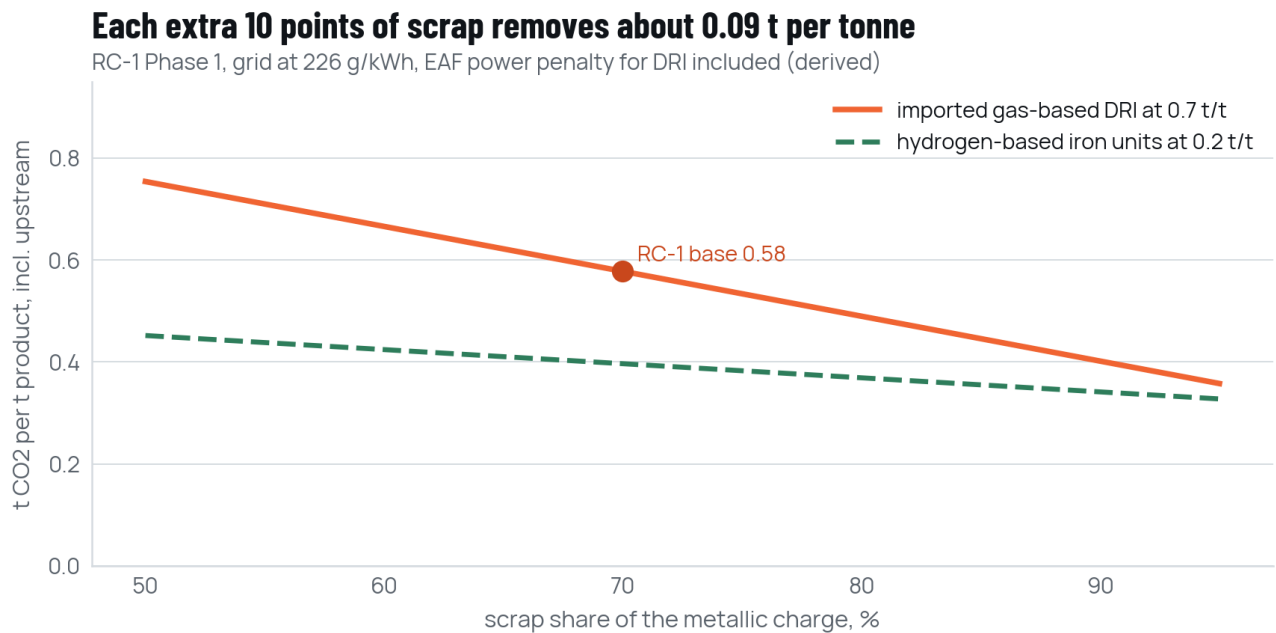
CIRCULARITY: SCRAP IS THE CLEANEST INPUT, AND SLAG AND DUST ARE RESOURCES

Circularity is not a side topic for a steelworks; it is one of its main carbon levers. Each tonne of scrap melted in place of ore-based iron avoids about 1.5 t of CO₂, and for RC-1 each extra 10 points of scrap in the charge removes about 0.09 t of CO₂ per tonne of product. Cameroon, however, generates little scrap: the only published estimate is 53,000 to 62,000 t a year, most of it already used by existing mills, against an RC-1 need of about 254,000 t in Phase 1. RC-1 therefore plans on about 30,000 t a year of domestic scrap and imports the rest. On the output side, the works would produce about 45,000 t of slag and about 4,800 t of zinc-bearing furnace dust a year in Phase 1. Both can be valorised, the first as aggregate for roads, the second as a source of recovered zinc, if the outlets are prepared before the first heat.

8.1 Scrap is the most powerful lever the industry already has

worldsteel estimates that each tonne of scrap used to make steel avoids about 1.5 t of CO₂ [S02]. Around 630 Mt of scrap is used in global steelmaking each year, avoiding nearly 950 Mt of CO₂, according to the Bureau of International Recycling; consumption reported by its tracked countries rose by 4.5% to 480 Mt in 2025 [S68]. Under the accounting conventions described in Chapter 2, scrap enters a steelworks with no upstream emissions, and ferrous scrap (CN 7204) is outside the scope of the EU CBAM [S27].

For RC-1, the scrap share is the second-largest lever after the carbon content of purchased DRI. Figure 8.1 shows that, at the Phase 1 configuration and a grid factor of 226 g/kWh, raising the scrap share of the charge by 10 points (and lowering the DRI share accordingly) reduces the total intensity by about 0.09 t per tonne. A works melting 90% scrap would emit about 0.40 t per tonne including upstream iron units; one melting 50% would emit about 0.75 t.



DERIVED Figure 8.1. RC-1 Phase 1 intensity including upstream iron units as a function of the scrap share of the metallic charge, with imported gas-based DRI at 0.7 t CO₂ per tonne (solid) or hydrogen-based iron units at 0.2 t (dashed). The furnace's extra electricity for DRI is included.

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; DRI power penalty [S15].

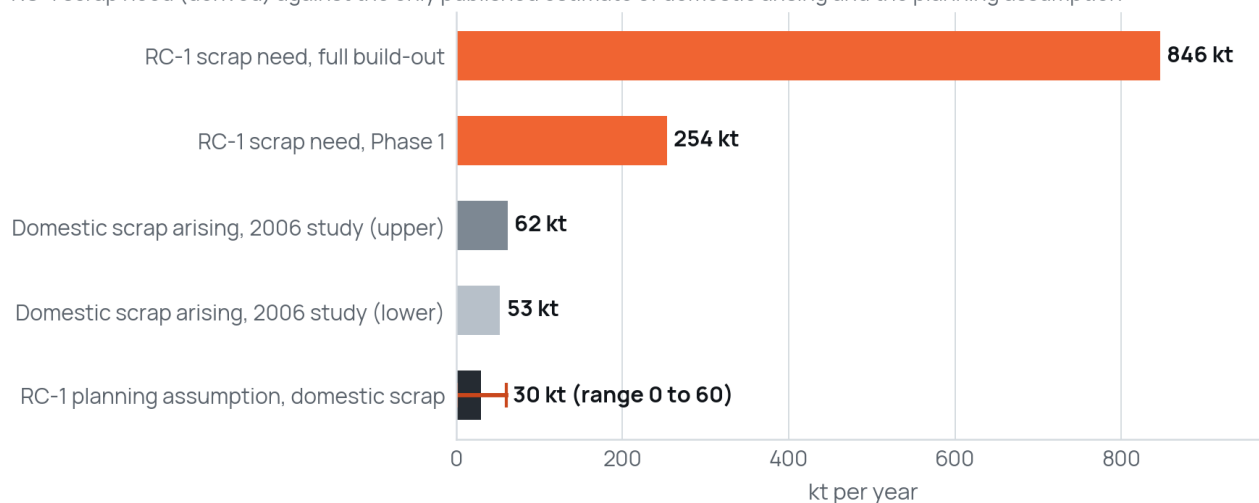
8.2 Cameroon is short of scrap

Scrap availability depends on how much steel a country put into use decades ago. Cameroon's stock of steel in use is small by international standards, and its scrap arisings are correspondingly limited. The only quantified study, by researchers at the national polytechnic school and the local materials research centre, estimated arisings of 53,000 to 61,833 t a year using 2006 data, of which about 53% was collected by recyclers, 29% by informal dismantlers and 15% by exporters [S88]. More recent industry statements indicate that local scrap covers only about 40% of the needs of Cameroon's existing mills, the balance coming from imported billets [S89]. Africa as a whole is a net importer of ferrous scrap, with exports of about 1.2 Mt and imports of about 3.4 Mt in 2025 [S03].

Figure 8.2 sets RC-1's scrap need against that evidence. Even allowing for growth in arisings since 2006, domestic scrap could supply only part of Phase 1 and a small share of the full build-out, and most of what is collected already feeds existing mills. The RC-1 planning case therefore assumes about 30,000 t a year of domestic scrap, with a range of 0 to 60,000 t [S90]. The balance would have to be imported scrap or a higher share of DRI or HBI, which, as Chapter 4 showed, raises the footprint.

Scrap is the cleanest input, and Cameroon does not have enough of it

RC-1 scrap need (derived) against the only published estimate of domestic arising and the planning assumption



DERIVED **Figure 8.2.** RC-1's annual scrap need against the only published estimate of domestic scrap arising in Cameroon and the RC-1 planning assumption for domestic supply. The 2006 estimate is dated; current arisings are likely higher but are not documented, and most are already used by existing mills.

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; Bidoung et al. (2007), 2006 data [S88].

Table 8.1 Scrap in Cameroon and in the RC-1 balance

Indicator	Value	Year	Status	Source
Domestic scrap arising (only published estimate)	53,000 to 61,833 t/yr	2006 data	sourced	[S88]
Share of domestic scrap collected by formal recyclers	about 53%	2006 data	sourced	[S88]
Local scrap coverage of existing mills' needs	about 40%	2026	sourced	[S89]
Africa ferrous scrap exports / imports	about 1.2 Mt / 3.4 Mt	2025	sourced	[S03]
RC-1 scrap need, Phase 1	about 254,000 t/yr	at nameplate	derived	[S90]
RC-1 planning assumption for domestic scrap	about 30,000 t/yr (range 0 to 60,000)	Phase 1	assumed	[S90]
Imported scrap and DRI/HBI, Phase 1	about 224,000 t and 109,000 t/yr; port receipts with consumables about 351,000 t/yr	at nameplate	derived	[S90]
RC-1 scrap need, full build-out	about 846,000 t/yr	at nameplate	derived	[S90]
Effect of 10 more points of scrap in the charge	about -0.09 t CO ₂ per t product	Phase 1	derived	[S90]

Source: as listed.

Three implications follow. First, RC-1 will be a scrap importer as well as a buyer of domestic scrap, and its carbon performance depends on its ability to secure scrap of suitable quality on the international market. Second, a well-organised domestic collection system is worth developing for both carbon and economic reasons: it creates local jobs, keeps value in the country and lowers the works' footprint. That system must meet international labour and safety standards, including checks against child labour in informal collection, which lenders will

require under IFC Performance Standard 2 [S21]. Third, domestic scrap supply will grow over time as Cameroon builds: the reinforcing bar and sections that RC-1 and other mills supply to the country's buildings and infrastructure today will be part of its scrap stock in the second half of the century.

A domestic scrap programme for RC-1 would draw on several streams: demolition and construction waste, end-of-life vehicles and machinery, industrial offcuts and turnings, and end-of-life public assets sold through tender. It would work through licensed collectors and dealers rather than through informal purchases at the gate, with weighbridges, traceable payments, safety training and personal protective equipment for collection partners. It would also need safeguards against the purchase of stolen material, such as power cables, rail fittings or road furniture, which is a recurrent problem wherever scrap prices rise. A programme of this kind takes years to build, and its benefits accumulate: each additional tonne of domestic scrap replaces an imported tonne of scrap or DRI, reducing both freight and the works' footprint.

Scrap quality matters as well as quantity. Copper and tin from wiring and coatings cannot be removed in an electric furnace and accumulate in the steel; wire rod for drawing is particularly sensitive to them. A scrap-sorting and quality-control system at the yard, with radiation detection at the gate, is a standard requirement for an electric-arc works.

8.3 Importing scrap: the other half of the charge

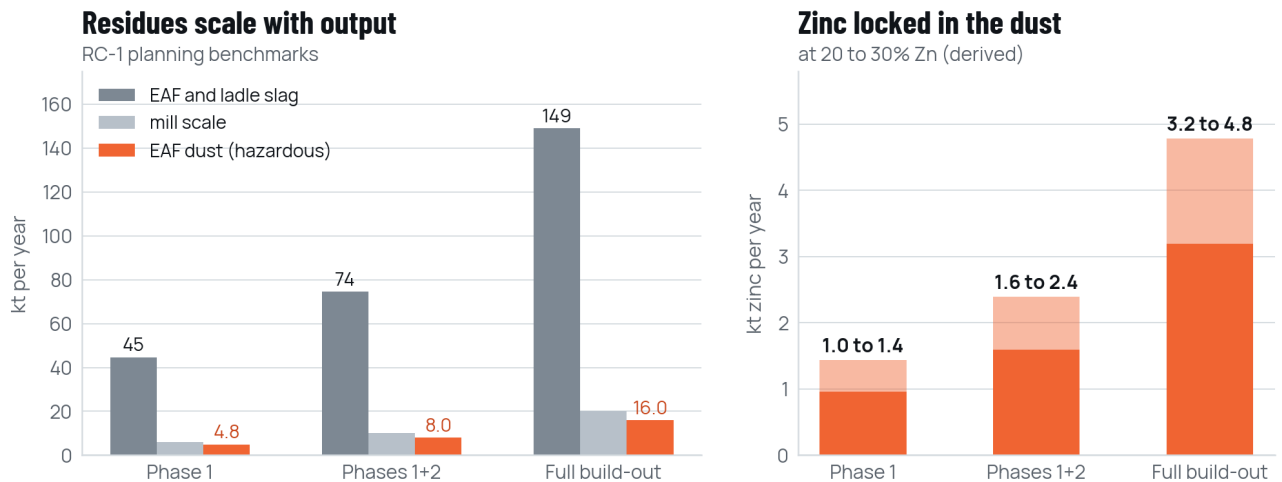
On the planning case, Phase 1 would import about 224,000 t of scrap a year, in addition to about 109,000 t of DRI or HBI (derived). With consumables, port receipts would come to about 351,000 t a year [S90]. Africa as a whole is already a net importer of ferrous scrap [S03], and the world market is large: the countries tracked by the Bureau of International Recycling used about 480 Mt in 2025 [S68]. Buying a few hundred thousand tonnes a year is therefore feasible, but it has three consequences for carbon. First, ocean freight and handling of imported scrap add Scope 3 emissions that this paper does not count (Chapter 4); they are small per tonne but should be reported. Second, imported scrap competes with buyers whose own decarbonisation plans depend on scrap, so the price and availability of low-residual grades may tighten as electric steelmaking grows (Chapter 1). Third, ferrous scrap is not a CBAM good and enters the CBAM calculation with no embedded emissions [S27], so every tonne of scrap that replaces a tonne of DRI lowers the CBAM charge on an EU-bound tonne as well as the total footprint, by about €7 per tonne of product for every 10 points of charge (Chapter 5).

The planning case is deliberately cautious. If domestic collection reached the upper end of the 2006 estimate, about 60,000 t a year, the works would still import about three-quarters of its Phase 1 scrap; if it found none, port receipts would rise by about 30,000 t. Either way, the carbon result depends on the share of scrap in the charge, not on where the scrap comes from. That is why the pathway in Chapter 10 treats more scrap in the charge, domestic or imported, as a single lever, and why a domestic collection programme is worth building for economic and social reasons as much as for carbon.

8.4 Slag: from residue to road aggregate

An electric-arc furnace leaves about 110 to 180 kg of solid residue, mostly slag, per tonne of product, according to the IFC's guidelines for steel mills [S20]; RC-1 uses 140 kg of slag per tonne of liquid steel. That gives about 45,000 t a year in Phase 1 and about 149,000 t at full build-out (Figure 8.3). EAF slag is a hard, dense, angular material that, after crushing, metal recovery and weathering to stabilise free lime, is widely used as road base, asphalt aggregate and fill. The IFC guidelines note that slag from iron and steel making is sold as a by-product for civil engineering, road construction and cement [S20].

European practice shows what is possible. In 2024, of about 16.5 Mt of steelmaking slag produced in the EU, about 13.5 Mt (82%) was used, including about 9 Mt in road construction; including blast-furnace slag, 92% of ferrous slag was used, avoiding the extraction of about 40 Mt of natural stone [S67].



DERIVED Figure 8.3. Annual residues by phase (left) and the zinc contained in the furnace dust (right), at nameplate output. Zinc is shown for an assumed content of 20% to 30%, which depends on the share of galvanised scrap in the charge.

Source: Cameroon Steel reference configuration RC-1 (planning estimate): slag 140 kg/t, dust 15 kg/t, mill scale 20 kg/t [S90]; IFC benchmark for solid residue [S20]; zinc content range [S69]. Derived by Cameroon Steel.

The Kribi area offers a local market. Motorway, port and industrial-zone construction all need aggregate, and every tonne of slag used replaces a tonne of quarried stone. The condition is quality assurance: each slag product must be tested for volume stability and for the leaching of metals such as chromium and vanadium under recognised test methods, and approved by the road authority for its intended use. Cameroon Steel would seek a slag-product approval with the public works authorities before the first heat, so that slag leaves the site as a product rather than accumulating as a waste.



ILLUSTRATIVE Illustrative view. Generated image of a road base of processed slag aggregate under construction; not a photograph of any project, place or person.

8.5 Furnace dust: a hazardous waste that contains zinc

The dust captured by an electric-arc furnace's fume-extraction system carries zinc, lead and cadmium from the scrap [S20] and has to be managed as a hazardous waste. The planning range is 10 to 20 kg per tonne of liquid steel (the European reference document reports 10 to 30 kg) [S19]; RC-1 uses 15 kg/t, giving about 4,800 t a year in Phase 1 and about 16,000 t at full build-out. Its zinc comes mainly from galvanised scrap, and zinc

contents above about 15% make recovery economically viable; typical dusts are at or above that level [S69]. At 20% to 30% zinc, RC-1's dust would contain about 1,000 to 1,400 t of zinc a year in Phase 1 and about 3,200 to 4,800 t at full build-out (derived).

The established recovery route is the Waelz kiln, which volatilises zinc from the dust and recovers it as a zinc oxide concentrate for zinc smelting. About 98% of the EAF dust produced by European steelmakers is recycled [S69], and the largest operator alone processed more than 1.2 Mt of dust in 2024 [S70]. There is no Waelz plant in Central Africa. In Phase 1, RC-1's dust would therefore be stored in a secure, covered facility and shipped to a licensed recovery plant abroad, following the prior-informed-consent procedures of the Basel Convention for transboundary movements of hazardous wastes [S71]. As volumes grow, or if other electric-arc works in the region generate dust, a regional recovery facility could become viable. Landfilling untreated dust is not an option a modern works should plan for.

Table 8.2 Main residues and co-products of the RC-1 works

Stream	Benchmark	Phase 1, t/yr	Full build-out, t/yr	Classification	Preferred route	Evidence needed
EAF and ladle slag	140 kg/t liquid (range 110 to 180)	about 45,000	about 149,000	Non-hazardous after testing	Crushing, metal recovery, weathering; road base and asphalt aggregate	Leaching and volume-stability tests; road-authority approval; local market
EAF dust	15 kg/t liquid (range 10 to 20)	about 4,800	about 16,000	Hazardous	Zinc recovery (Waelz) abroad under the Basel Convention; regional option later	Dust analysis; recycler contract; export permits
Mill scale	20 kg/t product (range 15 to 25)	about 6,000	about 20,000	Non-hazardous, oily fraction treated	Iron-bearing feed for sinter, pellet or cement makers	Oil content; buyer
Refractories, oily wastes, sludges	not benchmarked here	to be measured	to be measured	Mixed	Reuse of refractories where possible; licensed treatment	Waste inventory at design stage

Source: Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; IFC EHS Guidelines for Integrated Steel Mills [S20]; EAF dust recovery practice [S69][S70]; Basel Convention [S71].

8.6 Water and energy loops

Circularity also applies to water and heat. RC-1 plans closed-loop cooling with a make-up of about 2.0 m³ per tonne of product (range 1.5 to 3.0) [S90], against worldsteel's 2024 sector averages of 2.3 m³ consumed and 8.5 m³ withdrawn per tonne [S01]. With about 2,836 mm of rain a year, roof-water harvesting for cooling make-up is an obvious measure. Hot charging of billets from the caster to the mill reduces reheating energy; heat recovery from furnace off-gas and from reheating-furnace flue gas becomes worthwhile at the larger scale of Phases 2 and 3.

8.7 Circular by design

The principles that follow for RC-1 are straightforward:

- **Maximise scrap within quality limits**, through domestic collection partnerships and a disciplined import strategy, and report the scrap share every year alongside the carbon intensity.

- **Sell slag as a product**, with tests, approvals and a local market prepared before commissioning.
- **Recover the zinc in the dust**, through a contract with a licensed recycler from the first year and a regional solution as volumes grow.
- **Close the water loop** and harvest rainfall.
- **Design products for long life and recovery**. Steel reinforcing bar and sections are fully recyclable; world-steel's life cycle data assume a 95% end-of-life recycling rate for the credits reported in module D of an EPD [S44].

CIRCULARITY PAYS TWICE

Scrap, slag and dust are where carbon performance and cost meet. Every tonne of scrap collected locally lowers both the works' footprint and its import bill; every tonne of slag sold replaces a tonne of quarried stone; every tonne of zinc recovered avoids a hazardous-waste liability. These outlets take time to build, which is why they belong in the project plan before the first heat.

The next chapter turns from materials to money: what lenders, buyers and certifiers will ask a low-carbon steelworks to prove.

CHAPTER 9

FINANCE AND STANDARDS: LENDERS, BUYERS AND CERTIFIERS WILL ASK FOR PROOF

International lenders and steel buyers have converged on a common set of expectations for a new steelworks: quantify the greenhouse gas footprint, assess climate risk, compare lower-carbon alternatives, report annually and have the figures verified. RC-1 Phase 1 sits at or about the 100,000 t threshold of the Equator Principles, and later phases are well above it, so the strictest of those expectations apply in practice from the start. On the main certification scales, the illustrative RC-1 intensity clears the entry level comfortably but remains far from "near-zero". That position is credible and financeable, provided it is backed by a measured, verified and improving record.

9.1 Lenders' climate thresholds

Three sets of standards frame what development finance institutions and commercial banks will ask of the project.

IFC Performance Standard 3 on resource efficiency and pollution prevention requires projects expected to emit more than 25,000 t CO₂e a year to quantify their direct and indirect emissions annually and to consider technically and financially feasible options to reduce them [S21].

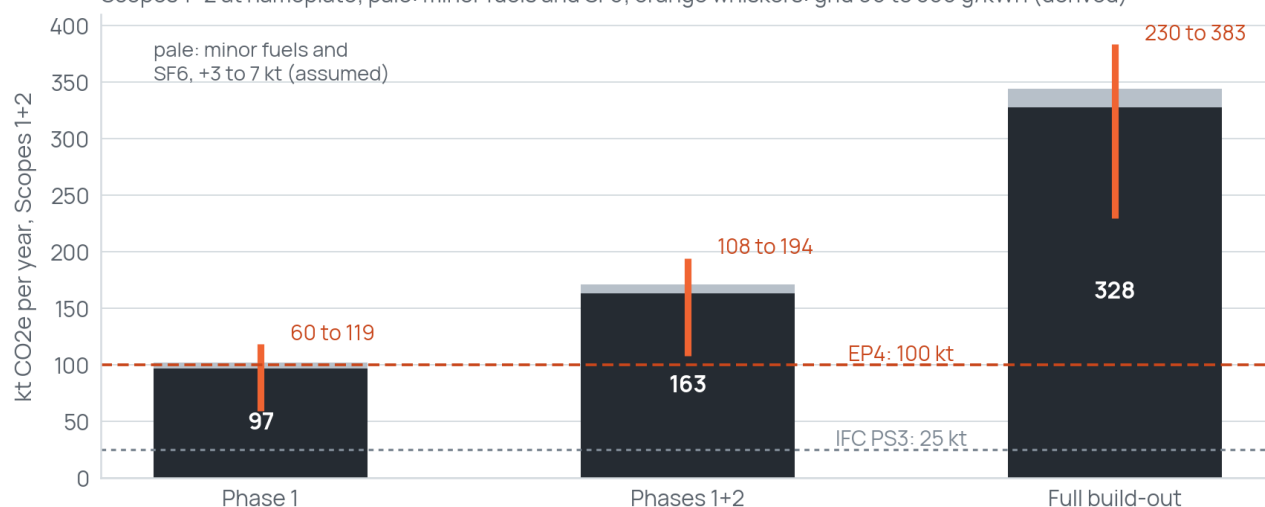
The Equator Principles (EP4), the risk-management framework applied by many banks to project finance, add two requirements above 100,000 t CO₂e a year of combined Scope 1 and Scope 2 emissions: a climate change risk assessment covering both physical and transition risks, including an alternatives analysis that evaluates lower-GHG technologies, and annual public reporting of emissions during operation [S22]. Climate change risk assessments are also required for all Category A projects, which a steelworks of this size would be. Because Cameroon is a non-designated country under EP4, the IFC Performance Standards and the World Bank Group's environmental, health and safety guidelines apply in full [S22].

Paris alignment. Multilateral development banks assess new operations against a joint methodology with two building blocks, one for mitigation and one for adaptation [S24]. The IFC committed to align 85% of its new real-sector operations from 1 July 2023 and 100% from 1 July 2025, and reports that it reached full alignment in its 2025 financial year [S23]. In practice, a steel project must show that its technology and emissions are consistent with low-carbon development pathways, that it does not lock in high-emission assets, and that it is resilient to physical climate risk.

Figure 9.1 sets the RC-1 footprint against these thresholds.

Phase 1 sits at the Equator Principles line; later phases are well above it

Scopes 1+2 at nameplate; pale: minor fuels and SF6; orange whiskers: grid 96 to 300 g/kWh (derived)



DERIVED **Figure 9.1.** RC-1 Scopes 1 and 2 by phase at nameplate output against the IFC and Equator Principles thresholds. The orange whiskers show the range for grid factors from 96 g/kWh (2025 mix cross-check) to 300 g/kWh. The pale segment adds diesel, LPG and SF6, which the RC-1 model omits (assumed, central value). On the model alone Phase 1 crosses 100,000 t at a grid factor of about 236 g/kWh; with the minor sources, at about 219 g/kWh.

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; IFC Performance Standard 3 [S21]; Equator Principles EP4 [S22].

At the planning grid factor of 226 g/kWh, Phase 1 process emissions and purchased electricity come to about 97,000 t a year on the RC-1 model. Diesel for mobile plant, LPG and leakage of SF6 from switchgear, which the model omits, would add about 3,000 to 7,000 t (assumed; Chapter 4), taking Phase 1 Scopes 1 and 2 to about 100,000 to 104,000 t. Phase 1 therefore sits at or about the EP4 threshold, not below it. On the model alone the threshold is crossed at a grid factor of about 236 g/kWh; with the minor sources it is crossed at about 219 g/kWh, below the 2024 average. At the expected sustained output of 270,000 to 300,000 t a year, the total would be about 90,000 to 104,000 t, on either side of the threshold. With Phase 2 the footprint reaches about 163,000 t and at 1 Mtpa about 328,000 t before the minor sources (derived). The practical conclusion is that Cameroon Steel should apply the above-100,000 t requirements from Phase 1, rather than plan around a threshold that the project's own estimate straddles.

Table 9.1 Lender climate requirements and the RC-1 response

Requirement	Trigger	What it asks	RC-1 status	Planned response
GHG quantification (IFC PS3)	Above 25,000 t CO ₂ e/yr	Annual quantification of Scope 1 and 2; feasible reduction options	Applies in every phase	Inventory from first heat (Chapter 2)
Climate change risk assessment (EP4)	Category A, or above 100,000 t Scopes 1+2	Physical and transition risk, aligned with recognised disclosure frameworks	Applies (Category A; Phase 1 at or about the threshold)	Completed within the environmental and social impact assessment (Chapter 7)
Alternatives analysis (EP4)	Above 100,000 t Scopes 1+2	Comparison of technically and financially feasible lower-GHG alternatives	Applies from Phase 1, which sits at or about the threshold; well exceeded from Phase 2	Route, power, iron-unit and reheating alternatives (Chapters 1, 3, 4, 6)
Public GHG reporting (EP4)	Above 100,000 t Scopes 1+2 (encouraged above 25,000 t)	Annual public reporting of emissions and intensity	Adopted from Phase 1	Annual verified report

Requirement	Trigger	What it asks	RC-1 status	Planned response
Paris alignment (MDBs)	All new operations	Consistency with low-carbon pathways; no lock-in; adaptation	Applies	Evidence in this paper; stepwise pathway (Chapter 10)

Source: IFC Performance Standards [S21]; Equator Principles EP4 [S22]; joint MDB methodology [S24]; IFC [S23].

9.2 The alternatives analysis is already largely written

The EP4 alternatives analysis asks a project to compare lower-GHG technologies used in the same industry. For a steelworks, the first and largest alternative is the route itself. By choosing an electric-arc furnace and excluding a blast furnace, RC-1 avoids about 1.8 t of CO₂ per tonne compared with the blast-furnace average: about 0.54 to 0.58 t against 2.34 t (Chapters 1 and 4). Within the electric route, the analysis must then compare the alternatives that remain open: sources and contracts for electricity (Chapter 3), the share and carbon content of DRI and HBI (Chapter 4), induction against gas reheating, scrap-preheating or continuous-charging furnace designs, and the timing and configuration of a domestic direct-reduction module (Chapter 6). This paper provides the desk-level analysis; the environmental and social impact assessment will complete it with supplier data.

9.3 What buyers and certifiers measure

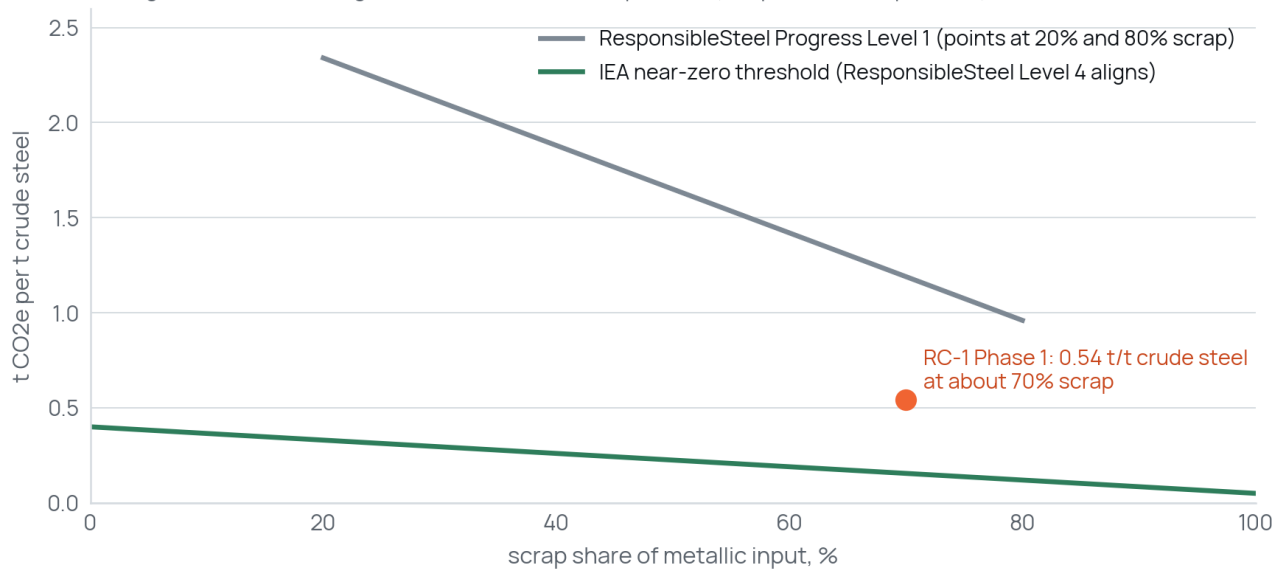
Buyers of steel increasingly ask for evidence of low emissions, either for their own Scope 3 reporting, for public procurement rules or to meet commitments made through buyers' clubs. Several definitions and certification schemes now compete. They share a boundary (Scopes 1 and 2 plus upstream emissions of purchased intermediates) but differ in how they treat scrap.

- **The IEA's near-zero definition**, proposed for G7 discussions in 2022, sets a threshold that slides with the scrap share of the metallic input: 0.40 t CO₂e per tonne of crude steel at 0% scrap, falling linearly to 0.05 t at 100% scrap [S06].
- **ResponsibleSteel**, a multi-stakeholder standard for site certification, defines four decarbonisation progress levels on a similar sliding scale. Progress Level 1 corresponds to about 2.34 t CO₂e per tonne at 20% scrap and 0.96 t at 80% scrap; Progress Level 4 aligns with the IEA near-zero threshold [S37][S38]. Sites that reach at least Level 1 for decarbonisation and materials sourcing may market their products as "Certified Steel" [S37].
- **The Global Steel Climate Council's Steel Climate Standard** takes a technology-neutral approach, applying the same threshold to all producers regardless of scrap content, combined with company-level science-based targets [S39].
- **Germany's Low Emission Steel Standard (LESS)**, launched in April 2024, classifies steel products into classes according to their product carbon footprint, documented in an EPD, and their scrap content [S40].
- **The European Union** announced a voluntary low-carbon steel label in its Action Plan for Steel and Metals of March 2025, intended to be referenced in public procurement and support schemes; its design was still under negotiation in 2026 [S36].

Figure 9.2 places the illustrative RC-1 Phase 1 intensity on the two published sliding scales.

RC-1 clears the first rung comfortably and is far from near-zero

Sliding-scale thresholds against the illustrative RC-1 position (Scopes 1, 2 and upstream)



DERIVED **Figure 9.2.** ResponsibleSteel Progress Level 1 and the IEA near-zero threshold as functions of scrap share, with the illustrative RC-1 Phase 1 intensity (Scopes 1 and 2 plus upstream DRI, per tonne of crude steel) at about 70% scrap. The ResponsibleSteel line joins its published points at 20% and 80% scrap.

Source: IEA (2022) [S06]; ResponsibleSteel, Decarbonisation Progress Levels (2024) [S37]; WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90].

At about 70% scrap, the IEA near-zero threshold is about 0.155 t CO₂e per tonne of crude steel, and the ResponsibleSteel Level 1 threshold, interpolated between its published points, about 1.19 t (derived). RC-1's illustrative 0.54 t per tonne of crude steel sits well inside Level 1 and about three and a half times the near-zero threshold. The sliding-scale approach is itself debated: recyclers have argued that it rewards ore-based production relative to scrap-based production [S100], while its proponents argue that scrap is limited and that the scale rewards progress where progress is hardest. Cameroon Steel's position is to report against both kinds of scale, transparently.

Table 9.2 Low-emission steel standards and labels compared

Standard or label	Owner	Unit assessed	Boundary	Treatment of scrap	Where RC-1 would stand (illustrative)
IEA near-zero definition	IEA (for G7)	Crude steel	Scopes 1, 2 and upstream	Sliding: 0.40 to 0.05 t CO ₂ e/t	About 3.5 times the threshold at 70% scrap
ResponsibleSteel progress levels	ResponsibleSteel	Site	Scopes 1, 2 and upstream Scope 3	Sliding; Level 4 aligned with IEA	Within Level 1; higher levels need lower-carbon iron and power
Steel Climate Standard	Global Steel Climate Council	Product and company	Scopes 1, 2 and 3	Technology-neutral, single threshold	To be assessed against the published trajectory
Low Emission Steel Standard (LESS)	German steel federation	Product (via EPD)	Product carbon footprint	Classes by footprint and scrap content	To be assessed once EPDs exist
EU low-carbon steel label	European Commission	Product	Under development	Under negotiation	Not yet applicable

Source: [S06][S37][S38][S39][S40][S36]. RC-1 positions derived by Cameroon Steel from the illustrative footprint.

9.4 Verification turns an estimate into evidence

Every requirement above assumes that the reported figures can be checked. Verification of greenhouse gas statements follows ISO 14064-3, which distinguishes reasonable assurance, a positive opinion comparable to a financial audit, from limited assurance, a statement that nothing has come to the verifier's attention to suggest a material misstatement [S101]. Lenders and buyers increasingly expect reasonable assurance for Scopes 1 and 2, where the works controls the data, and accept limited assurance for upstream emissions in the first years, while supplier data mature. CBAM adds its own layer: actual embedded emissions declared by an EU importer must be verified by an accredited verifier, or the importer falls back on default values [S27]. A works that plans one monitoring system and one verification cycle to serve all of these users avoids paying several times for the same evidence.

For RC-1 the practical sequence is a monitoring plan approved before commissioning, metering of the minor fuels and of the switchgear SF6 inventory as well as of the main inputs, a first verified inventory for the first full year of operation, and annual verification thereafter, with the verifier's statement published alongside the climate report (Chapter 10). Until then, every figure in this paper remains an estimate, and the statement of each figure's status is part of what a lender will check.

9.5 Disclosure: from lenders to investors and buyers

Lenders are not the only audience. The International Sustainability Standards Board's IFRS S2 standard on climate-related disclosures, issued in June 2023 and being adopted in a growing number of jurisdictions, requires reporting entities to disclose their Scope 1, Scope 2 and Scope 3 emissions and their climate-related risks and opportunities, building on the recommendations of the Task Force on Climate-related Financial Disclosures [S102]. Steel buyers that report under such rules will need their suppliers' emissions data to complete their own Scope 3 inventories, and will prefer suppliers who can provide it in a verified, standard form. Buyers' initiatives have reinforced the same message: the procurement thresholds used by the SteelZero initiative, as reported by the IEA, range from about 400 to 500 kg CO₂e per tonne for steel made entirely from ore to about 50 to 100 kg for steel made entirely from scrap [S06].

For Cameroon Steel this means that its climate data will be used by three different audiences (lenders testing thresholds, buyers completing their own inventories and certifiers assessing progress) and must satisfy all three. The questions a lender's climate due diligence is likely to ask, and where this paper begins to answer them, are summarised below.

Table 9.3 Questions a lender's climate due diligence is likely to ask

Question	Where this paper answers it	Evidence still needed
What are the expected Scope 1 and Scope 2 emissions, by phase, with ranges?	Chapter 4; Annex A	Supplier guarantees; contracted power
Which lower-carbon alternatives were considered, and why was the chosen design preferred?	Chapters 1, 3, 4 and 6	Formal alternatives analysis in the impact assessment
How exposed is the project to carbon pricing and border measures?	Chapter 5	Long-product benchmarks; default values by product
How exposed is the site to physical climate hazards, and how will it adapt?	Chapter 7	Site data; design basis
Is the project consistent with a low-carbon pathway, without lock-in?	Chapters 6 and 10	Ore and gas studies; power strategy

Question	Where this paper answers it	Evidence still needed
How will emissions be measured, verified and reported?	Chapters 2 and 10	Monitoring plan; verifier appointment

Source: Cameroon Steel, based on EP4 [S22], IFC Performance Standard 3 [S21] and the joint MDB methodology [S24].

9.6 Green finance follows verified performance

Green loans, green bonds and sustainability-linked loans are increasingly available for industrial decarbonisation, but steel is a sector where lenders and investors are wary of claims that cannot be checked. A use-of-proceeds instrument would need to show that the financed assets meet a recognised eligibility test; a sustainability-linked instrument would tie its margin to key performance indicators such as verified carbon intensity, the share of low-carbon electricity, the scrap share or the carbon content of purchased iron units, against an ambitious and pre-agreed trajectory. In either case, the foundation is the same: a robust inventory, third-party verification and annual public reporting.

WHAT MAKES RC-1 FINANCEABLE ON CLIMATE GROUNDS

An electric-arc route on a hydro-dominated grid; an intensity well inside ResponsibleSteel Level 1 and far below route averages; a credible, stepwise path towards lower-carbon iron units; and, above all, a measurement and verification system that lenders, buyers and certifiers can audit. The last element is the one most often missing in new steel projects in emerging markets, and the one Cameroon Steel can most easily get right.

9.7 Implications for Cameroon Steel

The standards reviewed here point to a consistent set of commitments that a credible low-carbon steelworks should be ready to make, and that Cameroon Steel intends to pursue as the project advances: an EP4-grade climate change risk assessment and alternatives analysis in the environmental and social impact assessment; an inventory designed to the GHG Protocol, ISO 14404 and CBAM rules from the first heat; annual verified public reporting from Phase 1; EPDs for its main products; and, after the first years of stable operation, certification against a recognised site standard such as ResponsibleSteel. Chapter 10 sets these alongside the operational and supply-chain levers in a single pathway.

CHAPTER 10

A DECARBONISATION PATHWAY: ABOUT 40% LOWER WITH KNOWN LEVERS, FURTHER WITH GREEN IRON

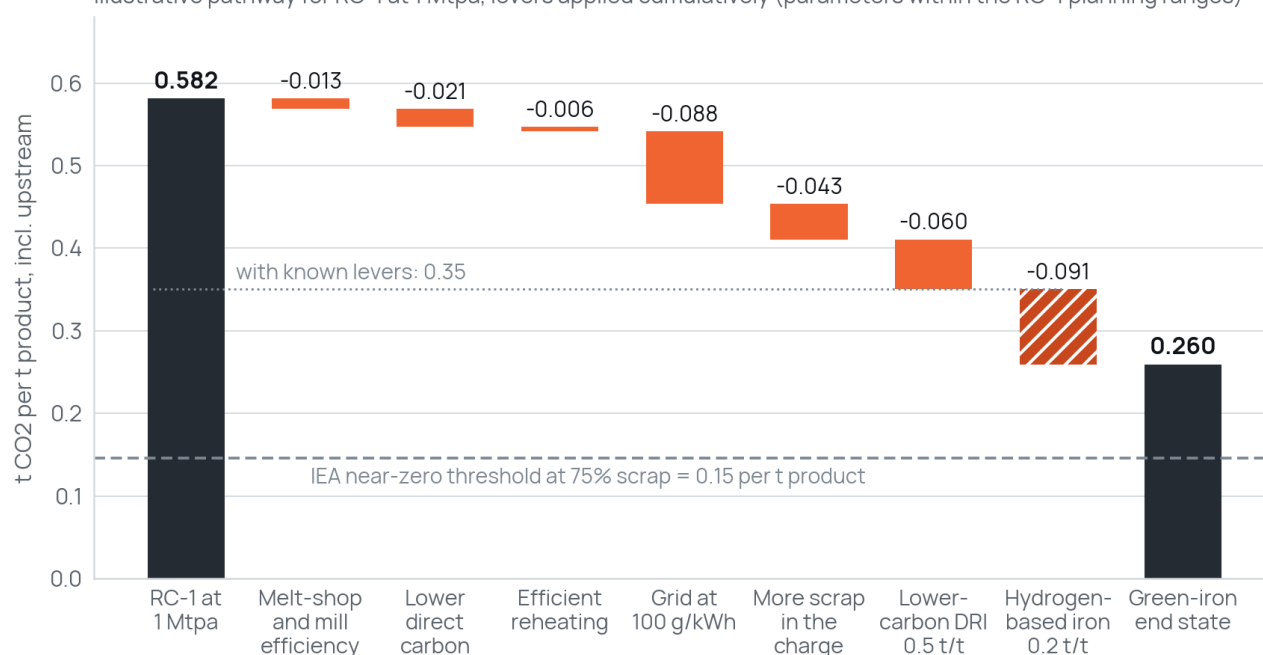
Starting from the illustrative 1 Mtpa footprint of about 0.58 t CO₂ per tonne including upstream iron units, known levers could bring the RC-1 works to about 0.35 t: a little furnace and mill efficiency, lower direct emissions, a grid closer to the 2025 mix, more scrap in the charge (domestic or imported) and certified lower-carbon DRI. Replacing gas-based DRI with hydrogen-based iron units would take it to about 0.26 t. None of these steps is automatic, and the largest depend on others: the power system, suppliers of iron units and the economics of hydrogen. The ten recommendations at the end of this chapter set out what Cameroon Steel would do, and what it would ask of its partners, to keep the works on that path.

10.1 The levers, in order of size

Figure 10.1 applies a sequence of levers cumulatively to the full build-out. Each parameter stays within the range in the RC-1 reference configuration, except the hydrogen-based iron step, which is derived from published process data (Chapter 6). The sequence is illustrative; levers can be pursued in parallel and their order does not imply timing.

Known levers cut the footprint by about 40%; green iron takes it to about 0.26

Illustrative pathway for RC-1 at 1 Mtpa, levers applied cumulatively (parameters within the RC-1 planning ranges)



ILLUSTRATIVE Figure 10.1. Illustrative decarbonisation pathway for RC-1 at 1 Mtpa, levers applied cumulatively, in t CO₂ per tonne of product including upstream iron units. The dotted line marks the level reached with known levers; the dashed line the IEA near-zero threshold for a plant with about 75% scrap, converted to a per-tonne-of-product basis.

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; DRI power penalty [S15]; hydrogen-based iron intensity derived from [S15]; IEA near-zero threshold [S06].

Table 10.1 Pathway levers and their illustrative effect at 1 Mtpa

Lever	Parameter change	Effect, t CO ₂ per t product	Cumulative intensity	Annual effect at 1 Mtpa, kt CO ₂	Who controls it
Starting point: RC-1 full build-out	As in Chapter 4		0.582		
Melt-shop and mill efficiency	Furnace 450 to 420 kWh/t; auxiliaries 70 to 60; rolling 110 to 95	-0.013	0.569	-13	Operations, technology supplier
Lower direct carbon	Furnace direct factor 0.10 to 0.08 t/t liquid	-0.021	0.547	-21	Operations
Efficient reheating	Gas 1.3 to 1.15 GJ/t (hot charging, recuperation)	-0.006	0.541	-6	Design, operations
Lower-carbon grid supply	226 to 100 g/kWh (2025 mix level or contracted supply)	-0.088	0.454	-88	Power system, contract
More scrap in the charge (domestic or imported)	DRI share 30% to 25%	-0.043	0.411	-43	Scrap collection, import contracts, purchasing
Certified lower-carbon DRI/HBI	Upstream factor 0.7 to 0.5 t/t DRI	-0.060	0.350	-60	Purchasing, suppliers
With known levers		-0.232	0.350	-232	

Lever	Parameter change	Effect, t CO ₂ per t product	Cumulative intensity	Annual effect at 1 Mtpa, kt CO ₂	Who controls it
Hydrogen-based iron units	Upstream factor 0.5 to 0.2 t/t DRI	-0.091	0.260	-91	Long term: green-iron option (Chapter 6)

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90] (Annex A). Values are illustrative; annual effects at nameplate output.

Three features stand out. First, the operational levers inside the works (efficiency, direct carbon, reheating) are real but small, about 0.04 t per tonne together. They should be pursued because they also save money, but they do not change the plant's carbon position. Second, the two levers that matter most in the medium term, the grid and the iron units, are largely outside the works' fence: they depend on contracts and on suppliers. Third, the step from 0.35 to 0.26 t requires a change in how iron is made, which is why green iron, not furnace practice, is the long-term frontier.

Even the end state does not reach near-zero. At about 75% scrap, the IEA's threshold corresponds to about 0.15 t per tonne of product [S06]. Closing the remaining gap would require a grid closer to zero, hydrogen-based reheating or electrification of reheating, and furnace direct emissions reduced further, for example with biogenic carbon in place of fossil charge carbon. These are options for the 2040s, not plans.

10.2 What the levers cost, and who pays

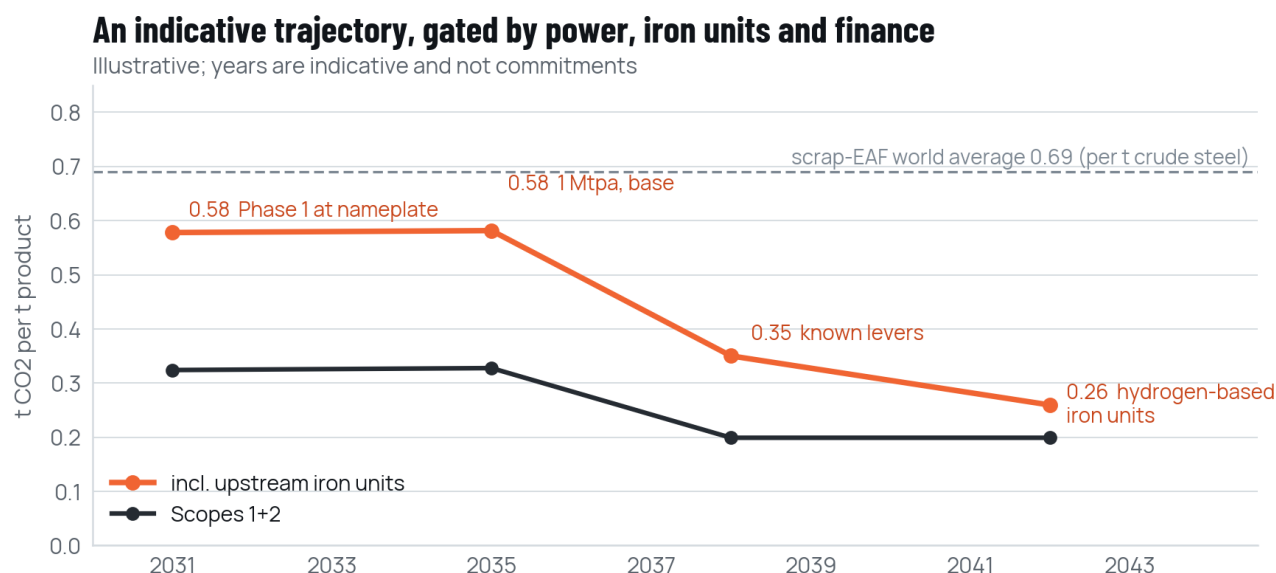
The levers differ as much in cost as in size. The operational levers (furnace and mill efficiency, lower electrode and carbon consumption, hot charging) usually pay for themselves through lower energy and consumable costs, which is why they are standard practice in well-run electric-arc works. The grid lever depends on the terms of the power contract: in Cameroon, realised high-voltage prices in 2025 ranged from about 18.4 FCFA per kWh under legacy contracts to a regulatory estimate of about 105 FCFA per kWh for the cost-reflective average across all customers [S50][S54], so firm, identified low-carbon supply may carry a premium over the cheapest available energy. The iron-unit levers depend on the market for low-carbon DRI and HBI, which is still thin and which analysts expect to tighten as demand for DR-grade feed outstrips supply [S11].

The hydrogen step is the expensive one. The Energy Transitions Commission estimated that fully decarbonising steel would cost about US\$60 per tonne of CO₂ abated, adding about US\$115 to a tonne of steel, falling to about US\$25 per tonne of CO₂ and US\$50 per tonne of steel where very cheap clean electricity is available [S09]. The Mission Possible Partnership estimated a premium of about US\$175 per tonne, about 40%, for near-zero primary steel around 2030, adding about 2% to the price of a building [S08]. Carbon border measures will cover part of that gap for exported products: Chapter 5 showed an illustrative CBAM differential of about €70 to €160 per tonne between RC-1 product and an average blast-furnace product by 2034 at today's certificate price; because CBAM prices the DRI in RC-1's charge, hydrogen-based iron units at 0.2 t per tonne would also cut RC-1's own charge by about €15 per tonne (derived). For the domestic and regional market, where no carbon price applies, the hydrogen step would need either a buyer's premium, concessional climate finance or very low-cost hydro, and probably all three.

The practical conclusion is a sequence: pursue the operational levers immediately because they pay; secure the grid and iron-unit levers through contracts because they are where most of the carbon is; and develop the hydrogen option as evidence and economics allow.

10.3 An indicative trajectory

Figure 10.2 places the pathway on an indicative timeline. Phase 1 would operate at about 0.58 t per tonne from its first heat, targeted for the second half of 2030, and through its ramp-up in 2031; the full build-out, if it proceeds after 2034, would hold that level; the known levers could bring it to about 0.35 t in the late 2030s; and hydrogen-based iron units could bring it to about 0.26 t in the 2040s. Scopes 1 and 2 would fall from about 0.32 t per tonne in Phase 1 (about 0.33 t at full build-out) to about 0.20 t, mostly through the grid.



ILLUSTRATIVE Figure 10.2. An indicative trajectory for RC-1's carbon intensity, including upstream iron units (orange) and Scopes 1 and 2 only (dark). Years are indicative and depend on power, iron-unit supply, markets and financing; they are not commitments.

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; phasing from the RC-1 indicative schedule [S90]; worldsteel scrap-EAF average [S01].

The trajectory is gated at each step. The grid lever needs the transmission reinforcements and supply contracts discussed in Chapter 3. The iron-unit levers need suppliers willing to certify their carbon content and, for hydrogen-based iron, firm low-carbon electricity at a cost that a carbon price or a buyer's premium can bridge. The scrap lever needs a collection system that does not yet exist at scale. Cameroon Steel would report progress against each lever annually, so that the trajectory can be tested against evidence rather than intentions.

10.4 Measurement, reporting and verification from the first heat

The pathway is only as credible as the measurement behind it. The monitoring plan for RC-1 would rest on four principles:

- One dataset, several reports.** A single, metered dataset of carbon inputs (electrodes, charge carbon, fluxes, gas), electricity by consumer, purchased iron units with their supplier data, and production by product feeds every report: the GHG Protocol corporate inventory, the ISO 14404 site intensity, CBAM embedded emissions and EPDs (Chapter 2).
- Supplier data for iron units.** Every cargo of DRI or HBI comes with verified carbon data from its producer, prepared on the CBAM or ISO 14404 basis.
- Independent verification.** An accredited third party verifies the annual inventory against ISO 14064-3 [S101] and the CBAM rules, and verifies EPDs under the applicable programme.
- Public disclosure.** An annual climate report publishes the inventory, the key performance indicators in Table 10.2 and progress against the pathway.

Table 10.2 Key performance indicators for the RC-1 climate report

Indicator	Unit	Basis	Why it matters
Scope 1, Scope 2 (location- and market-based), Scopes 1+2	t CO ₂ e/yr	GHG Protocol	Lender thresholds; corporate inventory
Upstream emissions of purchased iron units	t CO ₂ e/yr	ISO 14404; supplier data	The largest block of the footprint
Site intensity	t CO ₂ e per t crude steel	ISO 14404	Comparison with route averages and certification scales
Product intensity and CBAM embedded emissions	t CO ₂ e per t of each product	ISO 14067; CBAM	Buyers, EPDs, border charges
Scrap share and DRI/HBI share of the charge	%	Material balance	The main controllable carbon levers
Carbon intensity of purchased DRI/HBI	t CO ₂ e per t DRI	Supplier data, verified	Purchasing specification
Electricity use and grid factor, monthly	kWh/t; g CO ₂ /kWh	Metering; utility data	Seasonal power and carbon risk
Electrode and charge-carbon consumption	kg/t liquid steel	Material balance	Direct emissions
Slag used as product; dust sent to zinc recovery	% of arisings	Waste register	Circularity
Water make-up	m ³ /t product	Metering	Resource efficiency

Source: Cameroon Steel, monitoring design principles; standards as cited in Chapter 2.

10.5 Ten recommendations

Table 10.3 sets out the ten actions that follow from this paper, with the party that leads each and an indicative timing. They are written as Cameroon Steel's intentions and requests; they are not contractual commitments.

Table 10.3 Ten recommendations

#	Recommendation	Lead	Indicative timing
1	Contract firm, identified low-carbon power. Negotiate a bilateral supply with identified hydro or other low-carbon generation and firmness through the dry season; support the transmission reinforcements that bring hydro to Kribi; report location- and market-based Scope 2 monthly.	Cameroon Steel with the utility, the transmission operator and the regulator	Before the Phase 1 investment decision
2	Specify the carbon content of every iron unit bought. Require verified carbon data for each DRI or HBI cargo, set a contractual intensity ceiling that falls over time, and prefer suppliers with lower-carbon processes; under CBAM the DRI sets most of the charge on an EU-bound tonne.	Cameroon Steel purchasing	Phase 1 procurement
3	Raise the scrap share, at home and abroad. Develop domestic collection partnerships, with quality control, radiation screening and labour standards consistent with IFC Performance Standard 2, and secure import contracts for low-residual scrap for the balance.	Cameroon Steel with collectors and authorities	From construction
4	Design out direct emissions and energy waste. Evaluate scrap preheating or continuous charging in furnace selection, maximise hot charging, specify efficient fume extraction and hydrogen-ready burners for the Phase 2 and 3 reheating furnaces.	Cameroon Steel with the technology supplier	Front-end engineering

#	Recommendation	Lead	Indicative timing
5	Measure from the first heat. Design the inventory to the GHG Protocol, ISO 14404 and CBAM rules, including minor fuels and switchgear SF6; meter electricity by consumer; verify annually; publish an annual climate report.	Cameroon Steel	Commissioning
6	Document products. Publish verified EPDs for billets, wire rod and reinforcing bar within the first two years of operation and seek site certification against a recognised standard once operations are stable.	Cameroon Steel	Years 1 to 3 of operation
7	Apply the strongest lender requirements from Phase 1. Complete an EP4-grade climate change risk assessment and alternatives analysis within the environmental and social impact assessment, regardless of where Phase 1 falls relative to the 100,000 t threshold.	Cameroon Steel and its impact-assessment consultants	Impact assessment
8	Adapt by design. Size drainage and retention to the 100-year storm with a warming allowance; implement a heat-stress plan; provide covered DRI/HBI storage; install a site weather station at the start of construction.	Cameroon Steel with designers	Design and construction
9	Create outlets for co-products. Obtain approval for slag aggregates with the public works authorities; contract EAF dust recovery with a licensed recycler; close the water loop and harvest rainfall.	Cameroon Steel	Before commissioning
10	Keep the green-iron option open, on evidence. Commission a concentrate and pelletising study on Cameroonian ore, assess gas supply and reserves for a direct-reduction module, keep the reserve land and utilities corridor, and engage with green-iron corridor initiatives and partners.	Cameroon Steel with the sister mining company, the gas sector and partners	Studies from 2027

Source: this paper, Chapters 1 to 9.



**LOW CARBON IS A NUMBER A PLANT MEASURES,
HAS VERIFIED AND PUBLISHES, YEAR AFTER YEAR.**

Illustrative view. Generated image of an industrial control desk; not a photograph of any project, place or person.

10.6 What government and partners can do

Several of the levers sit with public institutions. Cameroon Steel would welcome progress in five areas, which would benefit every industrial electricity user and not only the steel sector:

- **Grid reinforcement and firm supply** for industrial zones, including completion of the transmission links that deliver hydro output to the coast [S51][S55].
- **A registry for electricity attribute certificates** or an equivalent mechanism, so that contracted low-carbon supply can be evidenced and not double-counted.
- **A national framework for industrial greenhouse gas reporting and verification**, consistent with international methods, which would also strengthen Cameroon's ability to document carbon prices or emissions for export markets.
- **Standards for recycled aggregates**, so that steel slag and other secondary materials can be used in public works with confidence.
- **Support for ore beneficiation studies**, consistent with the local-transformation objectives of the Mining Code [S86] and the KPIZ steel cluster [S74], so that the DR-grade question is answered with public data.

10.7 Conclusion

Cameroon has an unusual combination of assets for low-carbon steel: a hydro-dominated grid, large undeveloped hydro potential, iron ore under development and a deep-water port with an industrial zone that names steel among its clusters. An electric-arc works at Mboro could use the first of these from its first heat to make steel at about a third of the world's average carbon intensity. The others could, over two decades and under conditions this paper has set out, allow Central Africa to make its own low-carbon iron.

The difference between that possibility and a claim is measurement. A works that measures, verifies and publishes its carbon performance, and that contracts for low-carbon power and iron units with the same care it gives to cost and quality, will be able to turn Cameroon's natural advantages into a competitive one. That is the course this paper recommends.

CHAPTER 11

EVIDENCE GAPS: WHAT IS NOT YET KNOWN, AND HOW IT WILL BE RESOLVED

Every number for the RC-1 works in this paper is an estimate made before front-end engineering, before supply contracts and before a single heat. That is unavoidable at this stage, and it is why each figure carries a status and a range. This chapter lists the gaps that matter most for the conclusions, explains why each matters and states how and when it will be closed. None of them overturns the central finding, that an electric-arc works on Cameroon's grid would sit far below route averages, but several could move the illustrative intensity by a tenth of a tonne or more.

11.1 Gaps that could move the footprint

The largest uncertainties concern the inputs that the works buys rather than the processes it runs: the carbon content of imported iron units, the share of scrap it can secure and the emission factor of the electricity it draws. The tornado analysis in Chapter 4 ranks them; the table below sets out how each will be resolved.

Table 11.1 Evidence gaps affecting the carbon footprint

#	Gap	Why it matters	How it will be resolved	When
1	Carbon intensity of the DRI/HBI actually bought (0.5 to 0.9 t/t assumed)	Largest single block of the footprint; ± 0.07 t per tonne of product	Supplier-specific, verified data for every cargo; purchasing specification with an intensity ceiling	Phase 1 procurement
2	Achievable scrap share, domestic and imported	± 0.09 t per tonne for each 10 points of charge	Scrap market survey in Cameroon and the region; import supply contracts; quality tests	Before Phase 1 investment decision
3	Grid emission factor for 2025 onwards; the harmonised combined-margin factor used by lenders; seasonal variation	± 0.1 t per tonne for each 100 g/kWh	Published Ember data; the IFI harmonised dataset; hourly or monthly utility data; terms of the supply contract	Ongoing; at contract signature
4	Furnace direct emissions, minor fuels and switchgear SF ₆ , and furnace energy use (0.10 t/t and 450 kWh/t planning values; up to about 490 kWh/t with 30% DRI)	Largest uncertainty in direct emissions; the minor sources decide on which side of the EP4 threshold Phase 1 falls	Technology supplier's guaranteed consumptions at front-end engineering; measured carbon balance after commissioning	Front-end engineering; first year of operation
5	Other purchased inputs (ferroalloys, lime, electrodes, refractories) and freight	Needed for a complete product footprint and EPD	Life-cycle inventory at front-end engineering; supplier data	Before first EPD

#	Gap	Why it matters	How it will be resolved	When
6	Construction emissions and land-use change on the site	Not yet quantified	Vegetation and carbon-stock survey in the environmental and social impact assessment; construction plan	Impact assessment

Source: Cameroon Steel; sensitivities from the WP06 model (Chapter 4).

11.2 Gaps that affect carbon border exposure and certification

Table 11.2 Evidence gaps affecting market and certification outcomes

#	Gap	Why it matters	How it will be resolved	When
7	CBAM benchmark values for long products and their route classification for RC-1's charge	Sets the free-allocation adjustment for EU-bound tonnes	Review of the annexes to the CBAM implementing regulations; legal advice	Before any EU sale
8	CBAM default values that would apply to Cameroonian products	Determines the cost of unverified data for buyers	Review of the default-value annex by CN code	Before any EU sale
9	Numeric thresholds of the Steel Climate Standard and LESS classes; design of the EU low-carbon steel label	Certification targets and buyer requirements	Monitoring of standard-setters' publications	Ongoing
10	Existence of an electricity attribute-certificate registry in Cameroon	Credibility of any market-based Scope 2 claim	Engagement with the regulator and the utility	Before a market-based claim

Source: Cameroon Steel.

11.3 Gaps that affect the green-iron option

Table 11.3 Evidence gaps for the reserve direct-reduction module

#	Gap	Why it matters	How it will be resolved	When
11	Whether Cameroonian ore can be upgraded economically to DR-grade concentrate and pellets	Decides whether a domestic module would use local or imported feed	Metallurgical testwork, concentrate and pelletising study with the sister mining company	Studies from 2027
12	Gas reserves and supply terms for a direct-reduction module	A module needs about 9 to 10 PJ a year per Mt of DRI	Reserve audit; negotiation with gas producers	Before any module decision
13	Cost and firmness of low-carbon electricity for hydrogen	Hydrogen-based iron needs power at about US\$35 to US\$40/MWh to compete on published estimates	Power supply studies; new hydro or firming options	Long term
14	Port bulk handling for pellets and HBI	Required for imports of pellets or exports of HBI	Engagement with the port and the mineral terminal	With the module decision

Source: Cameroon Steel; requirements from Chapter 6.

11.4 Gaps that affect adaptation design

Table 11.4 Evidence gaps for climate adaptation

#	Gap	Why it matters	How it will be resolved	When
15	Short-duration rainfall intensities (intensity-duration-frequency curves) for Kribi	Sizing of roof drainage, channels and retention	National meteorological service data; site station from the start of construction	Design
16	Site heat-stress statistics (wet-bulb globe temperature)	Heat-stress plan; equipment ratings	Site measurements; reanalysis calibrated to the station	Design and first year
17	Lightning flash density	Lightning protection design	Satellite lightning climatology; site records	Design
18	Kribi-specific sea-level projections	Design of any coastal infrastructure	IPCC AR6 regional projections tool	Before any coastal works
19	Slag leaching behaviour and local acceptance for road use	Outlet for about 45,000 t a year in Phase 1	Standard leaching and stability tests; road-authority approval	Before commissioning
20	Access to a licensed EAF dust recycler and export permits	Avoiding a hazardous-waste liability	Recycler contract; Basel Convention procedure	Before commissioning

Source: Cameroon Steel.

11.5 How the gaps will be closed and reported

The gaps fall into three groups. The first, supplier, contract and study data (gaps 1, 2, 4, 5, 7, 8, 11, 12, 13 and 20), closes as the project moves through front-end engineering, procurement and the ore and gas studies; each new data point will replace a planning value in the RC-1 reference configuration, with its source and date. The second, site and environmental data (gaps 6, 15, 16, 17 and 19), closes through the environmental and social impact assessment and the site weather station. The third, external developments (gaps 3, 9, 10, 14 and 18), closes as institutions, the port and the grid publish or build; Cameroon Steel will update its figures when they do. Each of the twenty gaps sits in exactly one group.

HOW UPDATES WILL BE PUBLISHED

Cameroon Steel intends to republish the illustrative footprint in this paper when front-end engineering is complete, replacing planning values with supplier guarantees and contracted data, and to replace estimates with measured, verified figures in its first annual climate report after commissioning. Each update will state what changed and why.

The annexes that follow set out the method and assumptions in full (Annex A), define the technical terms used (Annex B), list every source (Annex C) and print the values behind every figure (Annex D).

ANNEX A

METHOD, ASSUMPTIONS AND RANGES

This annex sets out how every derived figure in the paper was calculated, so that a reader can reproduce it. The calculations are implemented in a short script that reads the Cameroon Steel reference configuration RC-1 (planning estimate, edition of 10 October 2026) and writes one data file per exhibit; the data files are published with the web edition and printed in Annex D.

A.1 Evidence status

Each figure in the paper carries one of four statuses:

- **Sourced:** taken directly from a cited document or dataset (Annex C).
- **Derived:** calculated from sourced or assumed inputs by the method in this annex.
- **Assumed:** a planning value chosen within a stated range, where no project-specific or published value is available.
- **Illustrative:** arithmetic that shows a mechanism or an order of magnitude; not a forecast or a commitment.

RC-1 project values (capacities, units, layout reservations, indicative schedule) are planning values from the RC-1 reference configuration [S90] and are labelled planned or indicative.

A.2 The footprint model

For each phase, with finished output P (t/yr):

- Liquid steel $L = P / y_r$, where y_r is the cast-and-roll yield (0.94).
- Metallic charge $M = L / y_m$, where y_m is the metallic yield (0.88).
- Purchased DRI/HBI $D = M \times s$, where s is the DRI share of the charge (0.30); scrap = $M - D$.
- Electricity E (kWh) = $L \times (e_{EAF} + e_{aux}) + P \times e_{roll} + P \times e_{ind}$ (induction heating in Phase 1 only).
- Gas G (GJ) = $P \times g_{rh}$ for Phases 2 and 3 (gas reheating); zero in Phase 1.
- Scope 1 = $L \times f_{EAF} + G \times 0.0561$ t CO₂/GJ.
- Scope 2 = $E \times \text{grid factor}$.
- Upstream iron units = $D \times f_{DRI}$.
- Intensities divide by P (per tonne of product) or by L (per tonne of crude steel).
- CBAM basis = (Scope 1 + upstream iron units) per tonne, excluding electricity, consistent with Annex II of the CBAM Regulation for iron and steel [S27].

The full build-out combines Phase 1 (300,000 t with induction heating) with 700,000 t of gas-reheated output. The model reproduces the balances in the RC-1 reference configuration to the tonne.

Table A.1 Parameters, central values and ranges

Parameter	Symbol	Central value	Range tested	Status	Basis
Electric-arc furnace electricity	e_{EAF}	450 kWh/t liquid (planning value); about 490 with 30% DRI/HBI (upper planning value)	347 to 500	sourced	IFC EHS Guidelines, 1,250 to 1,800 MJ/t [S20]; DRI penalty [S15]
Auxiliaries (ladle furnace, caster, oxygen, water, air)	e_{aux}	70 kWh/t liquid	50 to 100	assumed	RC-1 reference configuration [S90]
Rolling electricity	e_{roll}	110 kWh/t product	70 to 140	sourced	IFC EHS Guidelines [S20]
Induction billet heating (Phase 1)	e_{ind}	300 kWh/t	150 to 400	assumed	Partly hot-charged; RC-1 reference configuration [S90]
Gas reheating (Phases 2 and 3)	g_{rh}	1.3 GJ/t product	1.1 to 1.6	assumed	Walking-beam furnace; RC-1 reference configuration [S90]
Natural gas emission factor		0.0561 t CO ₂ /GJ	none	sourced	IPCC 2006 default [S57]
Furnace direct factor	f_{EAF}	0.10 t CO ₂ /t liquid	0.06 to 0.15	assumed	Electrodes, charge carbon, flux carbonates
Grid emission factor		226 g CO ₂ e/kWh	200 to 300 (also 0 to 800 in Chapter 3)	sourced (2024)	Ember via Our World in Data [S48]
DRI share of charge	s	30%	20% to 50%	assumed	RC-1 reference configuration [S90]
Upstream DRI/HBI intensity	f_{DRI}	0.70 t CO ₂ /t DRI	0.5 to 0.9 (0.1 to 1.0 in Figure 4.5)	assumed	Gas-based shaft furnace
Metallic yield	γ_{m}	0.88	0.85 to 0.91	assumed	Scrap and DRI mix
Cast-and-roll yield	γ_{r}	0.94	0.92 to 0.96	assumed	Caster and mill
EAF electricity penalty for DRI		+14.5 kWh/t per +10 points of DRI	applied in sensitivity cases	sourced	EC Innovation Centre for Industrial Transformation [S15]
Operating hours for average load		8,000 h/yr	none	assumed	Continuous operation with maintenance stops
Minor fuels (diesel, LPG), outside the RC-1 balances		0.015 t CO ₂ /t liquid	0.01 to 0.02	assumed	Mobile plant, ladle and tundish preheating, standby generators
SF6 leakage from switchgear, outside the RC-1 balances		0.5% a year of a 1.25 t inventory	0.5 to 2 t inventory	assumed	Global warming potential 23,500 [S105]

Source: Cameroon Steel reference configuration RC-1 (planning estimate) [S90] and sources as listed.

A.3 Sensitivity analysis

The tornado (Figure 4.4) changes one parameter at a time across its range, holding the others at central values, and reports the change in the Phase 1 intensity including upstream iron units and in Scopes 1 and 2. The DRI-share case adds the furnace electricity penalty for DRI relative to the 30% base. The joint-extreme case in Table

4.5 sets the DRI share, upstream intensity and grid factor simultaneously to their low (20%, 0.5 t/t, 200 g/kWh) and high (50%, 0.9 t/t, 300 g/kWh) values. The heat map (Figure 4.5) varies the DRI share from 10% to 60% and the upstream intensity from 0.1 to 1.0 t/t at a grid factor of 226 g/kWh.

A.4 The 2025 grid cross-check

No 2025 grid intensity was published on the Ember basis at the time of writing. The cross-check in Chapter 3 proceeds in three steps:

1. Total 2024 emissions = 225.9 g/kWh × 7.26 TWh = about 1,640 kt CO₂e [S48][S49].
2. Subtracting renewable generation at IPCC life-cycle medians (hydro 24, solar 48, bioenergy 230 g/kWh [S58]) leaves about 1,504 kt for 1.95 TWh of gas and oil generation, an implied fossil rate of about 771 g/kWh.
3. Applying that rate to ARSEL's 2025 fossil generation (559.7 GWh of gas, 153.9 GWh of light fuel oil, 66.7 GWh of heavy fuel oil) gives about 602 kt. Divided by 2025 generation of 8,119.9 GWh [S50], this is about 74 g/kWh on a combustion basis; adding hydro and solar at their life-cycle values gives about 96 g/kWh.

The cross-check assumes the 2024 fossil fleet performance applies in 2025 and that the Ember and ARSEL datasets have comparable coverage; neither is certain. It is used only as an indication that the published 2024 value is conservative against the average; it says nothing about the marginal factor (Chapter 3).

A.5 Carbon border arithmetic

The illustrative CBAM charge per tonne in Chapter 5 is:

$$\text{charge} = \max(0, E - B \times F_t) \times \text{price}$$

where E is the embedded emissions used (t CO₂/t) on the CBAM basis for steel, that is direct emissions plus the direct emissions of precursors, without purchased electricity [S27]; B the route benchmark (1.370, 0.481 and 0.072 t/t for blast-furnace, DRI-EAF and scrap-EAF routes, as reported for hot-rolled coil [S31] and used here as a proxy for long products, whose values in Implementing Regulation (EU) 2025/2620 [S104] were not extracted); F_t the CBAM factor for year t (97.5% in 2026 falling to 0% in 2034 [S28]); and the price a constant €82.32/t CO₂ (third quarter of 2026 [S26]). For RC-1, E is the CBAM basis defined above, taking the DRI's full upstream factor as its embedded direct emissions (a conservative simplification), and the scrap-EAF benchmark applies because more than half of its crude steel derives from scrap [S93]. The all-scrap case is the RC-1 model with no DRI, so that E equals Scope 1. For the ore-based routes, E is a range: the lower end is the IEA's direct-emission estimate (1.0 t for gas-based DRI-EAF, 1.2 t for BF-BOF [S05]), which omits purchased precursors; the upper end is the worldsteel 2024 route average (1.47 and 2.34 t [S01]), which also counts electricity and other upstream inputs. Each 10 points of DRI in the RC-1 charge add $1 / (0.94 \times 0.88) \times 0.10 \times 0.70 = 0.085$ t per tonne of product. The arithmetic ignores any carbon price paid at origin, transport and exchange-rate effects.

A.6 Hydrogen and green-iron arithmetic

Electricity for hydrogen-based reduction = DRI output × 54 kg H₂ per tonne of DRI [S17] × 45 to 52 MWh per tonne of H₂ [S05]. For RC-1's full build-out need of about 362,700 t of DRI a year this gives about 0.88 to 1.02 TWh; for a 1 Mt/yr module, about 2.43 to 2.81 TWh. The electricity used by the direct-reduction plant itself is excluded. Gas for a 1 Mt/yr gas-based module = 9.2 to 10 GJ per tonne [S16][S15], compared with 2025 national gas production of 75.5 billion cubic feet [S83], converted at about 1.09 GJ per thousand cubic feet.

The hydrogen-based iron intensity of about 0.2 t CO₂ per tonne of DRI used in Chapters 4, 6, 8 and 10 is derived from Energiron's stated reductions relative to the blast-furnace route (53% with natural gas, 86% with hydrogen [S15]): the hydrogen route emits about $0.14 / 0.47 \approx 30\%$ of the gas route, and 30% of 0.7 t is about 0.2 t. The derivation is approximate because the stated reductions refer to the whole DRI-EAF route.

A.7 Pathway arithmetic

The pathway in Chapter 10 applies the following parameter changes cumulatively to the full build-out, recomputing the model at each step: furnace electricity 450 to 420 kWh/t, auxiliaries 70 to 60 kWh/t and rolling 110 to 95 kWh/t; furnace direct factor 0.10 to 0.08 t/t; gas reheating 1.3 to 1.15 GJ/t; grid factor 226 to 100 g/kWh; DRI share 30% to 25% (with the furnace electricity penalty); upstream DRI intensity 0.7 to 0.5 t/t; and finally 0.5 to 0.2 t/t for hydrogen-based iron units. All values except the last lie within the ranges of the RC-1 reference configuration or the 2025 grid cross-check.

A.8 Other derivations

- **Residues:** slag 140 kg, dust 15 kg per tonne of liquid steel and mill scale 20 kg per tonne of product [S90]. The slag value sits within the IFC benchmark for solid residue, 110 to 180 kg per tonne of product, mostly slag [S20]; the dust value sits within a planning range of 10 to 20 kg (the European reference document reports 10 to 30 kg) [S19]. Zinc in dust at 20% to 30% Zn.
- **Standards thresholds at RC-1's scrap share:** IEA near-zero = $0.40 - 0.35 \times \text{scrap share}$ [S06]; ResponsibleSteel Progress Level 1 interpolated linearly between 2.34 t at 20% scrap and 0.96 t at 80% scrap [S37].
- **Minor sources:** liquid steel $\times 0.01$ to 0.02 t CO₂/t for diesel and LPG, plus an SF₆ inventory of 0.5 to 2 t $\times 0.5\%$ a year $\times 23,500$ [S105]; about 3,250 to 6,620 t CO₂e a year in Phase 1 (central 4,934 t).
- **Lender threshold crossing:** the grid factor at which Phase 1 Scopes 1 and 2 reach 100,000 t = $(100,000 - \text{Scope 1}) / \text{Phase 1 electricity}$ = about 236 g/kWh on the RC-1 model, or $(100,000 - 31,915 - 4,934) / 288,957$ MWh = about 219 g/kWh with the central minor sources.
- **Furnace electricity at the upper planning value:** $+40$ kWh/t $\times 319,149$ t of liquid steel = about 12,800 MWh a year in Phase 1, or about 2,900 t CO₂ at 226 g/kWh, $+0.010$ t per tonne of product.
- **Billet basis:** per tonne of cast steel, Scope 1 = 0.10 t; melt-shop Scope 2 = 520 kWh $\times 226$ g/kWh = 0.118 t; upstream DRI = $0.30 / 0.88 \times 0.70 = 0.239$ t.
- **Rainfall uplift:** station return values $\times 1.07$ per additional degree of global warming [S59].
- **Currency:** where US dollar equivalents are given, a planning rate of 600 FCFA per US dollar is used [S90]; the FCFA is pegged to the euro at 655.957.

Table A.2 Key derived values used in the text

Quantity	Value	Where used
RC-1 Phase 1 electricity per tonne of product	about 963 kWh/t	Chapters 3 and 4
Phase 1 Scopes 1+2 per t product at 226 g/kWh	0.324 t CO ₂	Throughout
Phase 1 total incl. upstream DRI per t product	0.578 t CO ₂ (0.543 per t crude steel)	Throughout
Full build-out Scopes 1+2 / total per t product	0.328 / 0.582 t CO ₂	Chapters 4 and 10
Grid factor at which Phase 1 total equals the scrap-EAF average (0.69)	about 343 g/kWh	Chapter 3

Quantity	Value	Where used
Grid factor at which Phase 1 Scopes 1+2 reach 100,000 t (RC-1 model / with central minor sources)	about 236 / 219 g/kWh	Chapters 4 and 9
Phase 1 Scopes 1+2 with minor fuels and SF6	about 100,000 to 104,000 t a year	Executive summary; Chapters 4 and 9
Phase 1 intensity with the furnace at 490 kWh/t (Scopes 1+2 / total)	0.334 / 0.588 t CO ₂ per t product	Chapters 3 and 4
CBAM basis, all-scrap furnace (RC-1 model, no DRI)	0.106 t CO ₂ per t product	Chapter 5
Fossil generation rate implied by 2024 grid data	about 771 g/kWh	Chapter 3
2025 grid cross-check (estimate)	about 74 to 96 g/kWh	Chapters 2 and 3
CBAM basis, Phase 1 / full build-out	0.360 / 0.411 t CO ₂ per t	Chapter 5
Effect of 10 more points of scrap in the charge	about -0.088 t per t product	Chapters 4 and 8
Hydrogen electricity, RC-1 iron units / 1 Mt module	0.88 to 1.02 / 2.43 to 2.81 TWh per year	Chapter 6

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90].

A.9 Limitations

The model is a steady-state balance at nameplate output. It does not represent ramp-up, part-load operation, product-mix effects on rolling energy, seasonal grid variation, the emissions of purchased inputs other than iron units, transport, or construction. Benchmarks are drawn from international guidelines and planning assumptions, not from supplier guarantees. All results should be read with the ranges shown and will be replaced by engineering and then measured data (Chapter 11).

ANNEX B

GLOSSARY AND ABBREVIATIONS

The terms below are defined as they are used in this paper. Where a standard or regulation defines a term formally, the definition here is a plain-language summary and the formal text prevails.

Term	Meaning in this paper
Alternatives analysis	Under the Equator Principles, an evaluation of technically and financially feasible alternatives that would reduce a project's greenhouse gas emissions
BF-BOF	Blast furnace and basic oxygen furnace: the integrated route that reduces iron ore with coke and converts the resulting pig iron into steel with oxygen
Benchmark (CBAM)	A reference emission value per tonne of a good, used with the CBAM factor to reduce the certificates an importer must surrender, reflecting free allocation still given to EU producers
Billet	A semi-finished cast steel product of square section, rolled into bars, wire rod or light sections
CBAM	Carbon Border Adjustment Mechanism: the EU (and, from 2027, UK) system that charges importers for the carbon embedded in covered goods
CBAM factor	The percentage of the benchmark still deducted in a given year; 97.5% in 2026, falling to zero in 2034
CEMAC	Economic and Monetary Community of Central Africa (Cameroon, Central African Republic, Chad, Republic of the Congo, Equatorial Guinea, Gabon)
CN code	Combined Nomenclature code used by the EU to classify goods for customs purposes
CO ₂ e	Carbon dioxide equivalent: a quantity of greenhouse gases expressed as the amount of CO ₂ with the same warming effect
Combined margin	An emission factor for grid electricity that blends the average and marginal (operating and build) views, used by some lenders for project accounting
Crude steel	Steel in its first solid form after casting; the denominator used by worldsteel and most site-intensity standards
Default value (CBAM)	An emission value set by the EU for a good and country, used when actual embedded emissions are not documented and verified
Direct emissions	Emissions released from sources at the installation itself; Scope 1 in the GHG Protocol
DR-grade	Iron ore or pellets suitable for direct reduction: high in iron (ideally 67% Fe or more) and low in silica and alumina
DRI	Direct-reduced iron: iron ore reduced in the solid state, usually in a shaft furnace with reformed natural gas or hydrogen
EAF	Electric-arc furnace: a furnace that melts scrap, DRI or pig iron with an electric arc between graphite electrodes and the charge
EAF dust	Fine dust captured from the furnace's fume-extraction system; classified as hazardous because of its zinc, lead and cadmium content
Embedded emissions	Under CBAM, the emissions released in producing a good, including those of relevant precursors; for iron and steel only direct emissions count, including the direct emissions of precursors such as DRI, and the emissions of purchased electricity are not priced
EN 15804	The European standard setting core rules for environmental product declarations of construction products

Term	Meaning in this paper
EP4	The fourth version of the Equator Principles (2020), a risk-management framework used by banks for project finance
EPD	Environmental product declaration: a verified document reporting the life-cycle environmental impacts of a product
Gangue	The non-iron minerals in iron ore, such as silica and alumina
GHG Protocol	The Greenhouse Gas Protocol corporate accounting and reporting standards of the World Resources Institute and the World Business Council for Sustainable Development
Green iron	Iron made with very low emissions, typically by hydrogen-based direct reduction using low-carbon electricity
Grid emission factor	The quantity of CO ₂ (or CO ₂ e) emitted per kWh of electricity supplied from a grid; may be average, marginal or contractual
HBI	Hot-briquetted iron: DRI compacted while hot into dense briquettes, which are more stable for shipping and storage
Hot charging	Charging billets from the caster into the reheating furnace while still hot, to save reheating energy
Induction heating	Heating billets electrically by electromagnetic induction before rolling
ISO 14404	The international standard series for calculating the CO ₂ intensity of iron and steel production sites
ISO 14067	The international standard for the carbon footprint of products
KPIZ	Kribi Port Industrial Zone, the industrial-port zone at Kribi within which the project is located
Ladle furnace (LF)	A secondary-metallurgy station where liquid steel is reheated, alloyed and refined before casting
Location-based Scope 2	Scope 2 emissions calculated with the average emission factor of the grid where the electricity is consumed
Market-based Scope 2	Scope 2 emissions calculated with the emission factor of the electricity a company has contracted for, evidenced by contractual instruments
Metallic charge	The iron-bearing materials melted in the furnace: scrap, DRI, HBI or pig iron
Mill scale	Iron oxide flakes formed on hot steel during reheating and rolling
Near-zero emission steel	Steel below a threshold intensity defined by the IEA, sliding from 0.40 t CO ₂ e per tonne at 0% scrap to 0.05 t at 100% scrap
Paris alignment	Assessment by multilateral development banks of whether an operation is consistent with the goals of the Paris Agreement
Precursor	Under CBAM, an input good whose embedded emissions are added to those of the final good, such as DRI or pig iron for steel
RC-1	Reference configuration 1: Cameroon Steel's planning estimate of the Mboro works (phases, benchmarks and balances), used for public and regulatory discussion
Scope 1, 2, 3	Direct emissions; emissions from purchased electricity, steam or heat; and all other value-chain emissions, in the GHG Protocol
Scrap-EAF	Steelmaking in an electric-arc furnace with a predominantly scrap charge
Shaft furnace	A vertical reactor in which iron-ore pellets descend against a rising reducing gas to produce DRI
Slag	The molten oxide layer that forms on liquid steel in the furnace, solidifying into a rock-like material that can be used as aggregate
SSP2-4.5, SSP5-8.5	IPCC scenarios combining socio-economic pathways with radiative forcing; intermediate and very high emissions respectively

Term	Meaning in this paper
Upstream emissions	Emissions released in producing purchased inputs before they reach the plant, such as the DRI made by a supplier
Waelz kiln	A rotary kiln process that recovers zinc from EAF dust as a zinc oxide concentrate
WBGT	Wet-bulb globe temperature: a heat-stress index combining air temperature, humidity, radiant heat and air movement (ISO 7243)

Source: Cameroon Steel, from the standards and documents cited in Annex C.

Units and conventions

- **t** is the metric tonne; **Mt** a million tonnes; **Mtpa** a million tonnes per year; **kt** a thousand tonnes.
- **t CO₂/t** is tonnes of carbon dioxide per tonne of steel; RC-1 values are per tonne of finished product unless stated, and worldsteel values per tonne of crude steel.
- **kWh, MWh, GWh, TWh** are kilowatt-hours and their multiples; **g/kWh** is grams of CO₂ (or CO₂e) per kilowatt-hour.
- **GJ, PJ** are gigajoules and petajoules; **bcf** is a billion cubic feet of natural gas.
- **FCFA** is the Central African CFA franc, pegged at 655.957 FCFA to the euro; dollar equivalents use a planning rate of 600 FCFA per US dollar.
- Ranges are written with "to"; "about" signals a rounded value.

ANNEX C

SOURCES

Every source cited in this paper is listed below with its identifier, title, publisher, date and address. Identifiers appear in square brackets in the text, tables and figure source lines. Web addresses were accessed on or before 10 October 2026. Documents of the Port Autonome de Kribi are cited by title and date without a link. Secondary sources are labelled as such and were used only where no primary source was available to the authors.

Table C.1 Source register

ID	Title	Publisher	Date	Address
S01	Sustainability Indicators 2025 report (2024 data; route table added February 2026)	worldsteel	Nov 2025; upd. Feb 2026	https://worldsteel.org/wider-sustainability/sustainability-indicators/
S02	Climate change and the production of iron and steel (policy paper)	worldsteel	accessed 10 Oct 2026	https://worldsteel.org/climate-action/climate-change-and-the-production-of-iron-and-steel/
S03	World Steel in Figures 2026	worldsteel	4 Jun 2026	https://worldsteel.org/data/world-steel-in-figures/world-steel-in-figures-2026/
S04	December 2025 crude steel production and 2025 global totals	worldsteel	23 Jan 2026	https://worldsteel.org/media/press-releases/2026/december-2025-crude-steel-production-2025-global-crude-steel-production/
S05	Iron and Steel Technology Roadmap	International Energy Agency	Oct 2020	https://iea.blob.core.windows.net/assets/eb0c8ec1-3665-4959-97d0-187ceca189a8/Iron_and_Steel_Technology_Roadmap.pdf
S06	Achieving Net Zero Heavy Industry Sectors in G7 Members	International Energy Agency	19 May 2022	https://iea.blob.core.windows.net/assets/c4d96342-f626-4aea-8dac-df1d1e567135/AchievingNetZeroHeavyIndustrySectorsinG7Members.pdf
S07	Emissions Measurement and Data Collection for a Net Zero Steel Industry	International Energy Agency	2023	https://www.iea.org/reports/emissions-measurement-and-data-collection-for-a-net-zero-steel-industry
S08	Making Net-Zero Steel Possible	Mission Possible Partnership	Sep 2022	https://missionpossiblepartnership.org/action-sectors/steel
S09	Mission Possible sectoral focus: Steel	Energy Transitions Commission	2019 (Mission Possible, Nov 2018)	https://www.energy-transitions.org/wp-content/uploads/2020/08/ETC-sectoral-focus-Steel_final.pdf
S10	Green Iron Corridors	RMI with the Green Hydrogen Catapult	2024	https://rmi.org/insight/green-iron-corridors/
S11	15 Insights on the Global Steel Transformation	Agora Industry	15 Jun 2023	https://www.agora-industry.org/publications/15-insights-on-the-global-steel-transformation

ID	Title	Publisher	Date	Address
S12	Green Iron, Shared Gains	Agora Industry and Cambridge Econometrics	8 Oct 2026	https://www.agora-industry.org/publications/green-iron-shared-gains
S13	2025 World Direct Reduction Statistics	Midrex Technologies	Sep 2026	https://www.midrex.com/world-dri-statistics/world-dri-production-reaches-151-0-mt-in-2025/Midrex-STATS-book-2025-FINAL.pdf
S14	Pedal to the Metal 2026	Global Energy Monitor	May 2026	https://globalenergymonitor.org/sites/default/files/2026-05/Pedal%20to%20the%20Metal%202026.pdf
S15	ENERGIRON technology: DRI-EAF production route using natural gas or H ₂	European Commission, Innovation Centre for Industrial Transformation	ref. 12 Feb 2026	https://innovation-centre-for-industrial-transformation.ec.europa.eu/innovative-techniques/energiron-technology-drieaf-production-route-using-natural-gas-or-h2
S16	Suez Steel sets new benchmark in energy consumption for DRI production	Danieli	16 Apr 2026	https://www.danieli.com/en/news-media/news/suez-steel-sets-new-benchmark-energy-consumption-dri-production_37_1051.htm
S17	Hydrogen uses in ironmaking (Midrex presentation, H ₂ @Scale)	US Department of Energy	1 Aug 2018	https://www.energy.gov/sites/prod/files/2018/08/f54/fcto-h2-scale-kickoff-2018-8-chevrier.pdf
S18	DRI-EAF implementation at Saarstahl and Dillinger steelworks (POWER4STEEL)	European Commission, Innovation Centre for Industrial Transformation	ref. Jul 2025	https://innovation-centre-for-industrial-transformation.ec.europa.eu/innovative-techniques/drieaf-implementation-saarstahl-dillinger-steelworks-power4steel
S19	Best Available Techniques Reference Document for Iron and Steel Production (EUR 25521)	European Commission, Joint Research Centre	2013	https://bureau-industrial-transformation.jrc.ec.europa.eu/sites/default/files/2019-11/IS_Adopted_03_2012.pdf
S20	Environmental, Health, and Safety Guidelines for Integrated Steel Mills	IFC / World Bank Group	30 Apr 2007	https://www.ifc.org/content/dam/ifc/doc/2000/2007-integrated-steel-mills-ehs-guidelines-en.pdf
S21	Performance Standards on Environmental and Social Sustainability	IFC	1 Jan 2012	https://www.ifc.org/en/insights-reports/2012/ifc-performance-standards
S22	The Equator Principles EP4	Equator Principles Association	Jul 2020 (effective 1 Oct 2020)	https://equator-principles.com/app/uploads/The-Equator-Principles_EP4_July2020.pdf
S23	Paris alignment at IFC	IFC	accessed 10 Oct 2026	https://www.ifc.org/en/what-we-do/sector-expertise/climate-business/paris-alignment-at-ifc
S24	Joint MDB methodological principles for assessment of Paris alignment of new operations (presentation)	Multilateral development banks (hosted by EIB)	5 Dec 2023	https://trad.eib.org/attachments/press/05-12-2023-joint-mdb-paris-alignment-presentation.pdf
S25	Carbon Border Adjustment Mechanism	European Commission, DG TAXUD	accessed 10 Oct 2026	https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism_en
S26	Price of CBAM certificates	European Commission, DG TAXUD	latest 5 Oct 2026	https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism/price-cbam-certificates_en
S27	Regulation (EU) 2023/956 establishing a carbon border adjustment mechanism, Annexes I and II	Official Journal of the EU, L 130	16 May 2023	https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32023R0956

ID	Title	Publisher	Date	Address
S28	Directive (EU) 2023/959 amending the EU Emissions Trading System Directive	Official Journal of the EU, L 130	16 May 2023	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023L0959
S29	EU adopts CBAM Omnibus Regulation (Regulation (EU) 2025/2083)	EY	22 Oct 2025	https://www.ey.com/en_gl/technical/tax-alerts/eu-adopts-cbam-omnibus-regulation
S30	Annexes to the Proposal amending Regulation (EU) 2023/956 as regards simplifying and strengthening the CBAM, COM(2025) 87 (Council document 6609/25 ADD 1)	European Commission / Council of the EU	27 Feb 2025	https://data.consilium.europa.eu/doc/document/ST-6609-2025-ADD-1/en/pdf
S31	EU Commission finalizes CBAM benchmarks, default values ahead of January 2026 launch	EUROMETAL	Dec 2025	https://eurometal.net/eu-commission-finalizes-cbam-benchmarks-default-values-ahead-of-january-2026-launch/
S32	European Commission issues CBAM operational rules and proposes downstream extension of the CBAM scope	Mayer Brown	Dec 2025	https://www.mayerbrown.com/ja/insights/publications/2025/12/european-commission-issues-cbam-operational-rules-and-proposes-downstream-extension-of-the-cbam-scope
S33	COM(2025) 989: proposal extending the CBAM to downstream goods	European Commission (EUR-Lex)	17 Dec 2025	https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52025PC0989
S34	Carbon Border Adjustment Mechanism (CBAM): guidance collection	HM Revenue and Customs, GOV.UK	updated Jul to Sep 2026	https://www.gov.uk/government/collections/carbon-border-adjustment-mechanism
S35	Final report from the Australian Carbon Leakage Review	PwC Australia	2026	https://www.pwc.com.au/tax/tax-alerts/final-report-from-the-australian-carbon-leakage-review.html
S36	Factsheet: Action Plan on Steel and Metals	European Commission	Mar 2025	https://ec.europa.eu/commission/presscorner/api/files/attachment/880887/Factsheet%20-%20Action%20Plan%20on%20Steel%20and%20Metals.pdf
S37	The Decarbonisation Progress Levels	ResponsibleSteel	23 Sep 2024	https://www.responsiblesteel.org/resources/the-decarbonisation-progress-levels
S38	Revisions to ResponsibleSteel's Principle 10: Greenhouse Gas Emissions and Climate Change	ResponsibleSteel	23 Apr 2024	https://www.responsiblesteel.org/news/revisions-to-responsiblesteels-principle-10-greenhouse-gas-emissions-and-climate-change
S39	The Steel Climate Standard	Global Steel Climate Council	accessed 10 Oct 2026	https://globalsteelclimatecouncil.org/the-standard/
S40	Germany introduces new green steel certification standard (Low Emission Steel Standard)	EUROMETAL	Apr 2024	https://eurometal.net/germany-introduces-new-green-steel-certification-standard/
S41	ISO 14404-1:2024 and ISO 14404-2:2024, Calculation method of carbon dioxide emission intensity from iron and steel production, Parts 1 and 2	International Organization for Standardization	Sep 2024	https://www.iso.org/standard/88111.html
S42	ISO 14404-3:2024, Part 3: Steel plant with electric arc furnace and coal-based or gas-based direct reduction iron facility	International Organization for Standardization	2024	https://www.iso.org/standard/85990.html
S43	ISO 14404-4:2020, Part 4: Guidance for using the ISO 14404 series	International Organization for Standardization	2020	https://www.iso.org/standard/77622.html

ID	Title	Publisher	Date	Address
S44	Life cycle inventory data and eco-profiles	worldsteel	accessed 10 Oct 2026 (2024 dataset released May 2026)	https://worldsteel.org/steel-topics/life-cycle-thinking/life-cycle-inventory-data-and-eco-profiles/
S45	GHG Protocol Corporate Standard (2004) and Scope 2 Guidance (2015)	World Resources Institute and WBCSD	2004; 2015	https://ghgprotocol.org/corporate-standard ; https://ghgprotocol.org/scope-2-guidance
S46	ISO 14067:2018, Greenhouse gases: carbon footprint of products	International Organization for Standardization	2018	https://www.iso.org/standard/71206.html
S47	ISO 14025:2006, Environmental labels and declarations, Type III; EN 15804:2012+A2:2019, core rules for construction products	ISO; European Committee for Standardization (CEN)	2006; 2019	https://www.iso.org/standard/38131.html
S48	Carbon intensity of electricity generation (Ember data)	Our World in Data	dataset accessed 10 Oct 2026	https://ourworldindata.org/grapher/carbon-intensity-electricity
S49	Electricity production by source (Ember and Energy Institute data)	Our World in Data	dataset accessed 10 Oct 2026	https://ourworldindata.org/grapher/electricity-production-source-stacked
S50	Rapport d'activités 2025 de l'ARSEL	ARSEL (electricity regulator, Cameroon)	7 Sep 2026	https://arsel-cm.org/wp-content/uploads/2026/09/Rapport-ARSEL-2025.pdf
S51	Nachtigal power line delays leave 150 MW of industrial demand unmet	Business in Cameroon	9 Oct 2026	https://www.businessincameroon.com/public-management/0910-16939-nachtigal-power-line-delays-leave-150-mw-of-industrial-demand-unmet
S52	Énergie: Nachtigal franchit le cap des 3,6 TWh injectés dans le réseau en un an	Journal du Cameroun	15 Jun 2026	https://fr.journalducameroun.com/energie-nachtigal-franchit-le-cap-des-3-6-twh-injectes-dans-le-reseau-en-un-an/
S53	Cameroon: Energy (Country Commercial Guide)	US International Trade Administration	13 Apr 2026	https://www.trade.gov/country-commercial-guides/cameroon-energy
S54	Décision fixant le montant de la RMA ENEO au titre de l'exercice 2025 (réajustée)	ARSEL	19 Dec 2025	http://arsel-cm.org/wp-content/uploads/2026/01/Decision-fixant-le-Montant-de-le-RMA-Eneo-au-titre-de-l'exercice-2025-du-19-12-2025.pdf
S55	Kribi franchit la ligne électrique 225 kV (communiqué)	Port Autonome de Kribi	6 Aug 2025	Cited by title and date; no link given
S56	Énergie et infrastructures: un nouvel élan pour la compétitivité du Port de Kribi (communiqué)	Port Autonome de Kribi	19 Aug 2026	Cited by title and date; no link given
S57	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2: Energy	IPCC	2006	https://www.ipcc-nggip.iges.or.jp/public/2006gl/vol2.html
S58	Climate Change 2014: Mitigation, Annex III: Technology-specific cost and performance parameters	IPCC Working Group III	2014	https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf
S59	Climate Change 2021: The Physical Science Basis, Summary for Policymakers	IPCC Working Group I	2021	https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf
S60	Monographie du Nyong et des fleuves côtiers, Tome 1 (J.-C. Olivry)	ORSTOM	Jul 1979	https://horizon.documentation.ird.fr/exl-doc/pleins_textes/divers111-03/01948.pdf
S61	Kribi Deep Sea Port, investors partner to construct 125-million-tonne mineral terminal worth \$2 billion	Business in Cameroon	5 Nov 2025	https://www.businessincameroon.com/transport/0511-15300-kribi-deep-sea-port-investors-partner-to-construct-125-million-tonne-mineral-terminal-worth-2-billion

ID	Title	Publisher	Date	Address
S62	Weakening of coastlines and coastal erosion in the Gulf of Guinea: the case of the Kribi coast (Fendoung, Tchindjang and Hubert-Ferrari), Land 11:1557	MDPI	2022	https://doi.org/10.3390/land11091557
S63	Geomatics-based assessment of coastal vulnerability in Kribi (Perabi et al.), Urban Resilience and Sustainability 3 (4)	AIMS Press	Nov 2025	https://www.aimspress.com/aimspress-data/urs/2025/4/PDF/urs-03-04-012.pdf
S64	ERA5 reanalysis, daily series 1991 to 2020 for the Kribi grid cell (rainfall and temperature), via the Open-Meteo archive API	ECMWF / Open-Meteo	accessed 10 Oct 2026	https://archive-api.open-meteo.com/v1/archive?latitude=2.75&longitude=10.00&start_date=1991-01-01&end_date=2020-12-31&daily=temperature_2m_max,temperature_2m_min,precipitation_sum&models=era5
S65	Working on a warmer planet: the impact of heat stress on labour productivity and decent work (as reported by UN News)	International Labour Organization	1 Jul 2019	https://news.un.org/en/story/2019/07/1041652
S66	ISO 7243:2017, Ergonomics of the thermal environment: assessment of heat stress using the WBGT index	International Organization for Standardization	2017	https://www.iso.org/standard/67188.html
S67	EU recycled 92% of steel slag in 2024 (EUROSLAG figures)	GMK Center	1 Dec 2025	https://gmk.center/en/news/eu-recycled-92-of-steel-slag-in-2024-euroslag/
S68	Global recycled steel use reaches 630 million tonnes (BIR, World Steel Recycling in Figures)	Recycling Product News	2026	https://www.recyclingproductnews.com/article/43829/global-recycled-steel-use-reaches-630-million-tonnes-in-2025
S69	Recycling of electric arc furnace dust (zinc recovery, Waelz process)	Galvanizers Association	n.d., accessed 10 Oct 2026	https://galvanizing.org.uk/?p=32698
S70	Befesa: steel dust and aluminium by-products recycling results 2024	Recycling Today	2025	https://recyclingtoday.com/news/befesa-steel-aluminum-byproducts-recycling-earnings-2024-europe-usa-china
S71	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (text)	UNEP, Secretariat of the Basel Convention	1989, as amended	https://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx
S72	Kribi: le Premier ministre, chef du gouvernement est là (foundation stone of the Kribi steel complex)	Cameroon Tribune	30 Dec 2024	https://cameroon-tribune.cm/article.html/68499/fr.html/details_2
S73	Industrialisation: la voie royale de l'émergence	Cameroon Tribune	2 Jan 2025	https://cameroon-tribune.cm/article.html/68558/fr.html/details_2
S74	Zone industrielo-portuaire de Kribi (KPIZ): jusqu'à +8 points de croissance et 150 000 emplois attendus sur 15 ans	Investir au Cameroun	4 Mar 2026	https://www.investiraucameroun.com/gestion-publique/0403-23163-zone-industrialo-portuaire-de-kribi-kpiz-jusqu-a-8-points-de-croissance-et-150-000-emplois-attendus-sur-15-ans
S75	Iron Ore Quality a Potential Headwind to Green Steelmaking	Institute for Energy Economics and Financial Analysis (IEEFA)	Jun 2022	https://ieefa.org/sites/default/files/2022-06/Iron%20Ore%20Quality%20a%20Potential%20Headwind%20to%20Green%20Steelmaking__June%202022.pdf
S76	Global high-grade iron ore market is set to grow	Institute for Energy Economics and Financial Analysis (IEEFA)	Mar 2026	https://ieefa.org/sites/default/files/2026-03/IEEFA_Global%20high-grade%20iron%20ore%20market%20is%20set%20to%20grow_March%202026_0.pdf

ID	Title	Publisher	Date	Address
S77	Global Gateway: Namibia becomes pioneer for Africa's green transition	European Commission, International Partnerships	11 Apr 2025	https://international-partnerships.ec.europa.eu/news-and-events/news/global-gateway-namibia-becomes-pioneer-africas-green-transition-2025-04-11_en
S78	Namibia opens renewables-powered green iron plant	Energize	15 Apr 2025	https://energize.co.za/article/namibia-opens-renewables-powered-green-iron-plant
S79	Global Hydrogen Review 2025	International Energy Agency	12 Sep 2025	https://www.iea.org/reports/global-hydrogen-review-2025
S80	Cameroon's updated NDC sets 35% conditional emission cut target for 2030	Enerdata	2021	https://www.enerdata.net/publications/daily-energy-news/cameroons-updated-ndc-sets-35-conditional-emission-cut-target-2030.html
S81	Arrêté n° 106/PM du 11 juillet 2025 portant approbation du Plan National Climat	Prime Minister of Cameroon (MINEPDED)	11 Jul 2025	https://minepded.gov.cm/wp-content/uploads/2025/08/decret-PM-plan-climat-1.pdf
S82	EU Emissions Trading System (factsheet)	International Carbon Action Partnership (ICAP)	2026	https://icapcarbonaction.com/en/ets/eu-emissions-trading-system-eu-ets
S83	Données pétrolières 2025	Société Nationale des Hydrocarbures (SNH)	Jun 2026	https://snh.cm/wp-content/uploads/2026/06/Donnees-petrolieres-2025.pdf
S84	Le navire usine quitte le Cameroun, le gaz s'arrête	Camer.be	9 Jul 2026	https://www.camer.be/9391112:1/le-navire-usine-quitte-le-cameroun-le-gaz-sarrete-cameroon.html
S85	Cameroon's SNH eyes Yoyo-Yolanda and new exploration blocks to sustain gas growth	Business in Cameroon	6 Jul 2026	https://www.businessincameroon.com/energy/0607-16422-cameroon-s-snh-eyes-yoyo-yolanda-and-new-exploration-blocks-to-sustain-gas-growth
S86	Loi n° 2023/014 du 19 décembre 2023 portant Code minier	Republic of Cameroon (FAOLEX)	19 Dec 2023	https://faolex.fao.org/docs/pdf/cmr223180.pdf
S87	Port de Kribi: un terminal minéralier d'avenir (memorandum of understanding for a mineral terminal)	Port Autonome de Kribi	4 Nov 2025	Cited by title and date; no link given
S88	La récupération et le recyclage des déchets ferromagnétiques: analyse de la situation au Cameroun (Bidoung, Fomethé, Yantio, Melo), Déchets: revue francophone d'écologie industrielle no. 48	ENSP Yaoundé / MIPROMALO (Episciences)	Q4 2007	https://eid.episciences.org/7942/pdf
S89	Cameroon: le groupe Prometal décroche 26 milliards FCFA auprès d'Afreximbank	Sikafinance	30 Sep 2026	https://www.sikafinance.com/marches/cameroon-le-groupe-prometal-decroche-26-milliards-fcfa-aupres-dafreximbank-pour-renforcer-sa-production-dacier-et-conquerir-de-nouveaux-marches_64623
S90	Cameroon Steel reference configuration RC-1 (planning estimate): phases, planning values, balances and indicative schedule, edition 10 October 2026	Cameroon Steel	10 Oct 2026	Values used in this paper are printed in Annexes A and D; chart data are published with the web edition
S91	Cameroon country profile	International Hydropower Association	accessed 10 Oct 2026	https://www.hydropower.org/country-profiles/cameroon
S92	worldsteel Short Range Outlook, April 2026	worldsteel	14 Apr 2026	https://worldsteel.org/media/press-releases/2026/worldsteel-short-range-outlook-april-2026/
S93	CBAM steel 2026: CN codes, emission factors, costs and compliance guide (route classification), secondary source	CBAMguide	accessed 10 Oct 2026	https://cbamguide.com/sectors/steel/

ID	Title	Publisher	Date	Address
S94	Enhanced EAF steelmaking through continuous charging, scrap preheating (Consteel)	European Commission, Innovation Centre for Industrial Transformation	n.d., accessed 10 Oct 2026	https://innovation-centre-for-industrial-transformation.ec.europa.eu/innovative-techniques/enhanced-eaf-steelmaking-through-continuous-charging-scrap-preheating-and
S95	Regulation (EU) 2026/1384 (steel tariff-rate quota replacing the safeguard)	Official Journal of the EU	24 Jun 2026	https://eur-lex.europa.eu/eli/reg/2026/1384/oj/eng
S96	Weekly steel prices (archive 40468)	Arab Iron and Steel Union (AISU)	3 Oct 2026	https://aisusteel.org/en/archives/40468
S97	Earthquake catalogue search, 400 km radius around Kribi, magnitude 3 and above, 1900 onwards	US Geological Survey	accessed 10 Oct 2026	https://earthquake.usgs.gov/fdsnws/event/1/query?format=csv&latitude=2.75&longitude=10.00&maxradiuskm=400&minmagnitude=3&starttime=1900-01-01
S98	IEC 62305 series, Protection against lightning	International Electrotechnical Commission	2010 onwards	https://webstore.iec.ch/en/publication/6793
S99	International Maritime Solid Bulk Cargoes (IMSBC) Code	International Maritime Organization	accessed 10 Oct 2026	https://www.imo.org/en/OurWork/Safety/Pages/BulkCarriers-Default.aspx
S100	BIR warns against sliding-scale steel green standards	EUROMETAL	accessed 10 Oct 2026	https://eurometal.net/bir-warns-against-sliding-scale-steel-green-standards/
S101	ISO 14064-3:2019, Greenhouse gases: specification for the verification and validation of GHG statements	International Organization for Standardization	2019	https://www.iso.org/standard/66455.html
S102	IFRS S2 Climate-related Disclosures	IFRS Foundation, International Sustainability Standards Board	Jun 2023	https://www.ifrs.org/issued-standards/ifrs-sustainability-standards-navigator/ifrs-s2-climate-related-disclosures/
S103	Décision portant compensation tarifaire ENEO au titre de l'exercice 2024	ARSEL	27 Dec 2024	http://arsel-cm.org/wp-content/uploads/2025/12/2024-Decsision-Tarifaire-2024-du-27-12-2024.pdf
S104	CBAM legislation and guidance: implementing acts, including Implementing Regulation (EU) 2025/2620 (benchmarks) and Implementing Regulation (EU) 2025/2621 (default values)	European Commission, DG TAXUD	accessed 10 Oct 2026	https://taxation-customs.ec.europa.eu/carbon-border-adjustment-mechanism/cbam-legislation-and-guidance_en
S105	Climate Change 2013: The Physical Science Basis, Chapter 8, Anthropogenic and natural radiative forcing (global warming potentials; SF6 = 23,500)	IPCC Working Group I	2013	https://www.ipcc.ch/report/ar5/wg1/
S106	SRTM 30 m digital surface model, accessed through the OpenTopoData API	NASA; OpenTopoData	accessed 10 Oct 2026	https://www.opentopodata.org/datasets/srtm/

Source: Cameroon Steel. Chart data files published with the web edition list, for each exhibit, the identifiers of the sources used.

ANNEX D

DATA TABLES BEHIND THE FIGURES

This annex prints the values plotted in each of the 31 figures of the paper, so that readers can check them, reuse them and cite them without reading values off a graphic. The tables are generated directly from the data files published with the web edition (one JSON file per exhibit, written by the same script that draws the charts), so they cannot drift from the figures. Each table states its unit and the status of its values (sourced, derived, assumed or illustrative, as defined in Annex A), and repeats the source line of the figure. Values are rounded as in the figures; totals are computed before rounding. Where a figure plots a continuous line, the table gives the values at regular steps; the model in Annex A reproduces any intermediate point. A few columns that are not plotted but help to read a figure (shares of a total, differences, Scopes 1 and 2 subtotals) are added and identified as such.

D.1 Executive summary and Chapter 1: steel and climate

Figure ES.1: RC-1 against worldsteel route averages

World route averages are per tonne of crude steel and are not split by scope in the figure; RC-1 values are per tonne of finished product, split by scope as in the bars.

Table D.1 Values plotted in Figure ES.1, t CO₂ per tonne

Series	Scope 1	Scope 2 (226 g/kWh)	Upstream DRI/HBI	Total	Basis	Status
BF-BOF, world average				2.34	per t crude steel	sourced
World average, all routes				1.92	per t crude steel	sourced
DRI-EAF, world average				1.47	per t crude steel	sourced
Scrap-EAF, world average				0.69	per t crude steel	sourced
RC-1 full build-out (1 Mtpa)	0.16	0.17	0.25	0.58	per t product	derived
RC-1 Phase 1 (0.3 Mtpa)	0.11	0.22	0.25	0.58	per t product	derived

On the per-tonne-of-crude-steel basis of the benchmarks, the RC-1 totals are 0.54 (Phase 1) and 0.55 (full build-out).

Source: worldsteel Sustainability Indicators 2025 (2024 data) [S01]; Cameroon Steel reference configuration RC-1 (planning estimate), edition 10 October 2026 [S90]; WP06 model (Annex A). Blank cells: not split in the source.

Figure 1.1: carbon intensity by route

Sustainability indicators of worldsteel for 2024, covering Scopes 1, 2 and upstream emissions, per tonne of crude steel.

Table D.2 Values plotted in Figure 1.1, tonnes per tonne of crude steel (sourced)

Route	t CO ₂	t CO ₂ e
BF-BOF, world average	2.34	2.66
DRI-EAF, world average	1.47	1.66
Scrap-EAF, world average	0.69	0.71
World average, all routes	1.92	2.18

Source: worldsteel, Sustainability Indicators 2025 report, route table added February 2026 [S01].

Figure 1.2: direct and indirect emissions by route

IEA estimates for 2019. Indirect emissions (electricity and imported intermediates) are the difference between the two published values; they are computed at a world grid factor of 538 g/kWh.

Table D.3 Values plotted in Figure 1.2, t CO₂ per tonne of crude steel (sourced)

Route	Direct	Indirect (difference)	Direct and indirect
BF-BOF	1.20	1.00	2.20
Gas DRI-EAF	1.00	0.40	1.40
Scrap EAF	0.04	0.26	0.30
Global average	1.40	0.60	2.00

Source: IEA, Iron and Steel Technology Roadmap (2020) [S05].

Figure 1.3: electric-arc share of output and capacity

Share of crude steel made in electric furnaces, and share of the world's steelmaking capacity under development that is electric.

Table D.4 Values plotted in Figure 1.3, % of the total (sourced)

Series	Electric	Oxygen and other
World crude steel output, 2025	30.3%	69.7%
Africa crude steel output, 2025	89.0%	11.0%
World capacity in development, 2026	50.0%	50.0%

Source: worldsteel, World Steel in Figures 2026 [S03]; Global Energy Monitor, Pedal to the Metal 2026 [S14].

D.2 Chapter 2: accounting for carbon in steel

Figure 2.1: what each framework counts

The matrix behind the figure, simplified by Cameroon Steel. Columns: (a) furnace and ladle-furnace carbon; (b) on-site gas; © grid power; (d) imported iron units; (e) lime, alloys and electrodes; (f) inbound freight; (g) use and recycling.

Table D.5 Values plotted in Figure 2.1: counted (yes), partly counted (partly) or not counted (no) (sourced)

Framework	(a)	(b)	©	(d)	(e)	(f)	(g)
GHG Protocol Scope 1	yes	yes	no	no	no	no	no

Framework	(a)	(b)	©	(d)	(e)	(f)	(g)
GHG Protocol Scope 2	no	no	yes	no	no	no	no
EP4 threshold (Scopes 1+2)	yes	yes	yes	no	no	no	no
EU CBAM, iron and steel	yes	yes	no	yes	no	no	no
ISO 14404 / worldsteel	yes	yes	yes	yes	partly	no	no
ResponsibleSteel, IEA near-zero	yes	yes	yes	yes	partly	no	no
Product footprint, cradle to gate	yes	yes	yes	yes	yes	yes	no
EPD incl. end-of-life (module D)	yes	yes	yes	yes	yes	yes	yes

Source: GHG Protocol [S45]; Equator Principles EP4 [S22]; Regulation (EU) 2023/956, Annex II [S27]; ISO 14404 series [S41][S43]; ResponsibleSteel [S37]; IEA [S06]; ISO 14067 [S46]; EN 15804+A2 [S47]. Simplification by Cameroon Steel.

Figure 2.2: one plant, seven numbers

The same RC-1 Phase 1 tonne at nameplate output (0.3 Mtpa) under seven reporting perimeters.

Table D.6 Values plotted in Figure 2.2, t CO₂ per tonne

Perimeter	t CO ₂ /t	Status
Scope 1 only (direct)	0.11	derived
Scopes 1+2, hydro contract (market-based)	0.11	derived
Scopes 1+2, grid 96 g/kWh (2025 check)	0.20	derived
Scopes 1+2, grid 226 g/kWh (2024)	0.32	derived
EU CBAM basis (direct + DRI, no power)	0.36	illustrative
ISO 14404 basis, per t crude steel	0.54	derived
ISO 14404 basis, per t product	0.58	derived

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; grid factors from Ember via Our World in Data [S48] and ARSEL [S50]; CBAM perimeter from Regulation (EU) 2023/956 [S27].

D.3 Chapter 3: the grid factor

Figure 3.1: Cameroon's generation mix and grid intensity

Left panel: generation by source in 2024 (Ember) and 2025 (ARSEL). Right panel: average grid intensity, 2010 to 2024, and the derived 2025 cross-check (Annex A).

Table D.7 Values plotted in Figure 3.1 (left): generation by source (sourced)

Source	2024, TWh	2024, share	2025, TWh	2025, share
Hydro	5.23	72.0%	7.27	89.6%
Gas	1.60	22.0%	0.56	6.9%
Oil	0.35	4.8%	0.22	2.7%
Solar	0.04	0.6%	0.07	0.8%
Bioenergy	0.04	0.6%	0.00	0.0%

Source	2024, TWh	2024, share	2025, TWh	2025, share
Total	7.26	100%	8.12	100%

Table D.8 Values plotted in Figure 3.1 (right): average grid intensity, g CO₂e/kWh (sourced)

Year	g/kWh	Year	g/kWh	Year	g/kWh
2010	206	2015	337	2020	320
2011	192	2016	300	2021	298
2012	168	2017	288	2022	281
2013	240	2018	324	2023	224
2014	282	2019	306	2024	226

2025 cross-check (derived; an estimate): 74 g/kWh counting combustion only and 96 g/kWh adding life-cycle emissions of renewables, using the fossil emission rate implied by the 2024 data (771 g/kWh of fossil generation).

Source: Ember via Our World in Data, carbon intensity and generation by source [S48][S49]; ARSEL, Rapport d'activités 2025 [S50]; life-cycle factors for hydro (24 g), solar (48 g) and bioenergy (230 g) from IPCC AR5 Annex III [S58]. 2025 cross-check derived by Cameroon Steel (Annex A).

Figure 3.2: grid intensities compared

Average carbon intensity of electricity generation in 2024, in ascending order.

Table D.9 Values plotted in Figure 3.2, g CO₂e/kWh, 2024 (sourced)

Country or region	g/kWh	Country or region	g/kWh
Ethiopia	23	Turkey	470
Norway	30	World	471
Namibia	49	Nigeria	496
Kenya	85	China	555
Brazil	106	Egypt	574
European Union (27)	211	Algeria	633
Cameroon	226	Indonesia	680
Germany	336	India	705
United States	384	South Africa	717

Source: Ember via Our World in Data, carbon intensity of electricity generation, accessed 10 October 2026 [S48].

Figure 3.3: RC-1 Phase 1 intensity against the grid factor

Values of the two lines every 50 g/kWh, and at the four marked points. The intensity is linear in the grid factor; the line including upstream iron units crosses the worldsteel scrap-EAF average (0.69) at about 343 g/kWh.

Table D.10 Values plotted in Figure 3.3, t CO₂ per tonne of product (derived)

Grid factor, g CO ₂ /kWh	Scopes 1+2	Scopes 1+2 + upstream DRI/HBI
0	0.11	0.36
50	0.15	0.41

Grid factor, g CO ₂ /kWh	Scopes 1+2	Scopes 1+2 + upstream DRI/HBI
100	0.20	0.46
150	0.25	0.50
200	0.30	0.55
250	0.35	0.60
300	0.40	0.65
350	0.44	0.70
400	0.49	0.75
450	0.54	0.79
500	0.59	0.84
550	0.64	0.89
600	0.68	0.94
650	0.73	0.99
700	0.78	1.03
750	0.83	1.08
800	0.88	1.13

Table D.11 Marked points in Figure 3.3 (derived)

Grid	g CO ₂ /kWh	Scopes 1+2	Including upstream
Cameroon 2024	226	0.32	0.58
World	471	0.56	0.81
China	555	0.64	0.90
South Africa	717	0.80	1.05

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; grid factors from Ember via Our World in Data [S48]; worldsteel route averages [S01].

D.4 Chapter 4: an illustrative footprint

Figure 4.1: process chain and emission points

Figure 4.1 is a diagram. The table lists its elements, the emission point each carries and the RC-1 planning values shown on it.

Table D.12 Elements of Figure 4.1 (illustrative)

Element	RC-1 planning value	Emission point
Scrap	about 70% of the metallic charge	no emission point shown
Imported DRI/HBI	about 30% of the metallic charge	upstream: DRI made abroad
Electric arc furnace	40 t class	Scope 1: electrodes, charge carbon, lime; Scope 2

Element	RC-1 planning value	Emission point
Ladle furnace		Scope 2
Billet caster		Scope 2
Reheating	induction (Phase 1) or gas (Phases 2 and 3)	Scope 2 (induction); Scope 1 (gas, Phases 2 and 3)
Wire-rod and rebar mills, or merchant billets	sections later	Scope 2
Grid supply	225 kV, hydro-dominated, 226 g/kWh in 2024	Scope 2: electricity

Source: Cameroon Steel reference configuration RC-1 (planning estimate) [S90]. Simplified diagram.

Figure 4.2: annual footprint by phase

Annual emissions at nameplate output, in thousand tonnes of CO₂ (kt). The Equator Principles threshold drawn on the figure is 100 kt of Scopes 1 and 2 a year.

Table D.13 Values plotted in Figure 4.2, kt CO₂ per year (derived)

Phase	Scope 1	Scope 2	Scopes 1+2	Upstream DRI/HBI	Total
Phase 1, 0.3 Mtpa	31.9	65.3	97.2	76.2	173.4
Phases 1+2, 0.5 Mtpa	67.8	95.3	163.1	126.9	290.0
Full build-out, 1.0 Mtpa	157.4	170.2	327.7	253.9	581.5

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; Equator Principles EP4 [S22].

Figure 4.3: a tonne of Phase 1 product, by source

Components of the RC-1 Phase 1 intensity per tonne of reinforcing bar and wire rod.

Table D.14 Values plotted in Figure 4.3, t CO₂ per tonne of finished product (derived)

Component	t CO ₂ /t	Share of total
EAF and ladle furnace, direct (Scope 1)	0.106	18%
Melt-shop electricity (Scope 2)	0.125	22%
Induction heating (Scope 2)	0.068	12%
Rolling electricity (Scope 2)	0.025	4%
Scopes 1+2	0.324	56%
Upstream imported DRI/HBI	0.254	44%
Total	0.578	100%

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90] (Annex A).

Figure 4.4: one-at-a-time sensitivity

Change in the RC-1 Phase 1 intensity when each parameter is set to the low and high ends of its range, all others central. Base: 0.578 t CO₂/t including upstream iron units; 0.324 t CO₂/t for Scopes 1 and 2. The DRI-share case includes the furnace electricity penalty for DRI. The figure plots the total; the Scopes 1 and 2 columns are added for reference.

Table D.15 Values plotted in Figure 4.4, change in t CO₂ per tonne of product (derived)

Parameter and range (low to high)	Total, low	Total, high	Scopes 1+2, low	Scopes 1+2, high
Imported DRI share of charge, 20% to 50%	-0.088	+0.176	-0.003	+0.007
Upstream factor of DRI/HBI, 0.5 to 0.9 t/t	-0.073	+0.073	0.000	0.000
Grid emission factor, 200 to 300 g/kWh	-0.025	+0.071	-0.025	+0.071
EAF direct factor, 0.06 to 0.15 t/t liquid	-0.043	+0.053	-0.043	+0.053
Induction heating, 150 to 400 kWh/t	-0.034	+0.023	-0.034	+0.023
EAF electricity, 347 to 500 kWh/t	-0.025	+0.012	-0.025	+0.012
Cast-and-roll yield, 0.96 to 0.92	-0.010	+0.011	-0.005	+0.005
Metallic yield, 0.91 to 0.85	-0.008	+0.009	0.000	0.000
Rolling electricity, 70 to 140 kWh/t	-0.009	+0.007	-0.009	+0.007
Auxiliary electricity, 50 to 100 kWh/t	-0.005	+0.007	-0.005	+0.007

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; DRI power penalty of about 14.5 kWh/t per 10 points of DRI in the charge from the EC Innovation Centre for Industrial Transformation [S15].

Figure 4.5: DRI share and upstream intensity

RC-1 Phase 1 intensity including upstream iron units, t CO₂ per tonne of product, grid at 226 g/kWh. Columns: imported DRI/HBI share of the metallic charge (balance scrap). Rows: upstream intensity of the DRI/HBI, t CO₂ per tonne. The RC-1 base is the cell at 30% and 0.7 t/t.

Table D.16 Values plotted in Figure 4.5, t CO₂ per tonne of product (derived)

Upstream t/t	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%
0.1	0.33	0.34	0.34	0.35	0.36	0.37	0.38	0.38	0.39	0.40	0.41
0.2	0.34	0.36	0.37	0.38	0.40	0.41	0.42	0.44	0.45	0.47	0.48
0.3	0.35	0.37	0.39	0.41	0.43	0.45	0.47	0.49	0.51	0.53	0.55
0.4	0.37	0.39	0.42	0.44	0.47	0.50	0.52	0.55	0.57	0.60	0.62
0.5	0.38	0.41	0.44	0.47	0.51	0.54	0.57	0.60	0.63	0.67	0.70
0.6	0.39	0.43	0.47	0.50	0.54	0.58	0.62	0.66	0.69	0.73	0.77
0.7	0.40	0.45	0.49	0.53	0.58	0.62	0.67	0.71	0.75	0.80	0.84
0.8	0.41	0.46	0.51	0.56	0.61	0.66	0.71	0.76	0.81	0.86	0.91
0.9	0.43	0.48	0.54	0.59	0.65	0.71	0.76	0.82	0.88	0.93	0.99
1.0	0.44	0.50	0.56	0.62	0.69	0.75	0.81	0.87	0.94	1.00	1.06

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; DRI power penalty from [S15]; hydrogen-based iron range discussed in Chapter 6.

D.5 Chapter 5: carbon border measures

Figure 5.1: CBAM phase-in

The CBAM factor is the share of the benchmark still covered by free allocation in the adjustment; the remainder is charged at the border.

Table D.17 Values plotted in Figure 5.1, % of the CBAM benchmark (sourced)

Year	CBAM factor (free allocation)	Phased out, charged at the border
2026	97.5%	2.5%
2027	95.0%	5.0%
2028	90.0%	10.0%
2029	77.5%	22.5%
2030	51.5%	48.5%
2031	39.0%	61.0%
2032	26.5%	73.5%
2033	14.0%	86.0%
2034	0.0%	100.0%

Source: Directive (EU) 2023/959 amending the EU ETS Directive, free-allocation phase-out schedule [S28]; CBAM implementing rules [S31].

Figure 5.2: gross CBAM charge on the CBAM basis

Gross charge per tonne at a CBAM certificate price of €82.32/t CO₂, before the free-allocation adjustment and before any carbon price paid at origin, on the CBAM basis for steel (direct and precursor emissions, purchased electricity not counted). Ore-based routes are ranges: low end, IEA direct-emission estimate; high end, worldsteel 2024 all-scope average.

Table D.18 Values plotted in Figure 5.2 (illustrative)

Series	t CO ₂ /t, CBAM basis	€ per tonne, gross
BF-BOF average	1.20 to 2.34	99 to 193
Gas-based DRI-EAF average	1.00 to 1.47	82 to 121
RC-1 full build-out	0.41	34
RC-1 Phase 1	0.36	30
RC-1 Phase 1, DRI bought at 0.5 t/t	0.29	24
All-scrap EAF (RC-1 model, no DRI)	0.11	9

Source: European Commission, price of CBAM certificates [S26]; Regulation (EU) 2023/956, Annex II [S27]; IEA [S05]; worldsteel [S01]; WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90].

Figure 5.3: net CBAM charge over time

Net charge per tonne at a constant €82.32/t CO₂ on the CBAM basis, after deducting the benchmark multiplied by the CBAM factor of each year. Benchmarks applied (t CO₂/t, as reported for hot-rolled coil and used as a proxy for long products): BF-BOF 1.370, DRI-EAF 0.481, scrap-EAF 0.072; RC-1 and the all-scrap furnace are assessed against the scrap-EAF benchmark. Ore-based routes are shown as ranges (low to high).

Table D.19 Values plotted in Figure 5.3, € per tonne (illustrative)

Year	RC-1 Phase 1	RC-1 full build-out	All-scrap EAF	BF-BOF	Gas DRI-EAF
2026	23.9	28.1	3.0	0 to 83	44 to 82
2027	24.0	28.2	3.1	0 to 85	45 to 83
2028	24.3	28.5	3.4	0 to 91	47 to 85
2029	25.1	29.3	4.2	11 to 105	52 to 90
2030	26.6	30.8	5.7	41 to 135	62 to 101
2031	27.3	31.5	6.4	55 to 149	67 to 106
2032	28.1	32.3	7.2	69 to 163	72 to 111
2033	28.8	33.0	7.9	83 to 177	77 to 115
2034	29.7	33.9	8.8	99 to 193	82 to 121

Source: as Figure 5.2; benchmarks as reported for hot-rolled coil, used as a proxy for long products [S31][S104]; CBAM factor [S28].

D.6 Chapter 6: green iron

Figure 6.1: ore-based route intensities

Published and derived intensities of ore-based steelmaking routes, t CO₂ (or CO₂e) per tonne of steel. Energiron values are derived by applying the stated percentages to the worldsteel blast-furnace average of 2.34.

Table D.20 Values plotted in Figure 6.1, t CO₂ per tonne

Route	t CO ₂ /t	Status	Source
BF-BOF, world average	2.34	sourced	[S01]
Gas DRI-EAF, world average	1.47	sourced	[S01]
Energiron with natural gas (53% below BF-BOF)	1.10	derived	[S15]
Saarstahl/Dillinger plan, gas DRI-EAF	1.10	sourced	[S18]
RC-1 Phase 1, 30% imported DRI (per t product)	0.58	derived	[S90]
Saarstahl/Dillinger, green hydrogen and green power	0.34	sourced	[S18]
Energiron with 100% hydrogen (86% below BF-BOF)	0.33	derived	[S15]

The IEA near-zero threshold drawn on the figure is 0.40 t CO₂e per tonne of crude steel at 0% scrap [S06].

Source: worldsteel [S01]; EC Innovation Centre for Industrial Transformation, Energiron and POWER4STEEL pages [S15][S18]; IEA near-zero threshold [S06]; WP06 model [S90]. Energiron values derived by applying the stated percentages to the worldsteel blast-furnace average.

Figure 6.2: direct-reduced iron output, 2025

Output in million tonnes (Mt); world total 151.0 Mt.

Table D.21 Values plotted in Figure 6.2, Mt of DRI, 2025 (sourced)

Producer	Mt	Share of world output
India	58.80	38.9%
Iran	37.20	24.6%

Producer	Mt	Share of world output
Algeria	6.70	4.4%
Egypt	6.06	4.0%
Libya	1.75	1.2%
Sub-Saharan Africa	0.09	0.1%

Source: Midrex Technologies, 2025 World Direct Reduction Statistics [S13]; East African estimate from worldsteel, World Steel in Figures 2026 [S03].

Figure 6.3: electricity for hydrogen-based direct reduction

Annual electricity, TWh. Hydrogen requirement 54 kg H₂ per tonne of DRI; electrolysis 45 to 52 MWh per tonne of H₂.

Table D.22 Values plotted in Figure 6.3, TWh per year

Item	Low	High	Status
Hydrogen for RC-1's iron units at 1 Mtpa (0.36 Mt DRI)	0.88	1.02	derived
Hydrogen for a 1 Mt/yr DR module	2.43	2.81	derived
Nachtigal hydro, 12 months to May 2026	3.61	3.61	sourced
Cameroon total generation, 2025	8.12	8.12	sourced

Source: hydrogen requirement [S17]; electrolyser efficiency [S05]; Nachtigal output [S52]; national generation [S50]; hydro potential [S53]. Derived by Cameroon Steel (Annex A).

Figure 6.4: a stepwise route to green iron

Figure 6.4 is a diagram. Each step is optional and gated; none is a commitment of this paper.

Table D.23 Elements of Figure 6.4 (illustrative)

Step	Configuration	Gate
1. From the first heat (2030)	Scrap and certified imported DRI/HBI	measure, verify, buy low-carbon iron units
2. Later, after the main phases	Domestic gas-based DR module, hydrogen-ready, on DR-grade pellets	needs DR-grade concentrate and a gas contract
3. As hydro grows	Hydrogen blended into the reducing gas	needs firm, low-cost hydro and electrolyzers
4. Long term	Hydrogen DRI and green HBI, also for export	needs CBAM-ready MRV and buyers who pay

Source: Cameroon Steel reference configuration RC-1 (planning estimate), reserve module [S90]; analysis in this chapter.

D.7 Chapter 7: climate risk and adaptation

Figure 7.1: monthly rainfall at Kribi

Mean monthly rainfall at Kribi station, 1937 to 1976, in millimetres; annual mean about 2,836 mm.

Table D.24 Values plotted in Figure 7.1, mm per month (sourced)

Month	Jan	Feb	Mar	Apr	May	Jun
mm	92	118	201	261	343	274

Table D.25 Values plotted in Figure 7.1 (continued), mm per month (sourced)

Month	Jul	Aug	Sep	Oct	Nov	Dec
mm	112	231	502	492	201	94

Source: Olivry, Monographie du Nyong et des fleuves côtiers, ORSTOM (1979), homogenised Kribi station record, 1937 to 1976 [S60].

Figure 7.2: one-day rainfall by return period

Station fit from the historical record (sourced), and the same values raised by about 7% per degree of global warming (illustrative uplift).

Table D.26 Values plotted in Figure 7.2, mm in 24 hours (illustrative)

Return period	Station fit	+1 °C (+7%)	+2 °C (+14.5%)
2-year	144	154	165
10-year	193	206	221
50-year	243	260	278
100-year	264	282	302

Source: Kribi station Pearson III fit [S60]; IPCC AR6 WGI, scaling of extreme daily precipitation with warming [S59]. Uplift applied by Cameroon Steel.

Figure 7.3: sea level and shoreline change

Left panel: likely range of global mean sea-level rise by 2100 relative to 1995 to 2014 (IPCC AR6). Right panel: mean rate of shoreline change on the Kribi coast; positive values are accretion, negative values retreat.

Table D.27 Values plotted in Figure 7.3 (left), metres by 2100 (sourced)

Scenario	Low end	High end
SSP2-4.5	0.44	0.76
SSP5-8.5	0.63	1.01

The figure also marks the low-likelihood, high-impact outcome of up to about 2 m by 2100 [S59].

Table D.28 Values plotted in Figure 7.3 (right), metres per year (sourced)

Period	Mean shoreline change
1973 to 2000	+0.4
2000 to 2015	-0.9
2015 to 2020	-2.0

Source: IPCC AR6 WGI Summary for Policymakers [S59]; Fendoung, Tchindjang and Hubert-Ferrari (2022) [S62].

D.8 Chapter 8: circularity

Figure 8.1: intensity against the scrap share

RC-1 Phase 1 intensity including upstream iron units, t CO₂ per tonne of product, grid at 226 g/kWh, with the furnace electricity penalty for DRI. The balance of the charge is imported iron units at the stated upstream intensity. Each additional 10 points of scrap changes the intensity by -0.088 t CO₂/t with gas-based DRI.

Table D.29 Values plotted in Figure 8.1, t CO₂ per tonne of product (derived)

Scrap share of the charge	Imported gas-based DRI at 0.7 t/t	Hydrogen-based iron units at 0.2 t/t
50%	0.75	0.45
55%	0.71	0.44
60%	0.67	0.42
65%	0.62	0.41
70%	0.58	0.40
75%	0.53	0.38
80%	0.49	0.37
85%	0.45	0.36
90%	0.40	0.34
95%	0.36	0.33

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; DRI power penalty [S15].

Figure 8.2: scrap need against domestic arising

RC-1 annual scrap need at nameplate output (derived) against the only published estimate of domestic scrap arising (2006 data) and the RC-1 planning assumption for domestic supply (range 0 to 60 kt).

Table D.30 Values plotted in Figure 8.2, kt per year

Series	kt per year	Status
RC-1 scrap need, full build-out	846.2	derived
RC-1 scrap need, Phase 1	253.9	derived
Domestic scrap arising, 2006 study (upper)	61.8	sourced
Domestic scrap arising, 2006 study (lower)	53.0	sourced
RC-1 planning assumption, domestic scrap	30.0	assumed

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; Bidoung et al. (2007), 2006 data [S88].

Figure 8.3: residues and zinc

Annual residues at nameplate output and the zinc contained in the furnace dust at 20% to 30% zinc, in thousand tonnes (kt).

Table D.31 Values plotted in Figure 8.3, kt per year (derived)

Phase	EAF and ladle slag	Mill scale	EAF dust (hazardous)	Zinc, low	Zinc, high
Phase 1	44.7	6.0	4.8	1.0	1.4

Phase	EAF and ladle slag	Mill scale	EAF dust (hazardous)	Zinc, low	Zinc, high
Phases 1+2	74.5	10.0	8.0	1.6	2.4
Full build-out	148.9	20.0	16.0	3.2	4.8

Source: Cameroon Steel reference configuration RC-1 (planning estimate): slag 140 kg/t, dust 15 kg/t, mill scale 20 kg/t [S90]; IFC benchmark for solid residue [S20]; zinc content range [S69]. Derived by Cameroon Steel.

D.9 Chapter 9: finance and standards

Figure 9.1: Scopes 1 and 2 against lender thresholds

Scopes 1 and 2 at nameplate output, kt CO₂ per year, at the 2024 grid factor and at the ends of the whisker range. Thresholds: IFC Performance Standard 3, 25 kt; Equator Principles EP4, 100 kt. The minor fuels (diesel, LPG) and switchgear SF6, drawn as a pale segment, are not in the RC-1 balances; their values are assumed (Annex A).

Table D.32 Values plotted in Figure 9.1, kt CO₂ per year, Scopes 1+2 (derived)

Phase	Grid 226 g/kWh (bar)	Grid 96 g/kWh	Grid 300 g/kWh	Minor fuels and SF6, central (range)
Phase 1	97.2	59.7	118.6	4.9 (3.3 to 6.6)
Phases 1+2	163.1	108.3	194.3	8.1 (5.4 to 10.9)
Full build-out	327.7	229.7	383.4	16.1 (10.7 to 21.5)

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; IFC Performance Standard 3 [S21]; Equator Principles EP4 [S22].

Figure 9.2: sliding-scale thresholds

Thresholds in t CO₂e per tonne of crude steel as functions of the scrap share of the metallic input, computed with the formulas used to draw the figure: IEA near-zero threshold 0.40 minus 0.35 times the scrap share; ResponsibleSteel Progress Level 1 interpolated linearly between 2.34 at 20% scrap and 0.96 at 80% scrap (not defined outside that interval).

Table D.33 Threshold lines plotted in Figure 9.2, t CO₂e per tonne of crude steel (sourced)

Scrap share	ResponsibleSteel Progress Level 1	IEA near-zero threshold
0%	not defined	0.40
10%	not defined	0.37
20%	2.34	0.33
30%	2.11	0.30
40%	1.88	0.26
50%	1.65	0.23
60%	1.42	0.19
70%	1.19	0.16
80%	0.96	0.12
90%	not defined	0.09
100%	not defined	0.05

RC-1 Phase 1 position (derived): 0.54 t CO₂ per tonne of crude steel at about 70% scrap, against 1.19 for Progress Level 1 and 0.16 for the near-zero threshold at the same scrap share.

Source: IEA (2022) [S06]; ResponsibleSteel, Decarbonisation Progress Levels (2024) [S37]; WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90].

D.10 Chapter 10: pathway and recommendations

Figure 10.1: illustrative decarbonisation pathway

RC-1 at 1 Mtpa, levers applied cumulatively, t CO₂ per tonne of product including upstream iron units. The IEA near-zero threshold at 75% scrap, converted to a per-tonne-of-product basis, is 0.15.

Table D.34 Values plotted in Figure 10.1, t CO₂ per tonne of product (illustrative)

Step (cumulative)	Change	Total after the step	of which Scopes 1+2
RC-1 at 1 Mtpa (base)		0.582	0.328
Melt-shop and mill efficiency	-0.013	0.569	0.315
Lower direct carbon	-0.021	0.547	0.293
Efficient reheating	-0.006	0.541	0.287
Grid at 100 g/kWh	-0.088	0.454	0.200
More scrap in the charge (domestic or imported)	-0.043	0.411	0.199
Lower-carbon DRI, 0.5 t/t	-0.060	0.350	0.199
Hydrogen-based iron, 0.2 t/t	-0.091	0.260	0.199

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; DRI power penalty [S15]; hydrogen-based iron intensity derived from [S15]; IEA near-zero threshold [S06].

Figure 10.2: an indicative trajectory

Years are indicative and are not commitments. The figure also draws the worldsteel scrap-EAF world average of 0.69 t CO₂ per tonne of crude steel.

Table D.35 Values plotted in Figure 10.2, t CO₂ per tonne of product (illustrative)

Year	Point	Including upstream iron units	Scopes 1+2
2031	Phase 1 at nameplate	0.58	0.32
2035	1 Mtpa, base	0.58	0.33
2038	known levers	0.35	0.20
2042	hydrogen-based iron units	0.26	0.20

Source: WP06 model on the Cameroon Steel reference configuration RC-1 (planning estimate) [S90]; phasing from the RC-1 indicative schedule [S90]; worldsteel scrap-EAF average [S01].

CAMEROON STEEL

FROM MINERAL RESOURCE TO INDUSTRIAL VALUE

Cameroon Steel is developing a phased steel complex at Mboro, in the Kribi industrial-port zone, beginning with an electric-arc melt shop making billets for wire rod, reinforcing bar and merchant sale. This paper is published for information and does not constitute an offer or a commitment.