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Primary gold GHG emissions intensities decline

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Gian Seblos | December 4, 2025

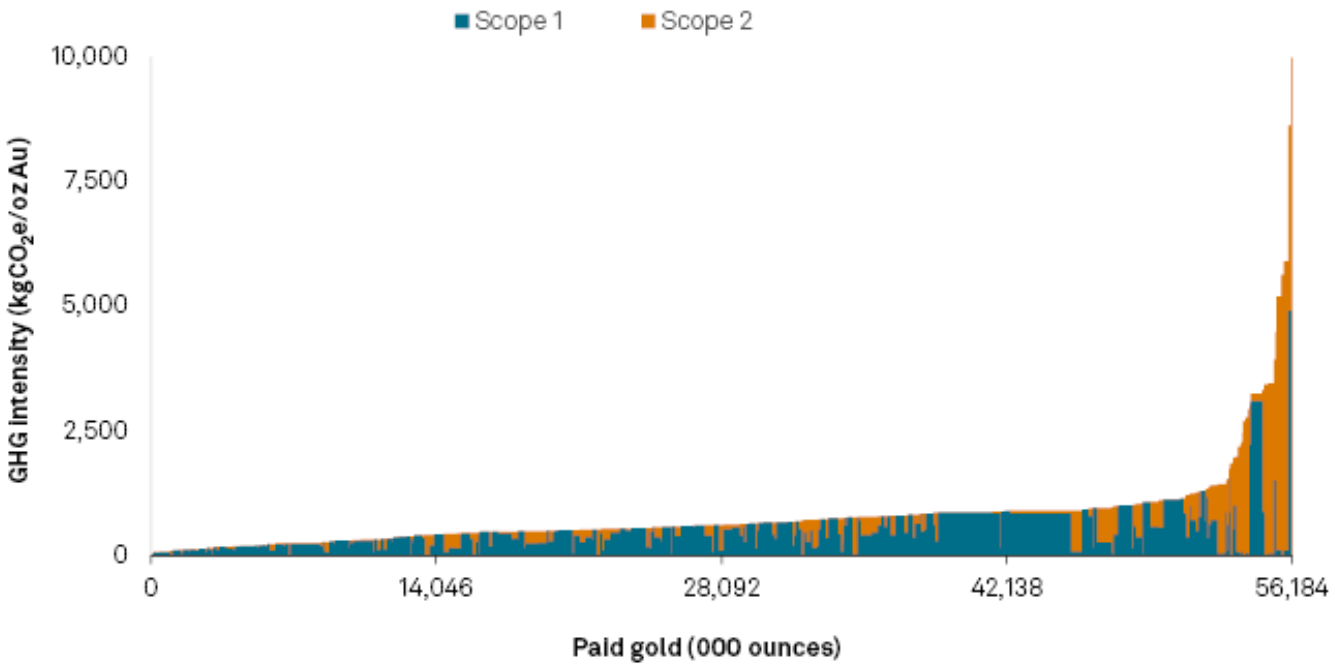
Based on the newly launched gold emissions curve, S&P Global Commodity Insights found that 329 primary gold mines emitted greenhouse gases at an average rate of 792 kilograms of CO_2 equivalent per paid ounce of gold ($kgCO_2e$/oz Au) produced, 39 $kgCO_2e$/oz Au lower than in 2021.

The Take

Scope 1 and Scope 2 emissions per paid gold ounce produced from primary gold mines have been declining since 2021, primarily driven by the reduction in indirect greenhouse gas emissions from the increasing renewables share in electricity generation. Major companies are decarbonizing their operations through power purchase agreements and offsets, but tackling Scope 1 emissions is proving to be a much harder challenge.

Scope 2 emissions — associated with purchased electricity, heating, cooling and steam — comprise 39% of the total in 2023, compared to a 41% share in 2021. Emissions intensity, or total Scope 1 and Scope 2 divided by paid gold ounces, has been decreasing since 2021, brought about by the increasing share of renewables in purchased electricity in most operations, thus lowering Scope 2 emissions.

2023 gold emissions curve



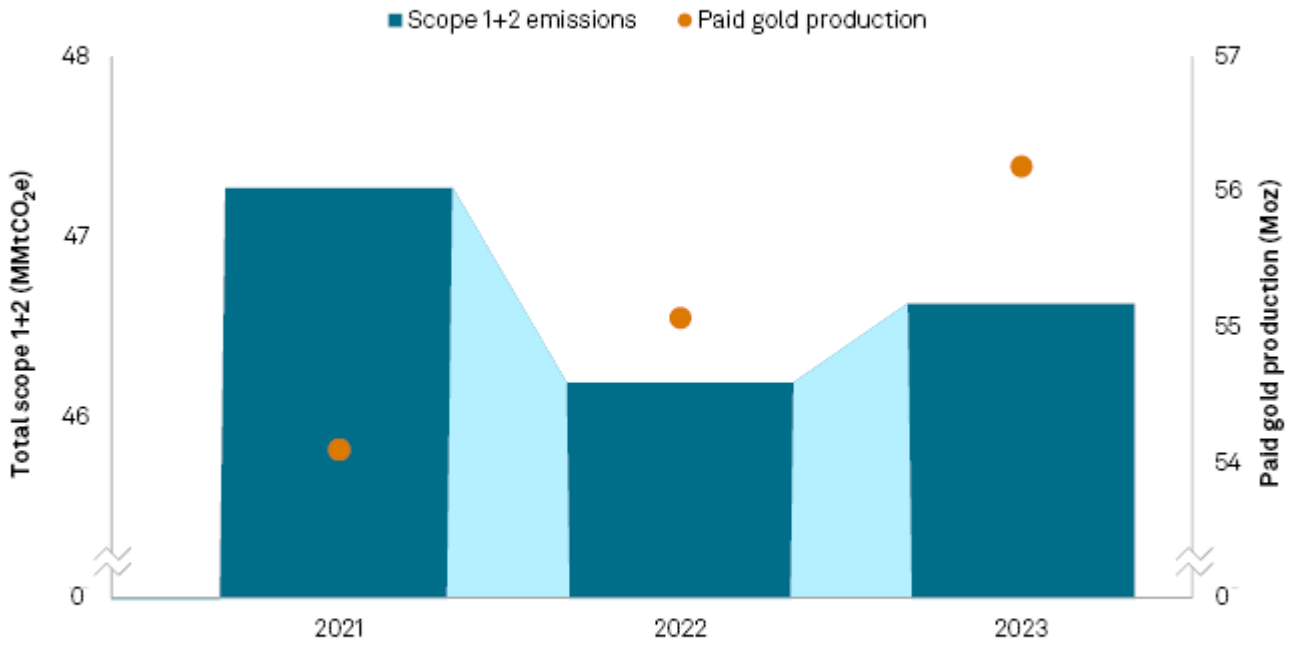
As of Nov. 25, 2024.

$kgCO_2e$/oz Au = kilograms of CO_2 equivalent per ounce of gold; GHG intensity = Scope 1+2 in $kgCO_2e$ divided by paid gold production in troy ounces.

Source: S&P Global Market Intelligence.

Comparing total global emissions since 2021, primary gold mines emitted a total of 46.63 million metric tons of CO2e in 2023. In a span of two years, total global Scope 1 emissions increased by 0.68 MMtCO2e, while total Scope 2 emissions decreased by 1.32 MMtCO2e, though gold output increased by 2.1 million ounces. Barrick Gold Corp.'s Nevada Operations, sitting in the fourth quartile of the emissions curve, reported the largest gold production and the largest Scope 1 and 2 emissions in 2023. The mining complex reduced its total Scope 1 and Scope 2 emissions by 13% but produced 9% less gold between 2021 and 2023.

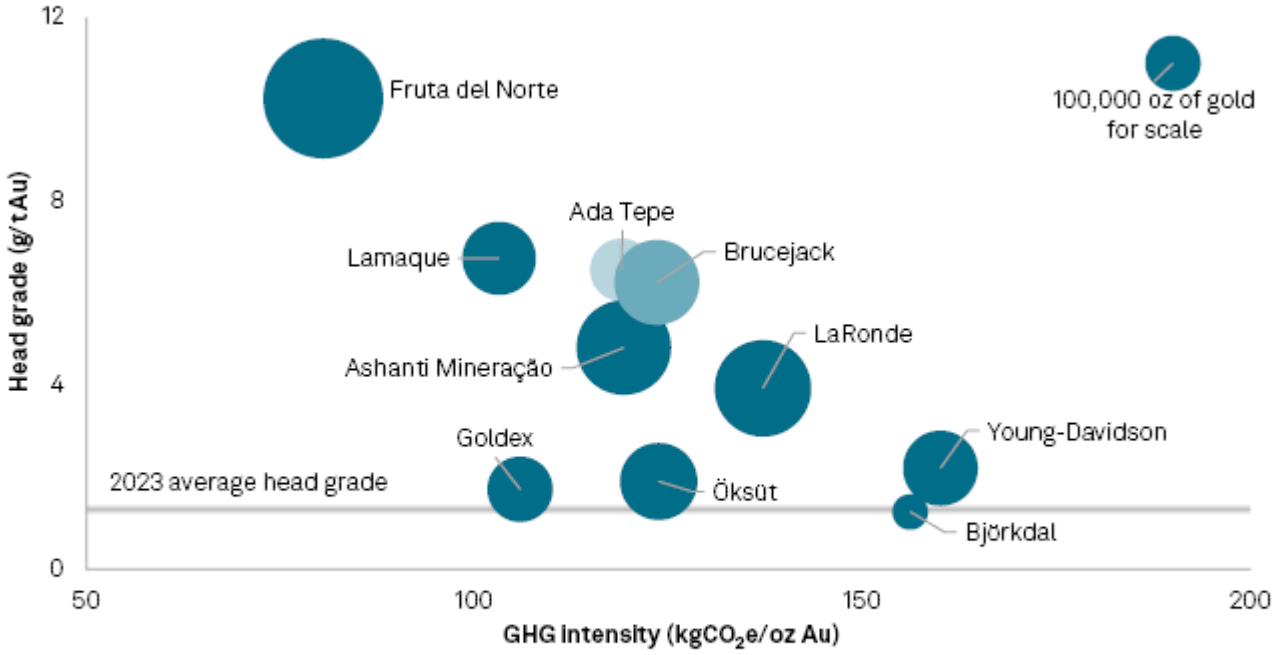
Emissions from primary gold mines 640,000 metric tons lower than in 2021 despite increased production



As of Nov. 25, 2024.
$MMtCO_2e$ = million metric tons of CO_2 equivalent; Moz = million ounces.
Source: S&P Global Market Intelligence.

Looking closely at the low emitters on the curve, Fruta del Norte — an underground mine in Ecuador — has consistently had one of the lowest emissions intensities. In 2023, it produced gold doré bars and precious metals concentrate at a combined Scope 1 and 2 rate of 80.5 kgCO2e/oz. It is currently mining an epithermal deposit, achieving head grades of above 10 g/t Au, compared to the 2023 average head grade of 1.32 g/t Au. Fruta del Norte is connected to Ecuador's national electricity grid, which, as of 2023, is composed of 81% renewables, helping Lundin Gold Inc.'s sole operating mine realize lower Scope 2 emissions. Similarly, Eldorado Gold Corp.'s Lamaque complex is connected to Quebec's grid, which is almost entirely powered by hydropower and therefore has negligible Scope 2 emissions. In 2023, the underground mine processed ore with a head grade of 6.76 g/t Au.

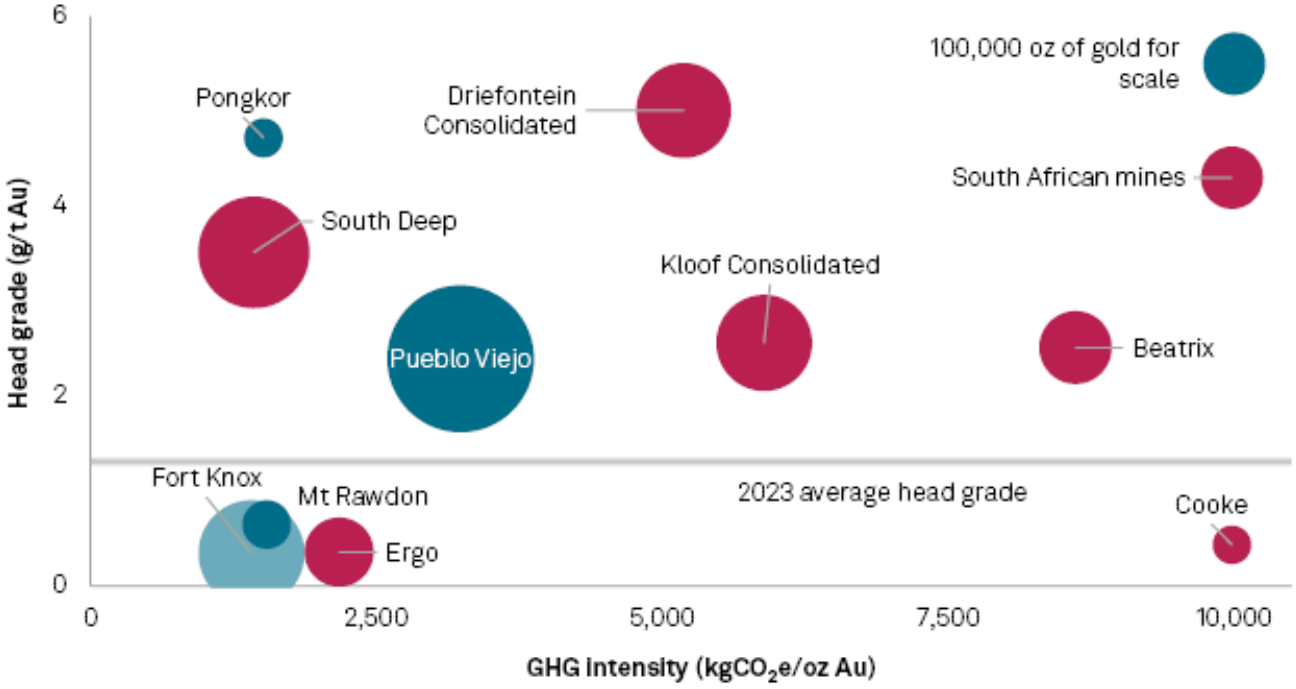
Low-emitting mines processed head grades significantly above 2023 average of 1.32 g/t Au



As of Nov. 25, 2024.
g/t Au = grams per metric ton of gold; $kgCO_2e/oz\,Au$ = kilograms of CO_2 equivalent per ounce of gold.
Bubble size represents paid gold ounces produced.
Source: S&P Global Market Intelligence.

The emissions intensity of Centerra Gold Inc.'s Oksut dropped 77% in 2023, primarily due to higher gold ounces sold during the year, as it suspended its gold doré bar production upon detection of mercury in the gold room at its adsorption, desorption and recovery (ADR) plant in 2022. The mine commissioned the mercury abatement system and resumed full operations in June 2023, producing 195,926 ounces of gold, its highest since achieving commercial production in 2020.

High-emitting mines either process lower-than-average grades or are connected to fossil fuel-heavy sources



As of Nov. 25, 2024.
g/t Au = grams per metric ton of gold; kgCO₂e/oz Au = kilograms of CO₂ equivalent per ounce of gold.
Bubble size represents paid gold ounces produced.
Source: S&P Global Market Intelligence.

Six of the 10 high-emitting mines are from South Africa, with Sibanye Stillwater Ltd.'s Cooke leading the list with 9,980 kgCO2e/oz Au in 2023. The operation mines historic tailings using high-pressure water jets and has two active processing plants, Cooke and Ezulwini, with the latter used as a toll-treating facility. Combining low grades from historic tailings and a coal-heavy grid in South Africa, most of the emissions from Cooke are from purchased electricity generation.

Outside South Africa, Pueblo Viejo in the Dominican Republic ranked as the next-highest emitter, with 3,236 kgCO2e/oz Au in 2023, a 25% increase from 2022. Despite having lower total emissions, emission intensity rose due to production falling 22% from lower head grades and lower throughput. The mine also sources its power from the diesel-powered Quisqeya I plant. Other mines included in the list are Mt Rawdon, a low-grade gold deposit in Australia; Pongkor, which is connected to the fossil-fuel-dependent Indonesian grid; and Fort Knox, a low-grade gold deposit in Alaska with power supplied by Golden Valley Electric Association Inc. (GVEA). As of 2023, GVEA had an operating nameplate capacity of 409.7 MW, 94% of which is sourced from oil and petroleum products, coal and other nonrenewables.

Most companies with decarbonization goals are reducing emissions by shrinking their Scope 2 emissions on grid-connected operations.

– Agnico Eagle Mines Ltd. halved its Scope 2 intensity between 2022 and 2023. The decrease in Scope 2 emissions was driven by Kittila mine sourcing its entire grid electricity from zero-emission sources through Certificates of Origin starting in 2023.

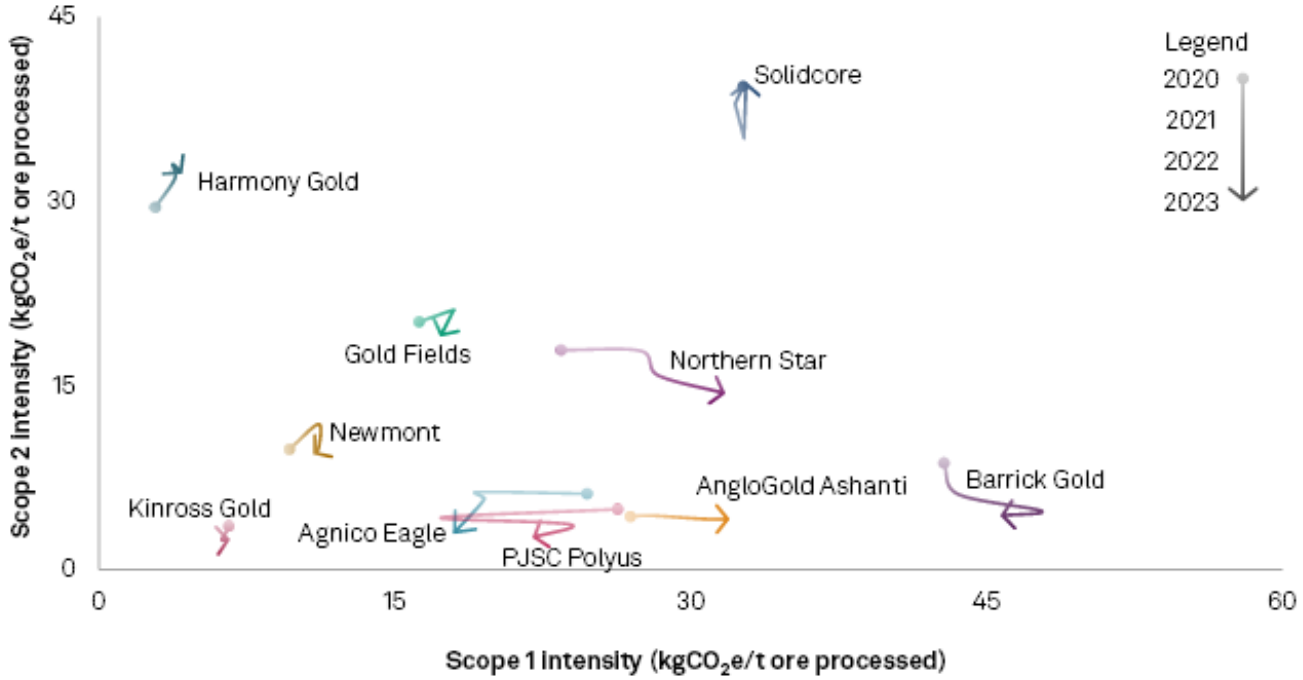
– PJSC Polyus covered all its indirect energy-related emissions with renewable energy starting in 2021 and offset its 72,000 metric tons CO2e of Scope 2 emissions in 2023 by acquiring carbon-free electric energy certificates from H2 Clean Energy LLC.

– Kinross Gold Corp.'s Scope 2 intensity shrank 31% since 2020, with its Paracatu mine sourcing 98% of its electricity from a hydroelectric dam it acquired in 2018. In 2023, 66% of electricity consumption from all the company's operations was supplied by hydroelectric and other renewables, up from 36% in 2020.

– Barrick Gold's Nevada Operations — which decreased its actual Scope 2 emissions to 197,000 metric tons CO2e in 2023 from 906,000 metric tons CO2e in 2020 — invested $307 million in a 200-MW solar power plant with First Solar Inc. and, along with a subsidiary, entered a power purchase agreement to purchase all energy credits produced by a new 100-MW solar power plant.

The chart below shows company-level intensities since 2020, with downward arrows showing decreases in Scope 2 emissions per metric ton of processed ore.

Most major gold producers able to reduce Scope 2 through PPAs, RECs; shrinking Scope 1 is more challenging



As of Oct. 17, 2024.
$kgCO_2e/t$ = kilograms of CO_2 equivalent per metric ton; PPA = power purchase agreement; REC = renewable energy credit.
Source: S&P Global Market Intelligence.

On the other hand, among the 10 companies, only Agnico Eagle and PJSC Polyus moved to the left of their starting points, showing that decreasing Scope 1 emissions is a much harder challenge for the industry. Agnico Eagle has one of the largest fleets of battery electric vehicles (BEVs) operating at its Canadian Malartic subproperty Odyssey and at its Kittila, Macassa and Detour Lake properties. The company is also implementing an automated haulage system, Rail-Veyor, at the Goldex mine, significantly reducing direct emissions from diesel combustion. PJSC Polyus' gold head grades have increased 10% since 2020, and the company is set to switch from coal to gas boiler houses in Kuranakh, projecting an annual reduction in direct emissions of 50,000 metric tons of CO2e.

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