NYAMONGO & TARIME MINES

GOLD MINING IMPACT ASSESSMENT

ELEMENT UNITED | HTTPS://ELEMENTUNITED.COM

SUMMARY

Element's report* provides
African Gold Artisanal Mining Environmental Impact Assessment for Nyamongo and Tarime mines in Tanzania.

Element's leadership

Scott Lomu • President
Over 25 years in the precious elements industry.
A passionate voice for responsible, humane mining.
Leading the digital gold rush to provide access for all.

David Kasteler • COO
FINSERV entrepreneur who has built multiple high-value organizations.
Consulted for or represented over $750M in mining assets.

Element's purpose
Element is bringing the blockchain + metaverse revolution to gold and precious elements. We digitize precious elements by building digital economies on top of mines.

Why is it important to slow mining?
- End Hoarding
- Reduce CO_2 Emissions
- End Exploitation
- Corruption
- Free Access for All

*Document information provided by a 3rd party. Data not verified by Element United.

EXECUTIVE SUMMARY

This report was produced independently and resulted from Element United's ambition to mine differently, support future generations by protecting the planet, and reclaim land once destroyed by harmful practices, ultimately giving power back to the people most hurt by industrial mining.

Research is intended to give the reader of this report an overview of artisan gold mining in the Mara Region of Tanzania and its impact on the sustainability framework surrounding underground mining. The sustainability nexus of people, planet, and prosperity underline this report's themes, starting with the introduction of gold mining in the late 19th century, Lake Victoria, and its lifecycle.

We discuss gold as part of the materials economy, from extraction to processing and refining, followed by gold's variable three-tiered market structure of jewelry, investment, and industrial use. Each link in the chain contains some reference to the frameworks measuring the impact on the Tanzanian people, the land surrounding the claim, and opportunities provided by the mine—or their absence.

In brief, this report introduces the people most impacted by the mine, paleo archaeology considerations, and environmental impacts. References and keywords are indicated in bold for the reader of this report to continue independent research on the rich history of the Tanzanian region and its people.

Closing this report, we offer carbon data related to Scopes 1, 2, and 3. Our team conducted no on-site testing. Instead, we used prevailing and relevant data, professional SME sources to include the airline industry, product retailers, and academics, as well as EPA calculators, and reliable, annotated, public, educational, and generally accepted resources to form estimations or conclusions.

Research notes and resources are provided at the end of this document.

INTRODUCTION

Tanzania's gold[1] industry began in Medieval times when Persian and Arab travelers stopped in the Swahili trading port city of Kilwa, located off the coast of Tanzania. Merchants on this island controlled much of the trade in the Indian Ocean, dealing in pearls, porcelain, perfumes, and gold[2].

Most of Tanzania's (originally known as Tanganyika) gold remained in-ground until the late 19th century when prospecting colonialists began exploring[3]. A discovery on the shores of Lake Victoria then catapulted Tanzania's gold industry, but much of the money flowed out of the country. In 1961, that changed when Tanzania gained its independence, and the government redistributed wealth, nationalizing the gold industry to benefit the Tanzanian people over foreign investors. Today, Tanzania produces 45 tons of gold annually; it is Africa's 8th largest gold producer and secures US $2.5 billion annually (and increasing) in Tanzania's total export revenue.

NYAMONGO & TARIME MINES

The Nyamongo and Tarime Mines are located in the North Mara region of Tanzania. Owners of the mine have committed to a sustainability initiative, which would prevent open pit mining; irrigate and farm thousands of acres in a move that seeks to increase food security in the region.

Nyamongo. The Nyamongo open pit mine consists of Precambrian terranes comprised of Archean block. Veins of gold are consistent with other mines in the area.

Tarime. The Tarime open pit mine is near the Kenyan border and part of the Lake Victoria goldfield. Historically, the location has been welcoming to artisanal gold miners.

[1] Miner, H. (2021, October 2). *A historical look at gold mining in Tanzania*. How to Find Gold Nuggets. https://howtofindgoldnuggets.com/tanzania-gold-mining-history/
[2] UNESCO World Heritage Centre. (n.d.). *Ruins of Kilwa Kisiwani and ruins of Songo Mnara*. UNESCO World Heritage Centre. https://whc.unesco.org/en/list/144/
[3] Miner, H. (2021, October 2). *A historical look at gold mining in Tanzania*. How to Find Gold Nuggets. https://howtofindgoldnuggets.com/tanzania-gold-mining-history/

Combined, the two mines offer 35,000 acres of land for rehabilitation—land that typically consists of black cotton soils (mbuga) with lightly forested grassland and hilly topography with dark brown earth.

TANZANIAN GOLD MARKET[4]

Today, Tanzania produces 45 tons of gold annually, securing US $2.5 billion in export revenue.

PC: SAVANNAH EXPLORERS

Tanzania's mining sector includes metals and industrial, fuel, and rare earth/critical minerals, with gold as the highest contributing export material. Tanzania's mining sector contributes 10.2% to its GDP. Smelting and processing are increasingly becoming part of Tanzania's portfolio to keep more revenue in-house and to make "concessions, contracts, and licenses to be made available to the public[5]."

As investor interest increases in Tanzania, so creates interest in local goods, services, and workers—a move intended to empower local communities and improve the quality of life, education, health & welfare for Tanzanians.

[4] International Trade Administration. (n.d.). *Tanzania - mining.* https://www.trade.gov/country-commercial-guides/tanzania-mining
[5] International Trade Administration. (n.d.). *Tanzania - mining.* https://www.trade.gov/country-commercial-guides/tanzania-mining

However, given Tanzania's unreliable power and grid system, investors are also inclined to alternative energy and transportation solutions, which adds to another market but creates some limitations. Until renewables can reach remote locations in Tanzania, companies must manage such hurdles as power outages, which lowers productivity, decreases worker safety, and limit profitability. Still, investors are being welcomed into Tanzania with government support and incentives, including more laws and accountability.

Gold, as an overall market, is fractioned into three steady income streams: jewelry, investments, and industrial use. Much of Tanzania's gold has been geared toward the jewelry market, making up the most significant percentage.

Jewelry (48%)[6]
Gold is a prestige item in many parts of the world, providing generational wealth. The most significant portion of gold is made into jewelry. Other and various cultures equate gold with religious symbology, some with power or office.

Investments (31%)
As stocks plummeted during the COVID-19 pandemic, so did gold, highlighting gold's volatile trading market alongside the most recent pandemic. But with economic shutdowns, gold investments quickly rebounded, climbing above $2000 for one troy ounce. Gold has since devalued, but it often fluctuates due to the breadth of the market it occupies. These quick, abrupt changes to valuation reveal how gold markets adjust to global goods trading—or a lack thereof.

Industrial (electronics, dental, medical) (21%)
Gold is a noncorrosive conductor, working efficiently with lower voltages. Made less expensive, producers electroplate (bind) palladium with gold using CuSO4 (Copper Sulfate), which is highly toxic to humans, and our environment.

SURFACE MINING

[6] Author notes: Some estimations suggest greater percentages for jewelry, and lower percentages for investments and industrial gold markets.

THE SURFACE (OPEN PIT) MINING LIFECYCLE[7][8]

PC: MINING REVIEW, Open pit Tanzania

Exploration, Feasibility studies	Geochemical and geophysical techniques identify gold ore deposits; scientists drill for locations and quality of ore; SA governments regulate permitting for exploration and water use.
Site Preparation	Wildlife relocation, plant relocation, erosion prevention tactics, water management
Construction	Site development includes building camps and permanent structures, facilities, storage, and mechanical shops
Planning	Access to the gold-bearing reef requires the boring of holes and readying site for explosives
Blasting and Hauling	Rock is exposed and broken; the ore is collected

[7] Minerals Council South Africa. (n.d.). *The Gold Mining Lifecycle*. Mining for schools. https://www.miningforschools.co.za/lets-explore/gold/the-gold-mining-life-cycle

[8] Investing News Network. (2022, March 9). *The life cycle of a gold mine: Mine construction*. INN.://investingnews.com/daily/resource-investing/precious-metals-investing/gold-investing/the-lifecycle-of-a-gold-mine-mine-construction/

Transporting	Rock is conveyed to milling circuits, where the gold from the ore extraction process begins
Crushing	Crushers and grinding mills make smaller rocks smaller until it becomes sand
Processing	Cyanide and other chemicals combine with the grains of sand to extract the gold, separating it from carbon and leaving a slurry of tailings from which to extract additional elements such as remaining gold, uranium, and sulfides.
Smelting	Gold is heated to liquid form and poured into doré bars
Refining	Doré bars are sent for further refining to 99.5% or 99.99% purity bullion
Closure and Rehabilitation	Mine exhaustion (all ore is gone) is followed by rehabilitation of the site to its preexisting condition or another defined use

Though an exceptional amount of energy is consumed upstream during the extraction and mineral processing stage, retrieving refined grains of gold, the grade or size of gold extracted has little impact on the refinery process downstream[9].

REFINING GOLD

Refining[10] requires hydrometallurgy and pyrometallurgy over several steps to separate, concentrate, and purify the gold. Tanzania's portfolio of gold processing now includes smelting and processing to keep the investment dollars in the country, but that can also make way for unintended pollution and disease.

Heap Leaching (hydrometallurgy) removes gold from ore deposits and tailings with a cyanide concentration in water (spills cause environmental disasters in water supplies and watersheds alike).

Additional solutions are used to separate and concentrate the gold, with electrolysis and other precipitation methods to return the gold to metallic form. After which, electrolysis plates out the gold. Copper, zinc, and other chemical compounds are likely employed in this process.

[9] Norgate, T. and Haque, N. *Energy and greenhouse gas impacts of mining and mineral processing operations*. Journal of Cleaner Production, Volume 18, Issue 3, 2010, Pages 266-274, ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2009.09.020.
[10] TheIPMI. (2015). *Gold Refining*. YouTube. https://www.youtube.com/watch?v=SfQxEKVx4xw.

Pyrometallurgy requires thermal treatment such as calcination, oxidation roasting, reactive gas refining, reduction melting, and fusion melting, stripping out silver and other metal alloys.

Tanzania's "Petroleum Act [of] 2015 and the Mining Act [of] 2010, [says that] licensed holders and contractors in the extractive sector are liable to pay taxes including corporate tax (30%), capital gain tax (30%), withholding tax (10%) and other taxes[11]. These initiatives are designed to prevent violence and theft so that the government can invest in the communities surrounding the mines, but this can scare investors away.

With additional carbon (pollution) taxation, some refineries now require carbon reduction emissions at the extraction point, refusing to work with some mining companies[12]. Moving away from diesel and toward renewables may advance carbon reduction efforts, which remote mining readily accepts. Still, without enforced laws and companies held to account, ecological damage, rampant corruption, and social constructs will fail to be mitigated, let alone addressed.

Additionally, few refineries are willing to advertise the value or impact of harmful environmental "waste liquids" created by hydrometallurgy—fewer still conduct due diligence to identify human rights abuses[13], conflict, or corrupt and ecological destruction[14]. One reason why when Tanzania builds its refineries, it can also increase its production, sale, and export values.

Still, these new Tanzanian laws[15] aim to "reduce risks, the country introduced new legal requirements and aggressively promoted FDI attraction, tax incentives, and technical assistance."

SUSTAINABILITY NEXUS

The Sustainability Nexus (people, planet, prosperity) is increasingly under pressure, especially when governments fail

[11] International Trade Administration. (n.d.). *Tanzania - mining.* https://www.trade.gov/country-commercial-guides/tanzania-mining
[12] *Mining.com*. (n.d.). https://www.mining.com/
[13] Dunnebacke, A., & Barry, A. (2014, February 25). *Revealed: Why Dubai's First Conflict Gold Audit never saw the light of day.* Global Witness. https://www.globalwitness.org/en/archive/revealed-why-dubais-first-conflict-gold-audit-never-saw-light-day/
[14] Global Witness. (2020, July). *Beneath the shine: A tale of two gold refiners*. Global Witness. https://www.globalwitness.org/en/campaigns/conflict-minerals/beneath-shine-tale-two-gold-refiners/
[15] Miner, H. (2021, October 2). *A historical look at gold mining in Tanzania*. How to Find Gold Nuggets. https://howtofindgoldnuggets.com/tanzania-gold-mining-history/

to adequately protect their citizens or advocate on their behalf, letting agencies or companies take advantage of communities via pollution, displacement, or an absence of pipeline advancements[16][17][18][19][20][21].

In contrast to other mining impact locations (See Element's growing library of mining impact reports), Tanzania's nexus of impact expands beyond mining locations and localized results. Instead, its secondary, such as its deforestation rate (483,859 hectares per year), forces communities to condense into urban areas, causing further and tertiary impacts. Climate change also becomes a multiplier of issues impacting the nexus.

People

- √ People suffer human rights abuses, violence
- √ Productions cause pressure, resource limitations
- √ Bottom-line protection prevails over community safety
- √ Resettlement issues or spatial containment creates pressure on areas increases, congested regions, land, opportunities
- √ Increased use of charcoal for heating causes respiratory issues
- √ Families disperse in search of employment
- √ Loss of culture grows as youth move to the city for employment

Planet

- √ Tanzania has 93.8% forest degradation/depletion
- √ Mining caused water degradation in river channels and water catchment
- √ Mining causes loss of game reserves, loss of biodiversity
- √ Increased chemical pollution – air and water
- √ Mining causes anthropogenic noise pollution, vibrations
- √ Increased dust–lung disease and plant and tree asphyxiation

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[16] Earthworks. (2022, June 3). *Ahafo Gold Mine implicated in human rights abuses and irresponsible practices*. Earthworks. https://earthworks.org/blog/wassa_ghana/

[17] All Africa. (2012, March 20). *Tanzania: Geita gold mine refutes human rights abuse allegations.* AllAfrica. https://allafrica.com/stories/201203200261.html

[18] McLaughlin, B. (2022, September 13). *South Africa tailings failure shows need for stronger guidelines*. Earthworks. https://earthworks.org/releases/south-africa-tailings-failure-shows-need-for-stronger-guidelines/

[19] Choyt, M. (2014, May 16). *The transformative power of fair trade gold mining in Tanzania*. The Transformative Power of Fairtrade Gold Africa. https://reflectivejewelry.com/news/the-transformative-power-of-fair-trade-gold-mining-in-tanzania

[20] Tilumanywa, V. (2021, July 10). *View of the impact of mining activities on forest resources in Nyamongo Gold Mine, Tarime District, Tanzania*. Journal of Geographical Association of Tanzania, Vol. 35:19-37. https://jgat.udsm.ac.tz/index.php/jgat/article/view/102/82

[21] Kangalawe, R. Y. (2012). Land Degradation, Community Perceptions and Environmental Management Implications in the Drylands of Central Tanzania. In (Ed.), Sustainable Development - Authoritative and Leading Edge Content for Environmental Management. IntechOpen. https://doi.org/10.5772/45897

- √ Exploratory operations start with the opening of reconnaissance trenches, pits, and roads for exploration—some may be used, others left without repair
- √ Increased, dense settlements also impact forestland, valley plains, and uncultivated lands – a race to exploit
- √ Lack of education and the nature of economic activities can impact soil, land, forest health, or abundance
- √ Ancillary employment seekers further congest resources at mining locations
- √ Solid waste enters the water, clogging systems and causing flooding events – killing people and displacing others
- √ Desertification of land leads to further soil degradation and soil infertility, affecting grazing animal food sources

PC: World Bank, Der es Salaam overcrowding

Prosperity

- √ Workers lack pipeline advancement or education, leaving them at poverty levels – no opportunities when mines close
- √ Locals receive inadequate compensation for displacement
- √ Displacement results in loss of livelihood in agriculture, small-scale mining, and fishing
- √ Settlements may not be suitable for known trades, skills
- √ Gold rush and quick money increases child labor prevalence
- √ Training for mining work does not guarantee employment
- √ Disenfranchised age groups in rural locations in search of income
- √ Forced urbanization can impact mental health
- √ Flood disasters from urban displacement cause even more financial damage to homeowners, social systems

GOLD EMISSIONS CLASSIFICATIONS[22]

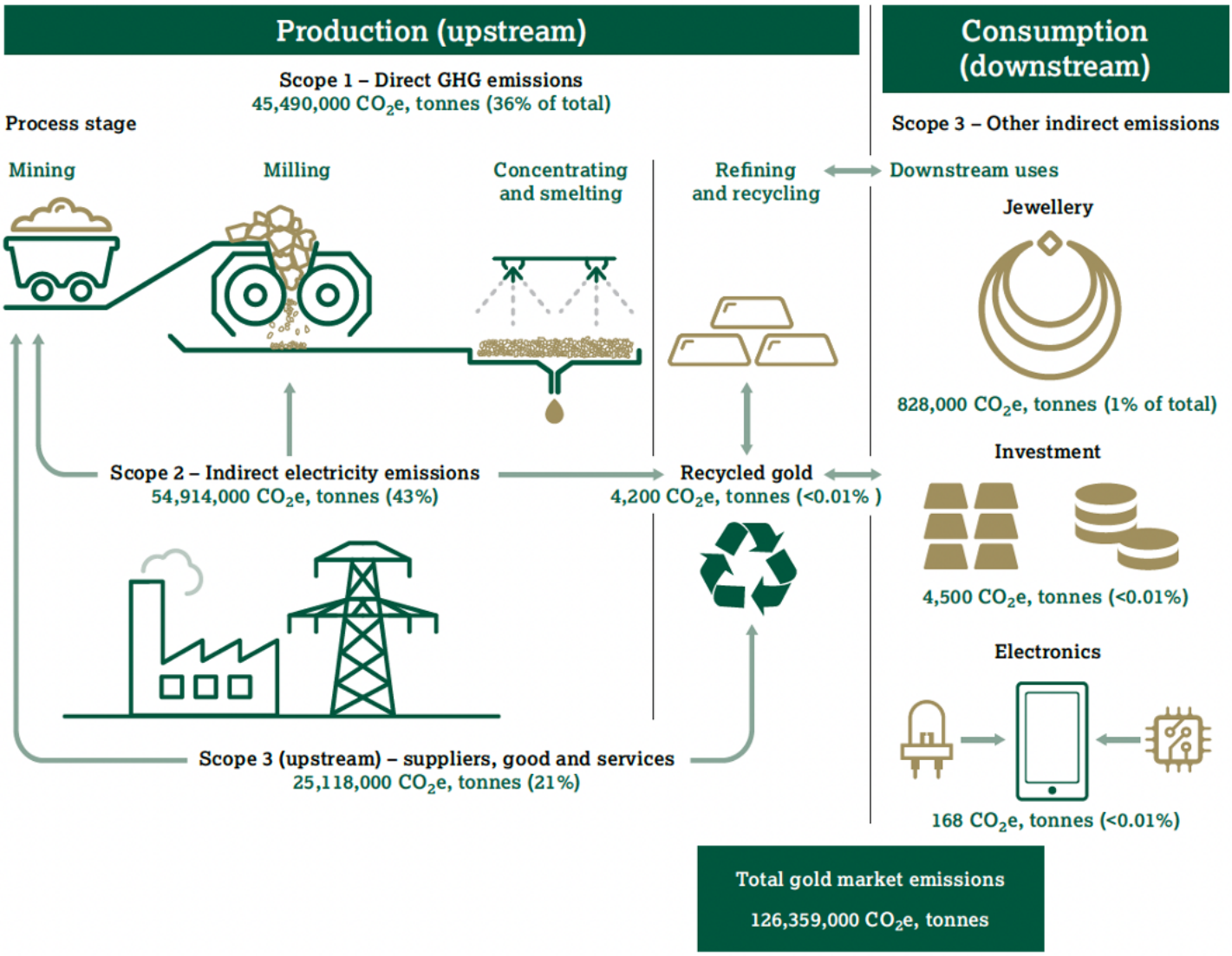


Figure 1 WORLD GOLD COUNCIL VIA KITCO NEWS

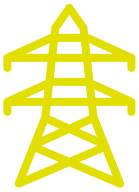
[22] Greenhouse Gas Protocol. (n.d.). https://ghgprotocol.org/

CARBON VALUE LIFETIME*

MEASURE: LIFETIME

SCOPE 1

- 75,491,481 LIFETIME MtC



SCOPE 2

- 90,170,380 LIFETIME MtC

SCOPE 3

- 44,036,697 LIFETIME MtC
-

SCOPE 1

CAT 330B
KOMATSU D65-E
REFUELING TRUCKS
ADDITIONAL MINING EQUIPMENT, I.E., GENERATOR
MILLING MACHINES, CONVEYORS
REFINING AND SMELTING
BIOMASS DISTURBANCES

SCOPE 2

INDIRECT ELECTRICITY CONSUMED

SCOPE 3

(UPSTREAM)
SUPPLIERS
GOODS
SERVICES

(DOWNSTREAM - CONSUMPTION)
JEWELRY
INVESTMENT
INDUSTRIAL (TECH, DENTAL, MEDICAL)

NYAMONGO & TARIME TOTAL CARBON PRODUCTION OVER A LIFETIME:

209,698,558 MtC

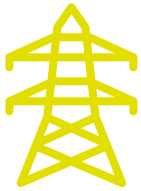
* See legal notes, pg. 18

CARBON VALUE MINE HALTED*

MEASURE: HALTED AFTER PROVEN SEASON

SCOPE 1

- 67,942,332 MtC AS A SHUTTERED MINE



SCOPE 2

- 188,728,702 MtC AS A SHUTTERED MINE

SCOPE 3

- 92,169,831 MtC AS A SHUTTERED MINE

SCOPE 1

CAT 330B
KOMATSU D65-E
REFUELING TRUCKS
ADDITIONAL MINING EQUIPMENT, I.E., GENERATOR
MILLING MACHINES, CONVEYORS
REFINING AND SMELTING
BIOMASS DISTURBANCES

SCOPE 2

INDIRECT ELECTRICITY

SCOPE 3

(UPSTREAM)
SUPPLIERS
GOODS
SERVICES

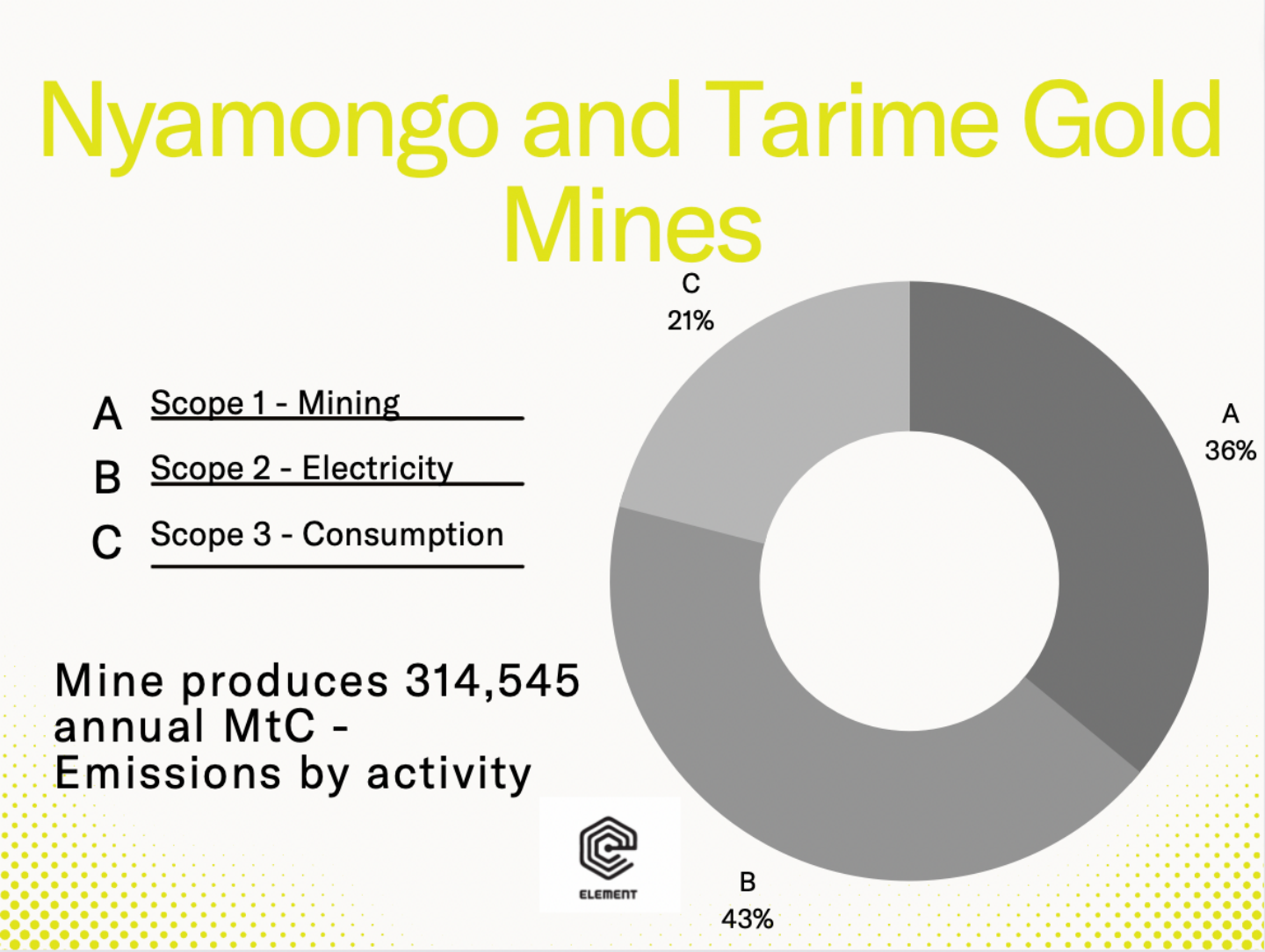
(DOWNSTREAM - CONSUMPTION)
JEWELRY
INVESTMENT
INDUSTRIAL (TECH, DENTAL, MEDICAL)

NYAMONGO & TARIME FULL CARBON SAVINGS AFTER SHUTTERING MINE

188,728,702 MtC

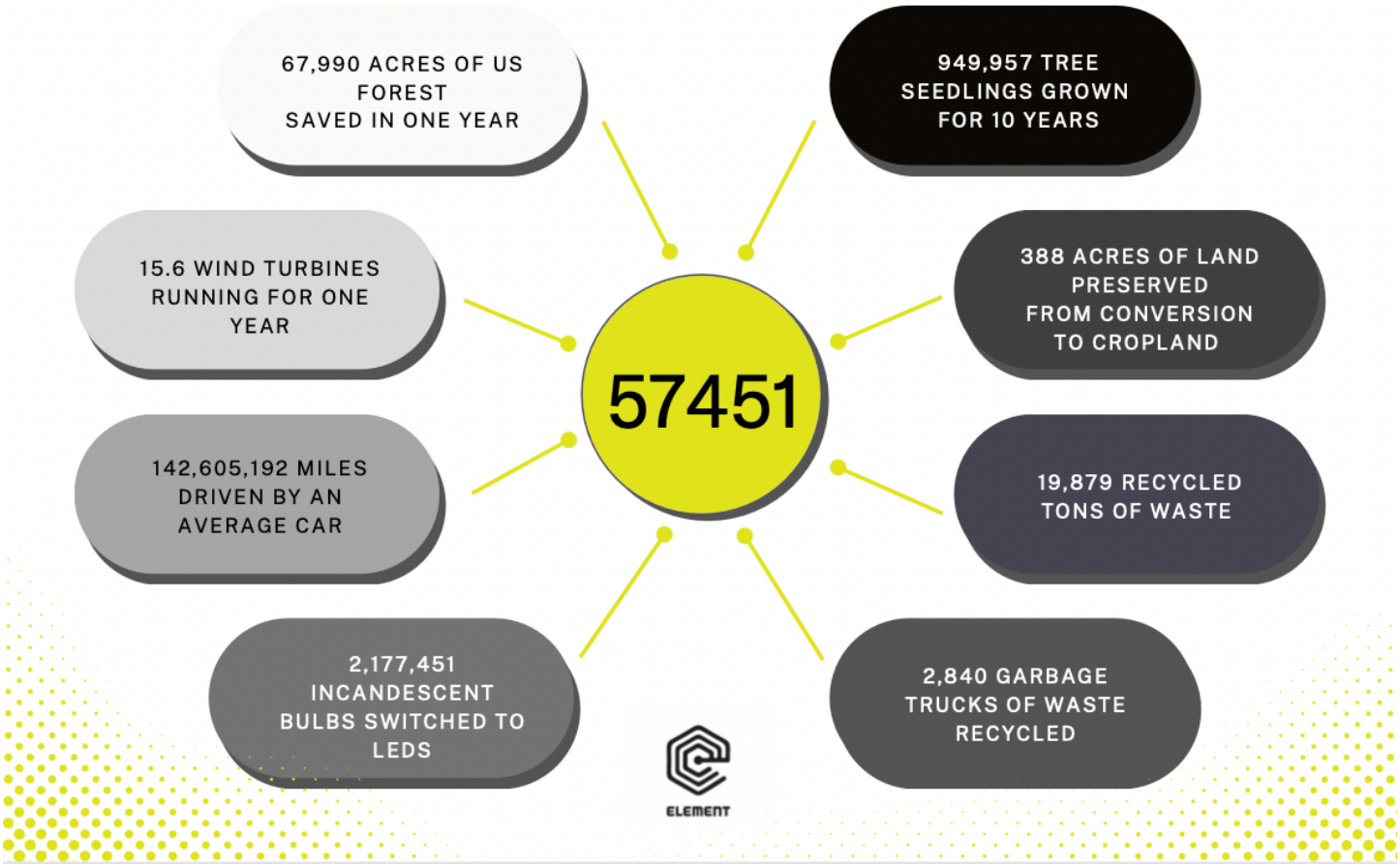
* See legal notes, pg. 18

EST. 314,545 METRIC TONS OF CARBON PRODUCED ANNUALLY[23]



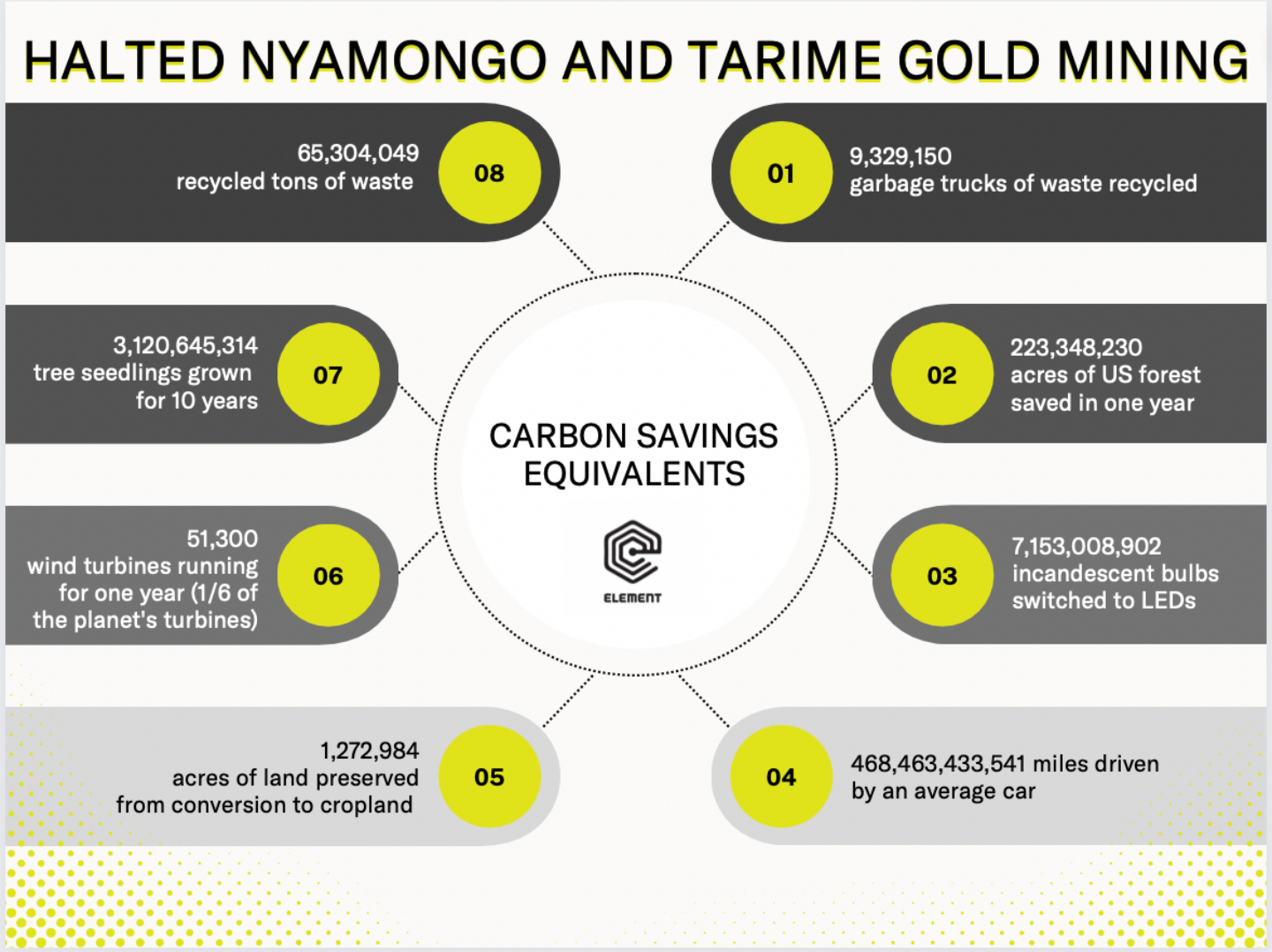
[23] See legal notes, pg. 18

EST. 57,451 METRIC TONS CARBON SAVED DAILY[24]



[24] See legal notes, pg. 18

SHUTTERED QUARRY SAVES EST. 188,728,702 METRIC TONS CARBON[25]



[25] See legal notes, pg. 18

LEGAL NOTES

FORWARD-LOOKING STATEMENT

This presentation may contain forward-looking statements that involve substantial risks and uncertainties. Forward-looking statements discuss plans, strategies, prospects, and expectations concerning the business, operations, markets, risks, and other similar matters. There may be events in the future that we cannot accurately predict or control. Any forward-looking statement in this presentation speaks only as of the date on which it is made. Factors or events that could cause our results to differ may emerge from time to time, and it is impossible for us to predict all of them. We do not plan to update or revise publicly any forward-looking statements except as required by law.

ELEMENT STANDARD DISCLAIMER

Rewards are not available for purchase from Element. They are digital rewards earned in exchange for work and action on the Element network. The digital reward is designed to have utility on the Element platform for the purchase of Element's products and services. The digital reward is not an investment product and may never have any value outside of the Element platform. Element node owners should not expect to recognize any value from the digital reward other than its utility with Element. Element does not anticipate correlation between the digital reward value and Element's business activities.

RESEARCH NOTES

SITE DETERMINATION

Data was collected from the Mining Technical and Progress reports in making site determinations

LAND SIZE AND MINING OPERATION

Calculations based on the Mining Technical report

Significant annual potential for mining equals 365 days; 24/7

Maximum 10 tons carrying weight per load via trucking @ rate of 6.5 mpg fuel burn.

PREVAILING DATA

Mining, extraction, refining, prime retrieval rate, and all other environmental estimations used prevailing data and gathered evidence from the U.S., Canadian, and other global agencies offering similar or general findings.

SME FINDINGS

SMEs were contacted for earth mover equipment fuel capacity verification - Local Caterpillar Dealership

Diesel carbon burn was calculated at 22.38 lbs. carbon/gal. Aviation SME contacted (Pilot – Captain David Parlotz)

OWNER'S MANUALS

Where such data as a fuel burn on Caterpillars and Komatsu earth moving machinery was unavailable, a general estimation of 7.5 diesel gallons per hour was used given retrievable owner's manuals.

CALCULATIONS

Maximum machine/vehicle daily run times measured @ 12 hours.
Diesel carbon burn was calculated at 22.38 lbs. carbon/gal.
Online conversion calculators use for kWh to CO_2, Btu to kWh, Lbs. to MtC
E.P.A. calculators were employed for compiling all other CO_2 scopes.

RESOURCES

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