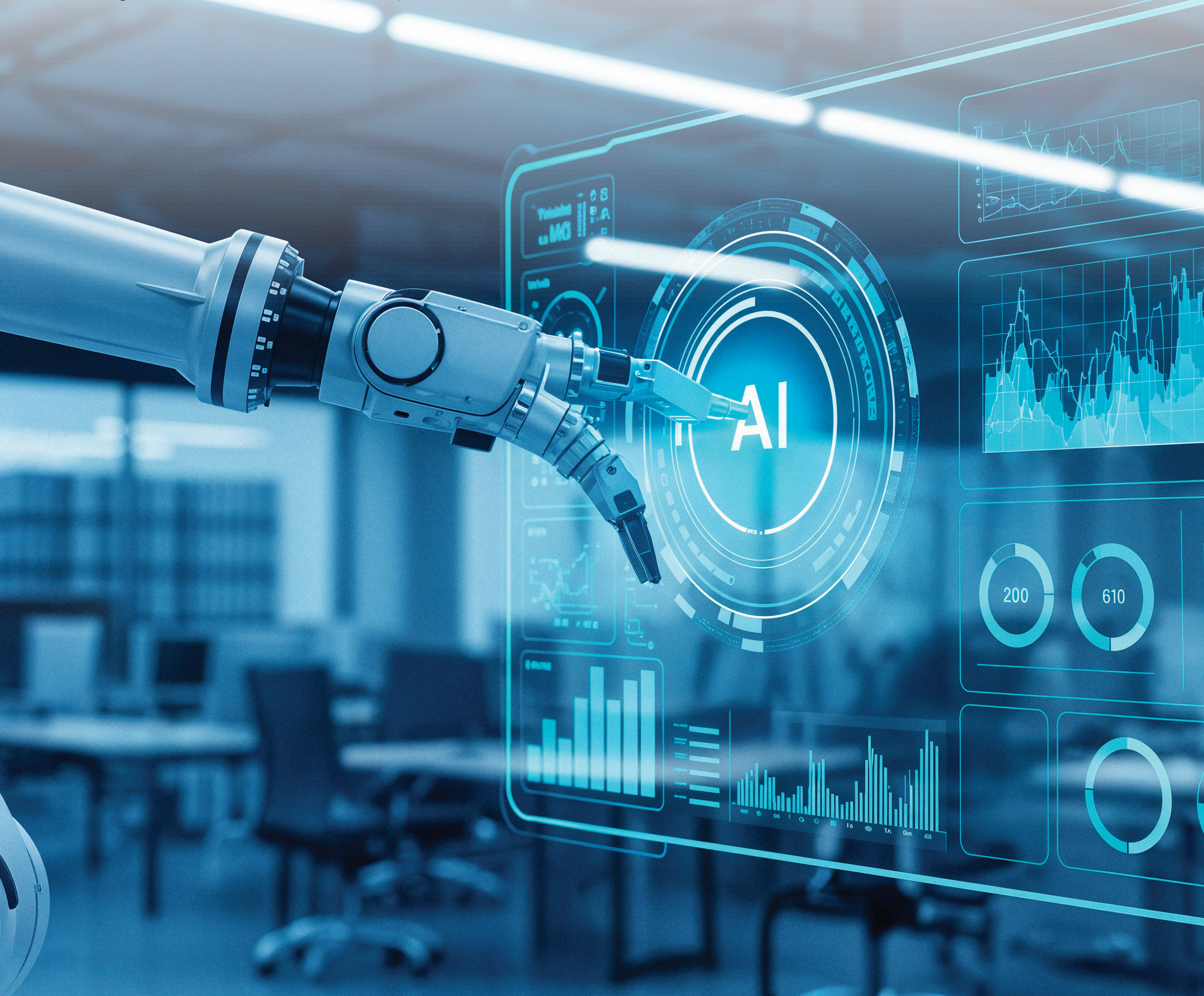
SABIAN

SABIAN GLOBAL INC.

THE NEXT 40 YEARS OF RARE EARTH MINING

What the Data Really Says – And What Comes Next

By Jason Wallace, Founder



Executive Summary – The Ground Truth

Rare earth elements (REEs) sit behind almost everything the 21st century wants to build:
electric vehicles, wind turbines, drones, data centers, AI hardware, defense systems, robotics, advanced motors, and medical imaging.

The world's dependence is increasing. According to the International Energy Agency (IEA), demand for critical minerals surged again in 2023; rare earth demand for clean energy technologies is growing in the high single to mid-teens percentage range annually, with the overall critical minerals market for the energy transition now worth around USD 325 billion, on par with iron ore. I

But when you strip away opinion and look only at hard filings and official data, three things are clear:

- Production is concentrated. The latest U.S. Geological Survey (USGS) data estimates global rare earth mine production at ~390,000 tonnes of REO equivalent in 2024, with China still the dominant producer.
- Processing is even more concentrated. Independent analyses based on government and industry reports put China's share of rare earth processing and refining at around 90%, and roughly 60% of mining across key critical minerals.
- New supply is slow. For major mines that actually made it from discovery to production between 2010 and 2019, the global average lead time is over 16 years; for recent projects entering production between 2020 and 2024, that has stretched to nearly 18 years. In the U.S. it can approach 29 years.

At the same time, automation, robotics and AI are no longer future concepts. The global autonomous mining equipment market is already worth around USD 4.5 billion and is projected to grow to nearly USD 12 billion by 2033, a compound annual growth rate (CAGR) of roughly 11–12%.

Patent and R&D activity in e-waste processing and rare earth magnet recycling has been climbing for over a decade, with organizations like Hitachi and others developing machinery to automatically remove and recover rare earth magnets from hard drives and compressors, and WIPO tracking a sustained increase in patents in this field.

In other words:

01 The world needs more rare earths.

02 The current system is too slow, too concentrated, and too fragile to provide them.

03 The tools to change this — AI, automation, robotics, digital twins, and circular recovery — already exist and are accelerating.

Sabian Global Inc. exists to connect these realities: to use data and intelligence to redesign how rare earths are discovered, produced, circulated, and governed — with developing nations at the table as real partners, not bystanders.

Why Sabian Exists – A Human Reason

I didn't build Sabian because I wanted to be in "mining tech."

I built Sabian because everywhere you look, the same pattern repeats:

- Countries rich in resources remain poor in outcomes.
- Data about those resources is fragmented, late, or locked away.
- Decisions that shape entire regions are made with partial visibility.
- New technologies benefit the same few, while the rest are told to be patient.

Rare earths are a pressure point where all of this converges.
If you control rare earths, you don't just control minerals; you control who gets to build tomorrow's technology.

And right now:

01 Brazil may hold over 20% of known rare earth reserves, yet it represents around 1% of global production.

02 Africa is hosting conferences and strategies around "the Africa we want" built on critical minerals, while still fighting to move beyond export-only models.

03 Canada has significant reserves and is now spending billions of dollars to try to capture more of the value chain, yet is publicly described in some analyses as "globally irrelevant" as a critical mineral refiner.

The data tells you this is not just a technical problem.
It is a fairness problem and a visibility problem.

Sabian was created to tackle that: to bring together data from geology, production, trade flows, automation, patents, and environmental reporting, and make it intelligible — so nations, communities, and companies can finally see the whole board, not just their corner.

The driving force is simple and human:

If we're going to live in an age of technology, the benefits can't keep skipping the people standing on the resources that make that technology possible.

Rare earths are where we start, because they're non-negotiable for everything else.

What the Data Actually Says About Rare Earths

Strip out speculation and focus on official, traceable data.

Production and Reserves – A Lopsided Map

USGS Mineral Commodity Summaries show global rare earth mine production increasing to roughly 390,000 tonnes of REO equivalent in 2024. China remains the largest producer by far. The same dataset shows:

- **China:** largest share of mine production, with substantial but not dominant reserves.
- **Brazil:** ~21–23 million tonnes of rare earth oxide reserves — about 23% of world reserves, but tiny current production.
- **Australia:** very large reserves (over 130 million tonnes in some recent estimates) and growing production, supported by government-backed critical minerals programs.
- **United States:** meaningful reserves (~1.9 million tonnes) and one dominant operating mine, but limited processing capacity.
  Canada, South Africa, others: significant resource potential and policy moves, but still in early stages of development.

On paper, the world's rare earths are not all in one country.
In reality, supply behaves as if they are.

Processing and Geopolitics – Real-World Dependency

Processing and refining are where power accumulates.

Multiple government-linked and industry assessments point to a pattern: China controls around 60% of global critical mineral mining and around 90% of processing and refining capacity across several of those minerals, including rare earths.

You see the consequences every time export controls tighten:

01 When China expanded controls on certain heavy rare earths in 2025, analysts warned automotive and wind sectors that magnet stockpiles could be depleted in 3–6 months, risking shutdowns.

02 The EU has launched measures to keep more magnets at home and aims for 20% of its magnet demand to be met from recycling by the end of this decade, explicitly to reduce exposure to Chinese policy.

Australia is building a strategic mineral reserve, Canada is leading a G7 Critical Minerals Production Alliance, South Africa is crafting a continent-focused critical minerals strategy — but even optimistic scenarios from the IEA say market concentration will remain high, with top-three suppliers in many critical minerals still controlling around 80%+ of supply by 2035.

The pattern is undeniable: countries are racing to claw back control, and the baseline they are starting from is deep dependency.

Time – The Silent Killer in Supply

Let's talk time, not rhetoric.

The IEA's analysis of mines that came online between 2010 and 2019 shows an average of over 16 years from discovery to production. More recent analysis from S&P Global indicates new mines starting up between 2020 and 2024 are averaging nearly 17.8 years.

A separate comparative report finds that in the United States, development times are approaching 29 years on average from discovery to first production, longer than almost anywhere except Zambia.

Those are not tech-industry timelines. They are generational.

When you combine high concentration with two-decade development cycles, you don't need a model to see the risk:

- Any disruption in the dominant producer's capacity, policy, or exports can hit global industries well before alternative supply can be brought online.
- That's not theory. It's what automakers and turbine manufacturers are living with already.

Automation and Robotics – Already Scaling

Now look at technology from the other side.

Market research based on company financials and industry disclosures shows:

01

Broader mining automation markets are expected to grow from roughly USD 4–5 billion in the mid-2020s to around USD 7–8 billion by early 2030s, depending on the analysis, driven by safety, cost pressure, and labor scarcity.

02

The autonomous mining equipment market is estimated at around USD 4.5 billion in 2024, projected to reach nearly USD 12 billion by 2033, with a CAGR of about 11–12%.

This is real capital being deployed. Every autonomous haul truck, robotic drilling rig, and underground sensing system is a step toward mines that no longer rely on people being physically present in dangerous environments.

The industry is not fully automated yet — far from it — but the trajectory is locked in: more autonomy, more robotics, more data.

The other source of hard truth is patent and engineering data around recycling.

WIPO's patent landscape on e-waste recycling shows a sustained rise in patents related to recovering rare earths and other critical materials from discarded electronics, with major industrial players designing systems to automatically disassemble devices and separate magnets.

A 2023 methodology paper on rare earth recovery from e-waste patents confirms an expanding field of innovation in hydrometallurgical, pyrometallurgical, and direct recycling pathways specifically focused on neodymium, dysprosium, and other magnet materials.

Put simply:

- The primary supply is concentrated and slow.
- The secondary supply — embedded in motors, hard drives, turbines, EVs — is large and increasingly technically recoverable.

The bottleneck is not physics; it's coordination and economics.

That is what Sabian was built to see.

Projecting Forward – What This World Looks Like in 40 Years

Sabian is not here to make up stories. We can only see as far as the data and trendlines allow.

If you take the verified signals above and push them forward 30–40 years, several outcomes are not just likely — they are hard to avoid:

- Rare earth demand continues to outpace "business-as-usual" supply.
  Clean energy and AI hardware pull more material into long-lived assets. The IEA already sees strong, sustained growth; even conservative scenarios show rising demand through 2050.
- Few countries remain comfortable with external dependency.
  Policy moves in Australia (strategic mineral reserves), Canada (stockpiles and alliances), the EU (magnet export limits and recycling mandates), and South Africa (critical mineral strategies) are all reactions to the same fear: being held hostage by bottlenecks.
- Automation in mining keeps compounding.
  At 7–12% CAGR over a decade, automation and autonomous equipment will not stay niche. As more operations adopt them, the economic case for non-automated mines weakens.
- Circular supply becomes material, or we run out of options.
  The mathematics of slow new-mine development plus growing demand make it almost inevitable that recycled rare earths move from "interesting pilot" to a major part of supply.
- Intelligence becomes non-optional.
  With lead times approaching 20+ years, nations and companies cannot afford blind spots. They will need system-level visibility: who has what, where it is in the value chain, what is at risk, what can be recycled, and how the environment is actually being affected in real time.

None of this requires science fiction. It's what the existing numbers already imply.

What Sabian Brings That the Industry Doesn't Have

Sabian's advantage is not that it knows the future.

It's that it is willing to look at the whole system at once.

Most actors in this space are stuck in one layer:

Sabian is built to ingest:

- geological surveys (USGS, Geoscience Australia, national geological services)
- trade and production data
- automation and equipment deployment trends
- patent and technology signals in robotics and recycling
- environmental and policy disclosures

and treat them as one system, not separate domains.

From that vantage point, a few truths become visible:

- Some countries will stay "resource rich, outcome poor" unless they gain access to this full picture.
- Some companies will invest billions in assets that are misaligned with where policy, automation, and demand are actually going.
- Some communities will either become partners in long-term value or be bypassed again.

Sabian's role is to surface these realities early, so the people who can act — governments, operators, investors, and communities — are not guessing.

A Different Kind of Vision – Firm, But Grounded

It would be easy to say: "By 2065, all mines will be fully autonomous, every rare earth will be recycled, and the world will be perfectly balanced."

That's not honest.

What the data does support saying is this:

- Automation in mining will be far larger than it is now, because the economics and safety arguments are strong and capital is already flowing.
- Policy actions in Australia, Canada, the EU, South Africa, and Brazil show that critical mineral sovereignty is now a core strategic objective, not a niche topic.
- Companies and institutions are steadily building the technical capability to recycle a meaningful share of rare earths from end-of-life products.
- Lead times for mines are not collapsing. If anything, they are lengthening, which makes intelligent planning and early warning systems more important, not less. From Sabian's perspective, the most likely long-term outcome is not a fantasy of perfectly circular, perfectly automated supply. It's a hybrid world:
- Some deposits will be mined with high automation and high environmental standards.
- Some will remain marginal or unmanaged.
- Some countries will use intelligence to climb the value chain.
- Some will be left out because they never saw the full picture in time.

Sabian's vision is to reduce that last category to zero — or as close to it as possible.

What This Means for the Industry

If you work in mining, processing, or advanced manufacturing, here is what the data is telling you directly:

- You will not be allowed to ignore supply concentration and lead times.
  Governments are already writing laws, forming alliances, stockpiling minerals, and backing projects to break bottlenecks.
- You will not stay competitive without automation and intelligence.
  The capital markets are already betting on autonomous equipment and automation as the future of safe, profitable mining.
- You will not keep your social license without real-time environmental accountability.
  With satellite monitoring and sensors, "we didn't know" is disappearing as an excuse.
- You will not hold onto old pricing opacity forever.
  As more players build data-driven indices based on real flows and real risks, energy-transition minerals will move toward more transparent, model-driven pricing, whether the incumbent beneficiaries like it or not.

The opportunity is enormous:

- To build mines that are safer, faster, and smarter.
- To bring countries like Brazil, South Africa, and others fully into the value chain instead of keeping them locked at the bottom.
- To create a second supply from recycling that reduces environmental pressure and geopolitical risk at the same time.

The risk is equally clear:

- If you keep operating as if the 1990s never ended, you will be out-competed by those who can see the system through data and act on it.

Closing – Sabian's Stance

Sabian is not claiming to see the future perfectly.

What we are saying is:

- We are willing to look at all of it at once — USGS tables, Geoscience Australia reviews, Canadian strategy documents, Brazilian reserve estimates, South African policy speeches, automation market data, patent filings, and environmental disclosures — and treat them as one integrated reality.
- We are prepared to tell the truth that emerges from that view, even when it makes people uncomfortable: that the system is too concentrated, too slow, too opaque, and too uneven to support the future as it stands.

And we are building tools to change it, starting with rare earths.

I built Sabian because I believe technology should close gaps, not widen them — and because the people living on top of the minerals that drive the 21st century deserve a fair shot at the life that comes with them.

Everything in this paper — the production numbers, the reserve estimates, the lead times, the automation growth, the recycling patents — is traceable. You can look it all up. You can argue with the interpretation, but the underlying reality is hard to deny.

The question for the industry is no longer,
"Will this change come?"

It's: "Who will be ready when the data stops being optional?"

Sabian intends to be ready — and to help those who are serious about seeing the whole field, not just their own pit, get ready too.

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