



CERION PRAXIS

BIO-MINING ENGINEERING

PRE-NDA · NOVEMBER 2026

BIO-TECH INFRASTRUCTURE FOR THE RARE EARTH ELEMENTS ECONOMY

AI-driven bio-technologies for recovery of rare earth elements from waste streams, brines, and industrial residues.

PRE-SEED ROUND · \$2.0M

cerionpraxis.com

The Rare Earth Bottleneck Is a \$6.5 Trillion Problem

Reliance on a single supplier and destructive extraction technologies have paralyzed the economy.



2,000 T

Toxic Waste

Produced for every 1 ton of target metal extracted with legacy methods



94%

China Monopoly

Share of global rare earth magnet production concentrated in one country



\$6.5T

Value at Risk

Global economic value dependent on a secure, diversified REE supply chain

Engineered Proteins Turn Waste Into Rare Earth Supply

Cerion Praxis's LanM platform uses AI-designed, CRISPR-engineered proteins to selectively bind and recover rare earth elements from brines, e-waste, and industrial residue — without the toxic extraction chemistry that defines today's REE supply chain.

*One engineered protein. Five product lines.
Zero solvent extraction.*



LAN-M
MOLECULE



Selective

Binds target rare earth ions with molecular precision — leaving bulk minerals untouched.



Clean

Bio-based recovery replaces solvent-heavy, high-emission extraction chemistry.



Distributed

Modular bioreactors deploy at the waste source — no centralized refinery required.

Lanmodulin or LAN-M is a newly discovered solution, however it is **very hard to produce**

Three Nobel-Winning Breakthroughs, One Platform

Cerion Praxis relying on super-synergy of Nobel-winning discoveries in combination with unique gene-editing.

THE NOBEL FOUNDATION (SCIENTIFIC CORE) made it possible

AI Protein Design (2024)

Precise molecular modeling of "smart magnets" for absolute metal selectivity.

CRISPR Gene Editing (2020)

Reprogramming extremophiles at the DNA level for continuous target synthesis.

Directed Evolution (2018)

Adapting microorganisms to survive in harsh, toxic industrial environments.



From Waste Stream to Recovered Rare Earths, in Four Steps

1



Feedstock Intake

Brines, e-waste leachate, and industrial tailings collected at the source



2



LanM Protein Binding

Engineered protein selectively captures target REE ions from the mixed stream



3



AI-Controlled Bioreactor

Digital twin + reinforcement learning optimize yield and timing in real time



4



Recovery & Output

Purified protein, resins, and metalloenzyme products ready for sale

A Proprietary, CRISPR-Engineered Production Chassis



Low Cost Cultivation

Grows on inexpensive media and does not require the costly cultivation conditions typical of many conventional biotechnology platforms.



Proprietary production control

Cerion Praxis can engineer the chassis, expression system and production triggers as proprietary know-how—creating an IP layer beyond the target protein itself.



Scalable production

Suitable for high-cell-density cultivation and potentially large-volume fermentation, providing a pathway from laboratory production to industrial-scale manufacturing.



Genetically engineered

Compatible with established molecular-biology and genetic-engineering approaches, enabling optimization for high-yield production of target proteins.

An AI-Controlled Bioreactor That Learns the Process



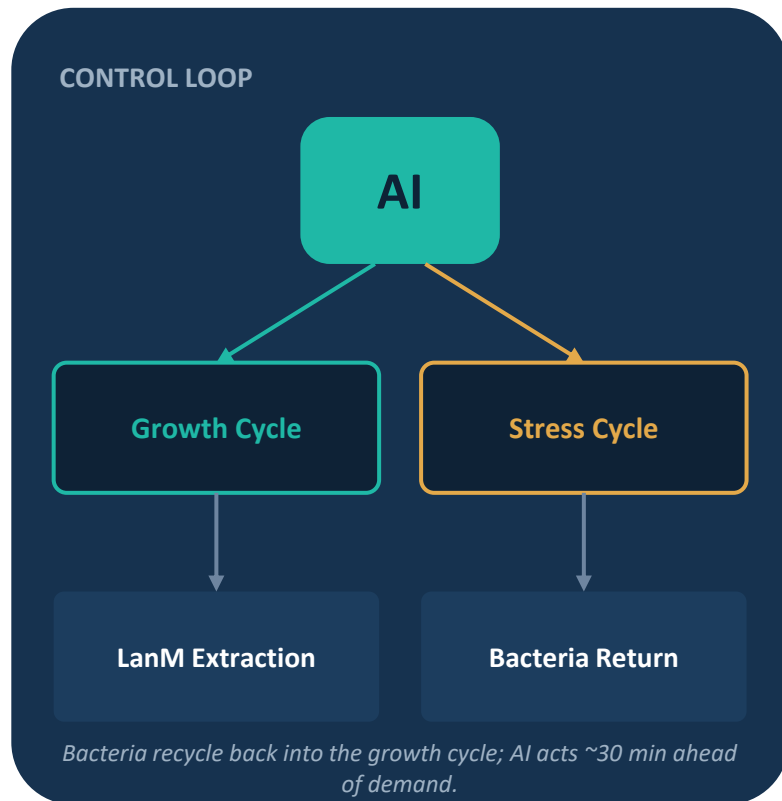
Mechanistic model + physics-informed neural network (PINN) simulate reactor state in real time.



A PPO agent continuously tunes feed and process parameters to maximize yield.



Industrial control via OPC UA / MQTT — built for real plant-floor deployment, not just the lab.



A \$500B Market Waiting for a Cleaner Recovery Method

TAM

\$6.5T value at risk across REE-dependent global industries

SAM

\$500B addressable market in brines, e-waste, tailings & nuclear waste recycling feedstocks

SOM

\$82M annualized revenue run-rate modeled by 2030 (Series A exit)



2,500,000 Tons

Annual global demand for high-performance rare earth sorbents

Endless Resources of REE in tailings and recycling



Mine water and flooded pit

Continuous water flow with no mining or crushing. Existing treatment infrastructure enables modular recovery.

ΣREE: 0.5–2.5 mg/L

Elements: Y, La, Ce, Nd, Gd, Dy, Tb



Fluorescent lamp phosphor leachate

Lower-volume but high-value feedstock, particularly attractive for europium and terbium recovery.

The red phosphor is predominantly $Y_2O_3:Eu$, and very high leach extraction has been demonstrated for Y, Eu, Tb and Ce.

ΣREE: 5–30 g/L

Elements: Y, Eu, Tb, Ce



Coal fly-ash leachate

REE are acid-leached from coal ash, followed by selective capture from the pregnant leach solution.

ΣREE: 50–100 mg/L

Elements: La, Nd, Y, Ce, Sc, Gd



Recycling: NdFeB magnet leachate

Highest-value feedstock for Cerion Praxis: concentrated, predictable and rich in magnet-critical elements. Magnet waste itself may contain approximately 22–24% Nd and 5–7% Pr, plus smaller quantities of Dy/Tb.

ΣREE: 10–50 g/L

Elements: Nd, Pr, Dy, Tb

Five Revenue Streams From One Core Platform

CORE BUSINESS



JV Partnerships

Revenue-share REE recovery projects from industrial waste (scandium from aluminum & titanium tailings).

JV / Equity



Ion-Exchange Resins

Recurring consumable product for REE separation — steady-volume, repeat-purchase revenue.

Global



Plug'n'Play Modules

Deployed REE recovery units at customer sites — hardware plus recurring resins consumable revenue.

Hardware+

POTENTIAL EXPANSION



Metalloenzymes

Contracted supply for industrial biocatalysis, including biodiesel production customers.

Global



LanM Protein Powder

High-value recombinant protein sold to industrial & specialty buyers at premium per-gram pricing.

R&D

Anchor Industrial Partnerships De-Risk Scale-Up



Direct Product Sales

Partnering with mining giant and industrial recyclists aimed to purchase ion-exchange resins — mid-term, global scale cash-generative revenue.



Infrastructure JVs & Licensing

Modular Plug'n'Plays deployed at mining and recycling majors' own waste streams, with revenue shared under long-term partnership agreements.



CASE STUDY

Joint Venture: Scandium Recovery from Aluminum Red Mud

A joint venture recovers scandium from acid waste generated during titanium production (~32 ppm Sc content), with net recovery revenue shared between partners — a template for future anchor-partner deployments.

Scandium recovery from aluminum red mud

Global red mud tailings
>4 bn tons

Hundreds of tailings locations with
>100 ppm Sc_2O_3

Current price of Sc_2O_3
\$600 per kg

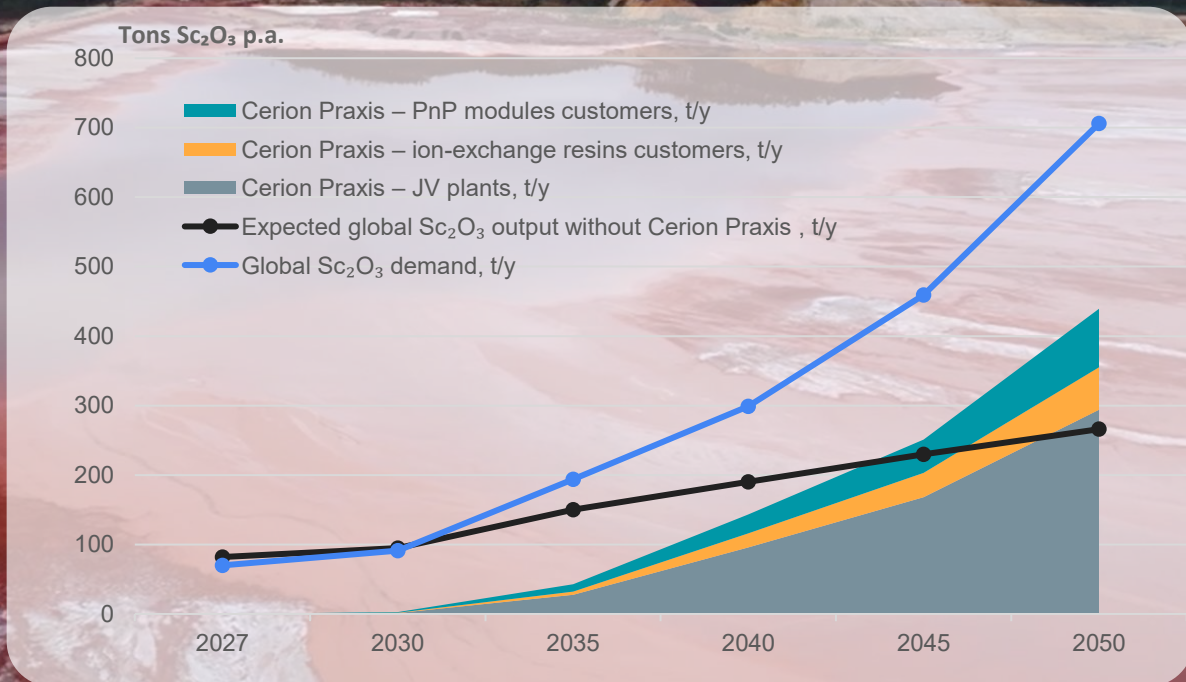
Global output of Sc_2O_3 in 2040
50%

Will be delivered by Cerion Praxis technologies

From China and Russia comes
92%
Global share of Sc_2O_3 output

Scandium alloys are used in aerospace, defense, automotive, additive manufacturing (3D printing), and other high-performance lightweight applications.

Scandium use across high-tech industries is expanding rapidly, and demand could be substantially higher if reliable, scalable supply becomes available.



Source: Scandium Canada — Updated EY-Parthenon Study Projects Global Scandium Demand to Triple by 2035

Four Rounds, Four Proof Points

1

PRE-SEED

2027– 2028

\$2.0M

- Lab-scale proof of concept
- Core IP portfolio filed
- Ion-exchange resins manufacturing facility
- Pilot project onsite at red mud tailings waste depot

2

SEED

2029

\$3.0M

- Demonstration scale plant project onsite opens gates to industrialization and global scaling

3

SERIES A

2030-2032

\$60M

- Massive ion-exchange resins factory construction
- 3 JV plants construction
- Sales of PnP modules globally
- Ramp up sales of ion-exchange resins

3

SERIES B

2033-2036

\$60M

- Upgrade of ion-exchange resins factory
- 3 JV plants construction
- Ramp up sales of modules
- Global sales of resins

Path to an ~\$82M Annualized Revenue Run-Rate



Series A quarterly revenue ramp (\$M)



Reflects Cerion Praxis's internal financial model (Aug 2026). Modeled to reach sustained positive EBITDA during the Seed stage, with margin expansion through Series A as production scales.

Tax assumption: combined 27.9% effective rate (21% US federal + 8.7% Delaware state corporate tax).

Industrial Scale & High-Margin Recurring Resin Revenue

PRE-SEED BUDGET

\$2.0 M

Validation and development budget

2035 REVENUE

\$96.7M

Annual industrial-scale revenue

2035 EBITDA

\$74.5M

77.0% EBITDA margin

2035 FREE CASH FLOW

\$50.3M

Before financing; modelled

RECURRING RESIN ECONOMICS | PER INSTALLED MODULE / YEAR

\$150/kg

Resin selling price

66.7%

Resin margin

\$3.0M

Annual resin sales

\$2.0M

Annual resin contribution

DCF VALUE SCENARIOS @ 10% DISCOUNT RATE

MODEL

BASE

GROWTH

\$26.2M

2026-'30

\$337.7M

+10% p.a. FCF to 2044

\$951.0M

+25% p.a. FCF to 2044

SINGLE JV RED MUD PLANT | OUTPUT - 7 t/y Sc_2O_3 | PRICE - \$650/kg

\$8.0M

Plant CAPEX

\$3.69M

Annual net revenue

\$2.17M

Pre-tax contribution*

58.8%

Contribution margin*

3.7 yrs

Simple payback*

27.1%

Cash return / CAPEX*

*Indicative, before resin purchases, taxes, financing and capital recovery; not ROCE. 7 t/y is a revised scenario (v5.3: 4.57 t/y). Net revenue assumes 90% sell-through × 90% interest; OPEX \$1.52M/y. IMPORTANT: v5.3 also assumes 60 t/y resin demand (\$9M at \$150/kg); reconcile before claiming plant profitability.

Market Expansion and Infrastructure Roadmap

Discovery,
to feasibility

Industrial
Planning

Global
Scaling



1

YEAR 1-2: R&D AND PILOT

Product: Ion exchange resins

On-Site tested Pilot Ecosystem

5-8 tons/year ion-exchange resins output

LanM protein sales to labs

Establishing partnerships with mining giants

2

YEAR 3-5: INDUSTRIAL INTEGRATION

Products: Plug and Play Modules, Ion-exchange resins.

JV's: 3 Downstream plants (scandium recovery)

Markets: Aluminum and Titanium downstream, Urban Mining, Bio-recycling, REE separation, wastewater remediation.

Model: Modules, JVs, resins sales

3

YEAR 5 -10 : GLOBAL SCALE

Products: Plug and Play Modules, Ion-exchange resins, metalloenzymes.

Model: JVs with mining and recycling global players. Selling and installing PnP modules directly at mining and recycling sites of customers (incl. nuclear facilities).

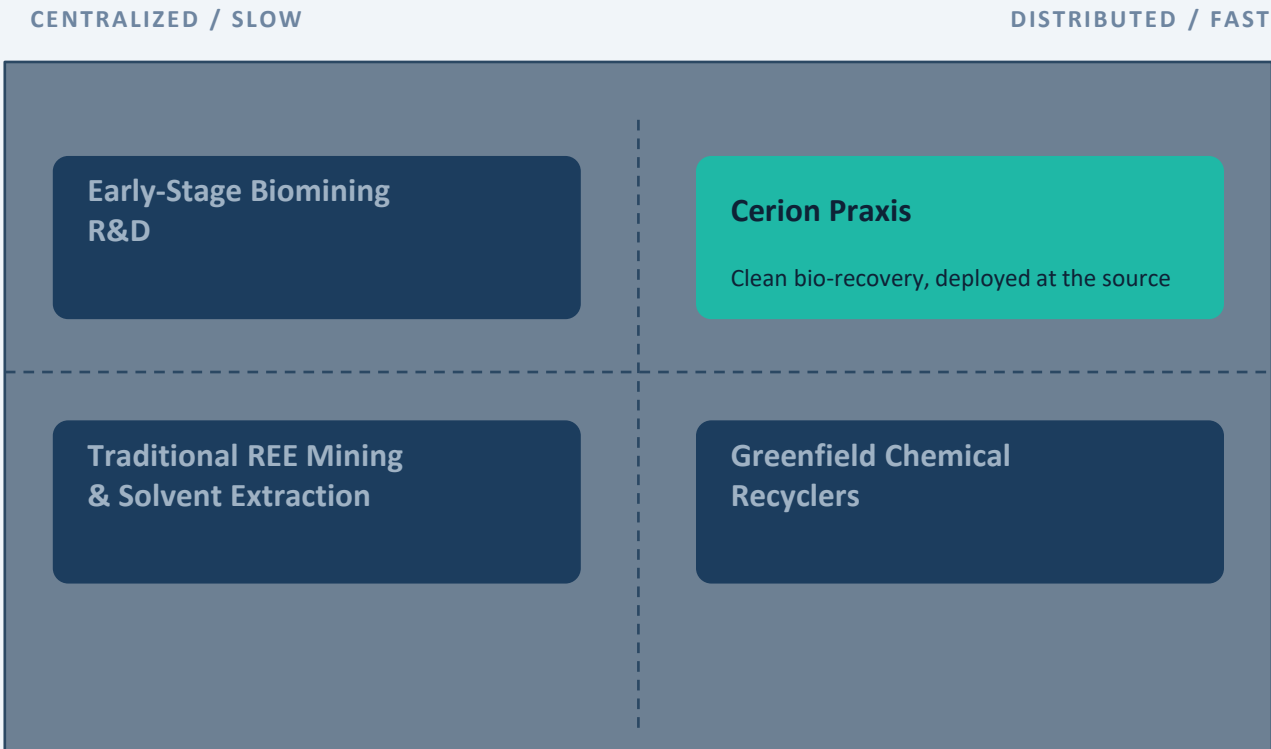
Markets: Aluminum and Titanium downstream, Urban Mining, Bio-recycling, REE separation, wastewater remediation.

Income: longterm technology subscriptions.

Positioned Between Dirty Mining and Slow Biotech

Why this quadrant wins

Legacy mining is fast to scale but environmentally toxic. Lab-stage biomining is clean but hasn't left the bench. Cerion Praxis is the only approach combining Nobel-grade protein engineering with modular, revenue-generating deployment today.



FOUNDERS TEAM



Ivan Karpenko, PhD

CEO

An upstream energy executive and geoscientist with 20 years of experience in oil and gas upstream and business development. Ivan leads Cerion Praxis' strategic direction, investor engagement, international partnerships and commercialization strategy.



Andrii Sevryukov

CBDO

A business development executive with 20 years of experience across mining, fundraising, strategic partnerships and commercial growth. Andrii leads market development, investor relations and the formation of industrial and technology partnerships.



Nataliya Stasyuk, PhD

CTO

A multidisciplinary scientist with expertise in biotechnology, bioelectrochemistry, and enzymology. Leads the development and industrial scaling of innovative, sustainable biological metal-recovery technologies.



Paw Juuls, PhD

Chair of Advisory board

A process-industry executive with more than 20 years of experience, including CEO and CTO roles. Paw brings deep expertise in industrial technology development, process scale-up, commercialization and the deployment of complex processing systems.

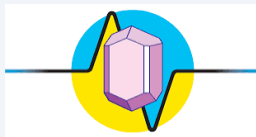
PARTNERS



Institute of Cell Biology of the National Academy of Sciences of Ukraine
(ICB NAS of Ukraine).



Explogen LLC (EXG) – The microbial strain Engineers.



M.P. Semenenko Institute of Geochemistry, Mineralogy and Ore
Formation of NAS of Ukraine



Institute of Physical Chemistry, Polish Academy of Sciences

Raising \$2.0M to Reach Seed-Ready Milestones

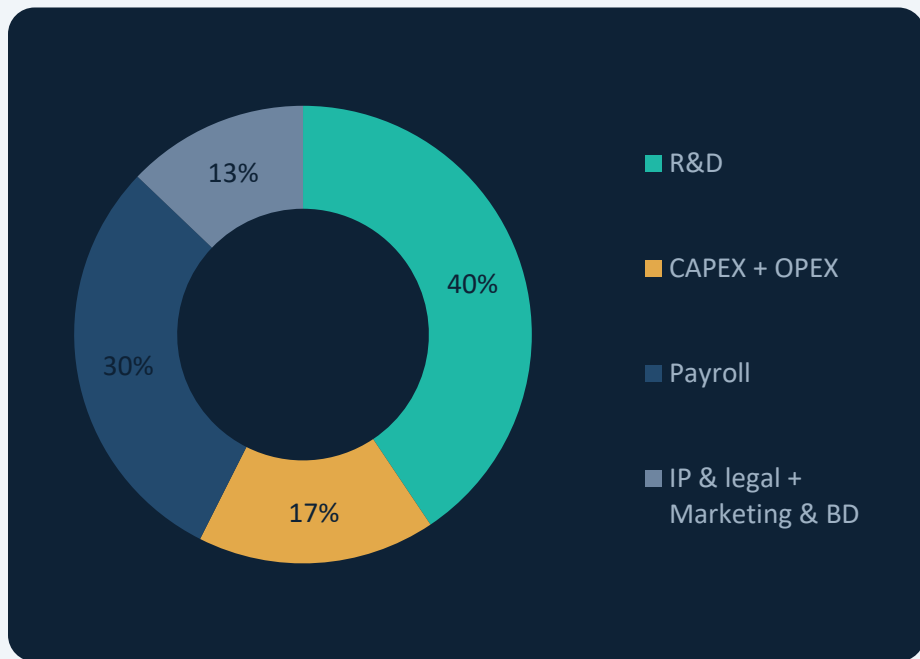
\$2.0M

Pre-Seed round · ~18-month runway (6 quarters)

- Lab-scale proof of concept across all three product lines
- Pilot project on site opens door to industrialization
- Resins manufacturing facility outputs production
- Core IP portfolio filed and defensible
- First revenue contracts signed (proteins & resins)
- Full data package and team in place to open Seed

Indicative pre-money valuation: \$10M (~16.7% for \$2.0M)

Use of Pre-Seed Funds





CERION PRAXIS

BIO-MINING ENGINEERING

Let's Build the Rare Earth Supply Chain the Planet Actually Needs

cerionpraxis.com

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CONTACT THE FOUNDERS