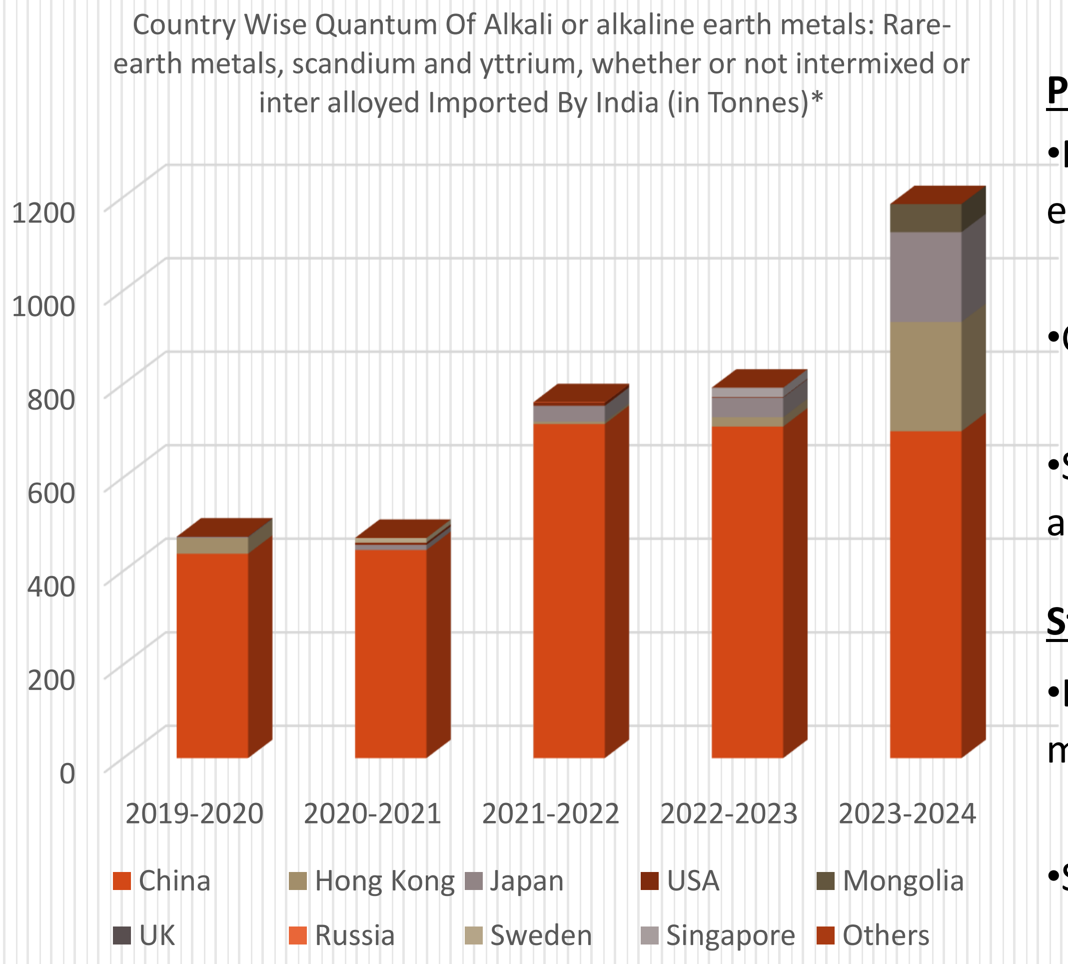
TejasREE

Building India's Domestic Rare Earth Capability

UDYAM REGISTRATION NUMBER: **UDYAM-WB-10-0207866**

NIC 5 Digit: 24209 - Manufacture of other non-ferrous metals n.e.c

The Opportunity - India's Critical REE Challenge



*Source: Lok Sabha Unstarred Question No. 5253 Answered On 02.04.2025 Import Of Rare Earth Metals

Target:

•National goal to establish 6,000 MTPA of integrated REPM manufacturing capacity

Problem:

•Nearly 60–80% by value and 85–90% by quantity (between 2022–25) of rare earths imported in India

•Critical item with consistently growing annual import bill

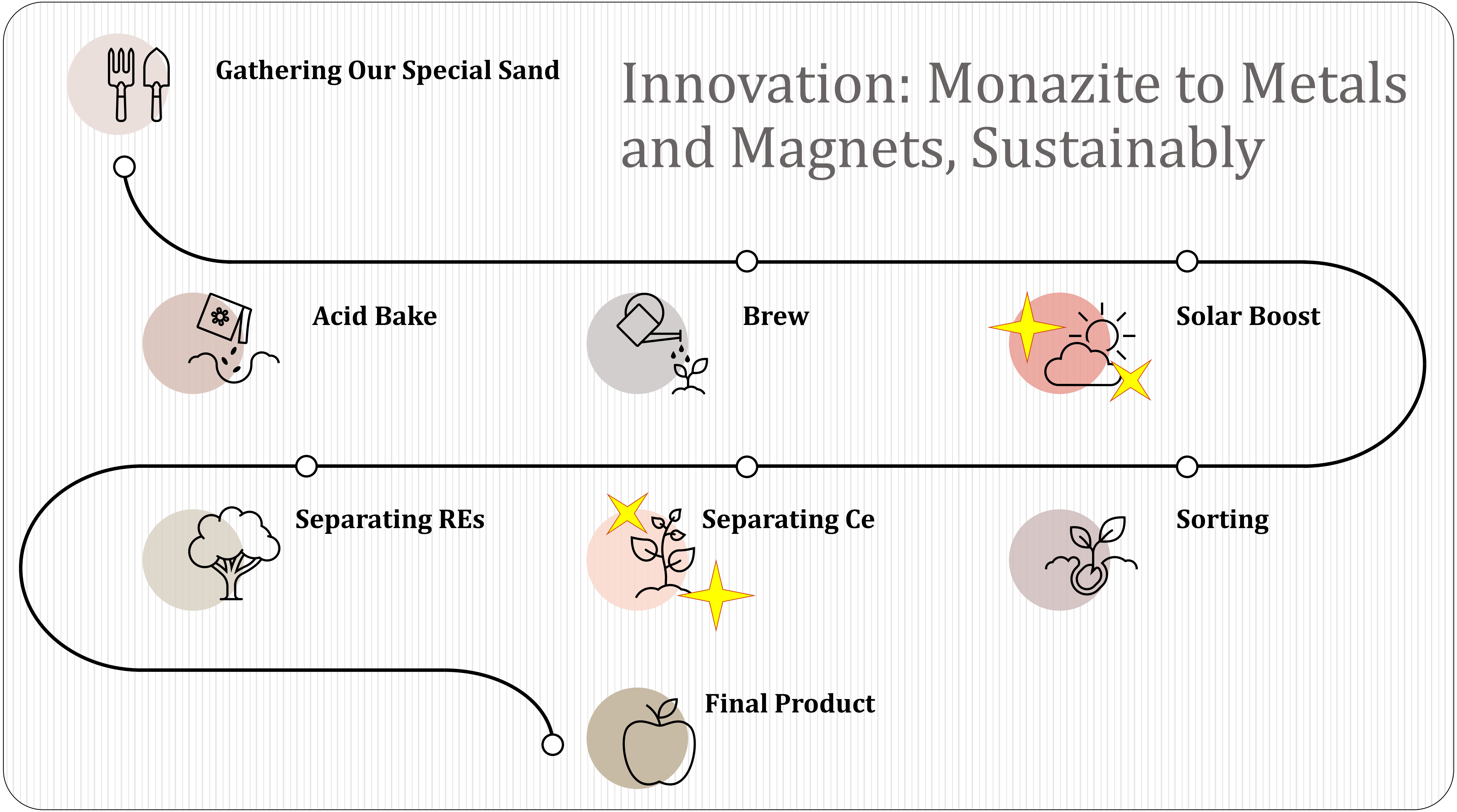
•Strategic vulnerability exposed from single block-dominance, price weaponization and volatility

Strategic Solution:

•Leveraging India's 13.15 million tonnes of monazite, containing an estimated 7.23 million tonnes of rare-earth oxides and other sources

•Strategic Infrastructure Building to reduce import dependency while creating jobs

•Customer Base: Clean tech companies (Electric mobility, renewable energy), electronics, aerospace, defence PSUs


Innovation: Monazite to Metals and Magnets, Sustainably
Gathering Our Special Sand
Acid Bake
Brew
Solar Boost
Separating REs
Separating Ce
Sorting
Final Product

Key Differences:

- <u>Conventional process*</u>
  - High carbon footprint from fossil fuel energy-intensive operations (30-60 kg CO_2-e/kg for Nd, Pr, Eu, etc.)
  - Massive water consumption (1000-2000 L/kg for Nd, Pr, Eu, etc.)
  - High energy costs (500-1000+MJ/kg for Nd, Pr, Eu, etc.)
  - Expensive chemical consumption
  - Low economic resilience due to fluctuating fossil fuel prices

- <u>Our process</u>
  - Near-zero carbon footprint by >80% solar powered process
  - >95% water recycling
  - Solar Integration >80% renewable energy
  - Recycled Chemicals: Photoacid leaching, BPM
  - Substantial upfront CAPEX but lower long term OPEX, implying better ROI, market resilience

*Source: Haque, N.; Hughes, A.; Lim, S.; Vernon, C. Rare Earth Elements: Overview of Mining, Mineralogy, Uses, Sustainability and Environmental Impact; 29 October 2014.

Innovation: Monazite to Metals and Magnets, Sustainably

Gathering Our Special Sand

1. Collect the Monazite-rich sand from designated areas by dredging or surface scooping
2. Separate crushed Monazite from silica etc. by gravity, magnetic, and/or electrostatic separation
3. Obtain Monazite packed with RE and Thorium and sell purified sand to construction industries

Acid Bake

1. Mix stable Monazite with conc. Sulfuric Acid in high **solar thermal heat** (150-200 C) to crack open its structure

Brew

1. Brew the mixture with water to dissolve the valuable elements in a Pregnant Leach Solution

Solar Boost

1. Use Photo Acid Generators and UV light from **solar powered LED arrays** to create tiny bursts of extra acid
2. Quicker and Greener

Sorting

1. Sell Phosphoric Acid as Fertilizer ingredient and solid waste of Gypsum and Silica in construction industries
2. Separate out Thorium & Iron by turning PLS pH to 1.8-3.5 using **Bipolar Membrane Electrolysis** (greener and more accurate)

Separating Ce

1. Handle Thorium cake in AERB-compliant way
2. Sell H2 generated as clean fuel, and reuse O2
3. Separate Ce by exposing the solution to UV light in **Photoelectrochemical Cells**

Separating REs

1. Mix the pre-heated solution with organic solvent and pass it through several **mixing tanks powered by solar panel farms**
2. Obtain pure RE individually, and **recycle organic solvent and water** from leftover liquid

Final Product

1. Convert each RE liquid to pure RE flakes by adding Oxalic Acid and bake them at 800-1000C (**solar thermal**) to RE-oxide powders in N2 rich atmosphere
2. Permanent Magnet Manufacturing (NdFeB Sintering) in Future

Advantages:

- Companies and nations willing to pay premium for reliable, green supply chains, especially EV manufacturers
- Stable Cost Base due to solar energy price certainty
- Byproduct revenue (e.g., purified sand, phosphoric acid, gypsum, silica, Th, Fe, Ce) acting as additional income streams
- Lower Compliance Costs due to being Future-proofed against regulations
- Reduce import dependency by 60% and position India as rare earth processing hub
- Aligned with National Critical Minerals Mission, PLI Scheme for ACC Batteries, Make in India, and Atmanirbhar Bharat

Our Goal (Timeline based on Expected Durations)

Phase 0: Pre-Seed/Seed Stage

Lab & Mini-Pilot Validation (33 months)

Seeding Goal: INR 25-47 Cr

01

Phase 1: Series A

Pilot Plant Validation (81 months)

Seeding Goal: INR 500-950 Cr

02

Phase 2: Project Financing – Commercial Scale

Full Industrial production of REOs (71 months)

Seeding Goal: INR 9000-17400 Cr

03

Phase 3: Vertical Integration (REPM Manufacturing)

Expand into Metal Production and NdFeB Magnet Manufacturing

(Post-Profitability)

04

Year 0 | Y2 | Y4 | Y6 | Y8 | Y10 | Y12 | Y14 | Y16

2026 ... 2042

PHASE 0 (18-24 MONTHS):

ROI

Best Case: Successful/promising technical validation leads to multiple bidding for Series A, valuation increases 5 – 10x from seed.

Requirements

Renting vs buying; Initial lab only vs include future expansion

10-15 R&D personnels

Reactors, chemicals, BPM/PEC, solvent extraction unit, etc.

Deliverables

Detailed lab reports, energy consumption & preliminary cost estimation per kg REO, safety audit reports, environmental performance report, patent applications, etc.

1

Validate Core Solar PAG-Assisted Leaching
With ≥ 80% Nd/Dy recovery and ≥ 15% reduction in overall acid consumption
Produce 100 g batches of mixed REO

2

Thorium/Uranium removal
(>98%) with <2% REE loss

3

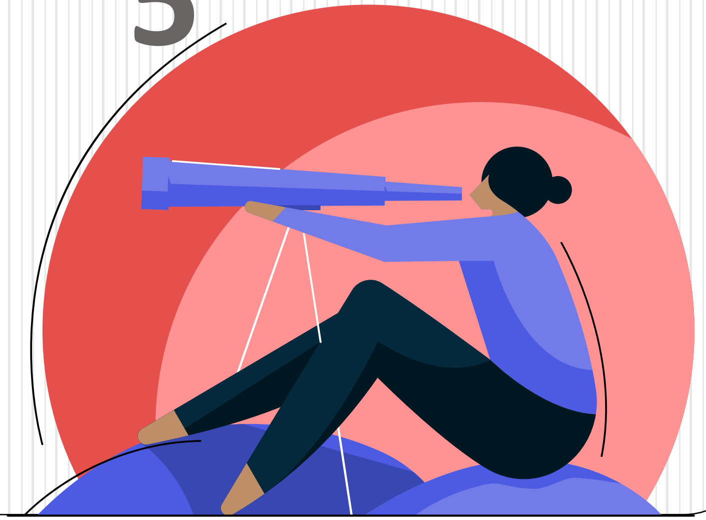
Ce(III) to Ce(IV) photo-oxidation
(>90%)

4

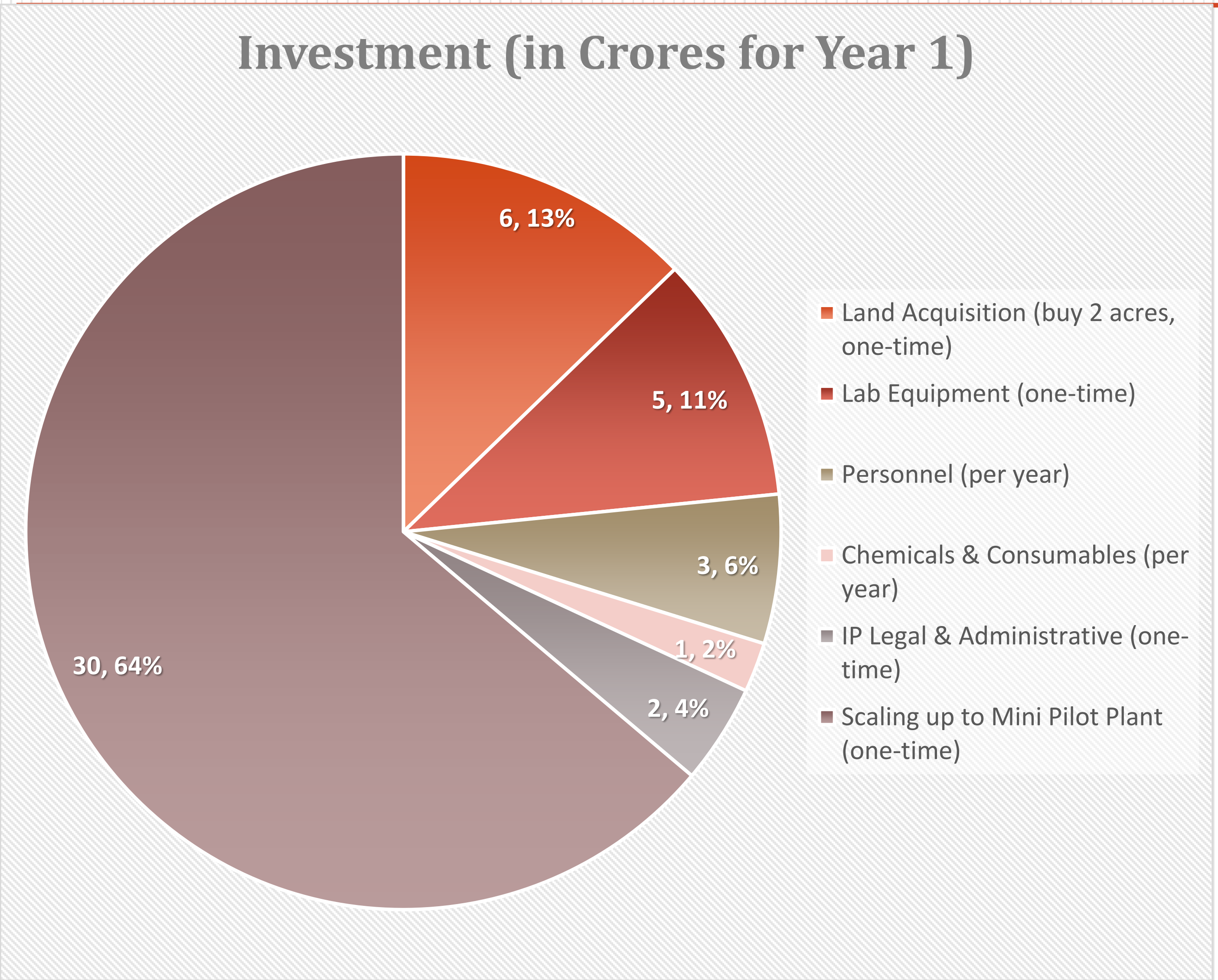
Operate ~10-20 Kg Monazite/Day
With >90% water recycling and compliant effluent discharge

5

Proven techno-economic model, strong IP portfolio
Showing potential cost competitiveness; Publish in peer-reviewed journals for credibility



Investment Requirements for Phase 0



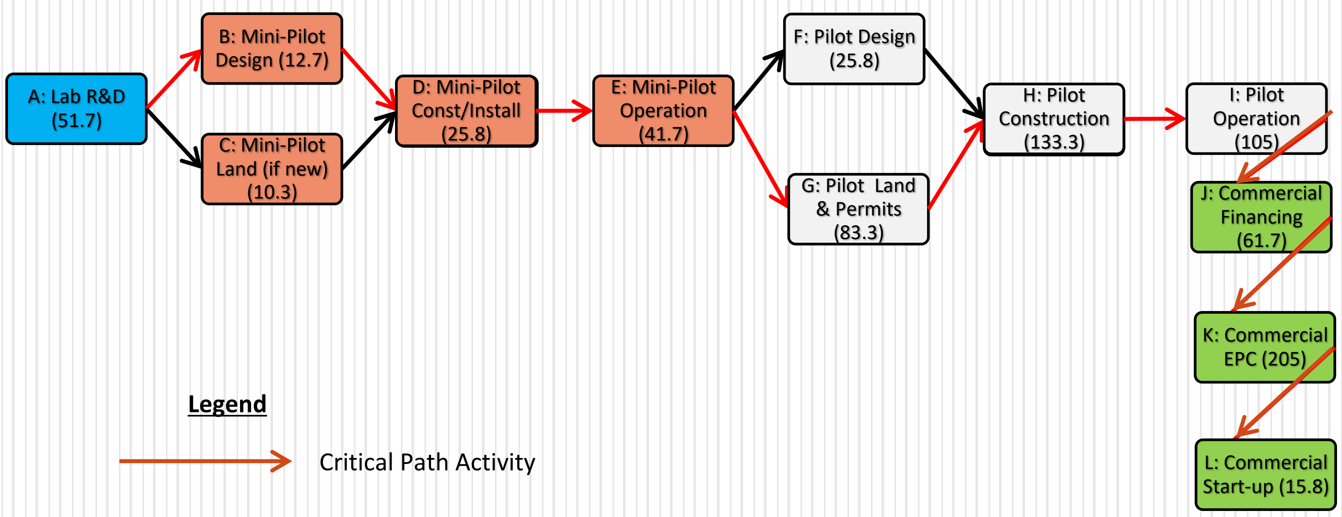
- Seeding Target: INR 47 Crores

Market Analysis & Expansion Strategy – PERT/CPM

Project: From Lab R&D to Commercial Plant Start-up

Activity		Predecessor(s)	Duration in weeks (optimistic, Most likely, pessimistic)	Expected Duration in weeks (Optimistic + 4 × Most Likely + Pessimistic) / 6	
A	Lab R&D	-	(40,50,70)	51.7	
B	Mini-Pilot Design	A	(10,12,18)	12.7	
C	Mini-Pilot Land (if new)	A	(08,10,14)	10.3	
D	Mini-Pilot Construction/Install	B,C	(20,25,35)	25.8	
E	Mini-Pilot Operation	D	(30,40,60)	41.7	
F	Pilot Design	E	(20,25,35)	25.8	
G	Pilot Land & Permits	E	(60,80,120)	83.3	
H	Pilot Construction	F, G	(100,130,180)	133.3	
I	Pilot Operation	H	(80,100,150)	105	
J	Commercial Financing	I	(40,60,90)	61.7	
K	Commercial EPC	J	(150,200,280)	205	
L	Commercial Start-up	K	(10,15,25)	15.8	
			Total Expected	736	weeks
				184	Months
				15.3	Years

Network Diagram (Expected Durations in Weeks)



Risk Mitigation Matrix

Risk (High to Low)	Mitigation Strategy	Competitive Edge
PAG Chemistry & Sourcing Uncertainty	Proprietary formulations based on quantified data	IP protection
Thorium Handling	Early AERB engagement with parallel approvals	Regulatory expertise
UV Reactor Fouling	Self-cleaning design with automated cleaning cycles	Operational advantage
Scale-Up Strategy	Conservative scaling	Lower technical risk
Solvent Extraction Complexity	Careful integration based on efficiency targets	Enhanced understanding
Energy Balance	Integrated Solar Design + Battery Energy Storage System	Cost stability and sustainability
Human Resource availability	Training partnerships with premium Indian institutions	Indigenous talent attraction

About Me

Atasi Roy Malakar

- Civil Engineer and ex-Transportation Engineering graduate student at UW-Madison
- Former Indian Railways engineer with experience in infrastructure delivery and project management
- Lean Six Sigma Green Belt certified
- Focused on AI, automation, simulation, and process optimization
- Building ventures in strategic industrial sectors including critical minerals, advanced manufacturing, and technology-enabled infrastructure systems

Thank You

Phase 1 & Phase 2 Details Available on Request

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