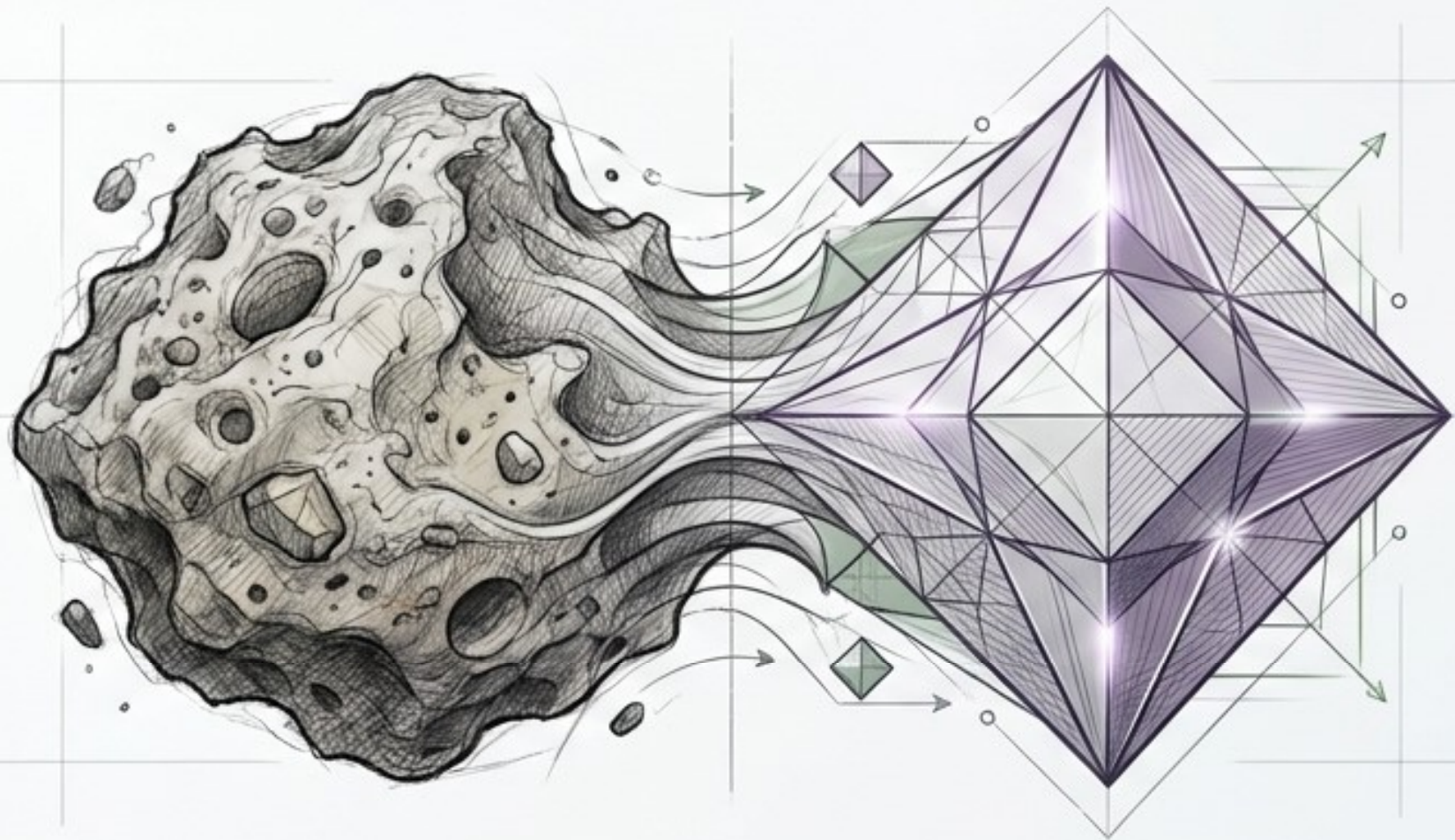


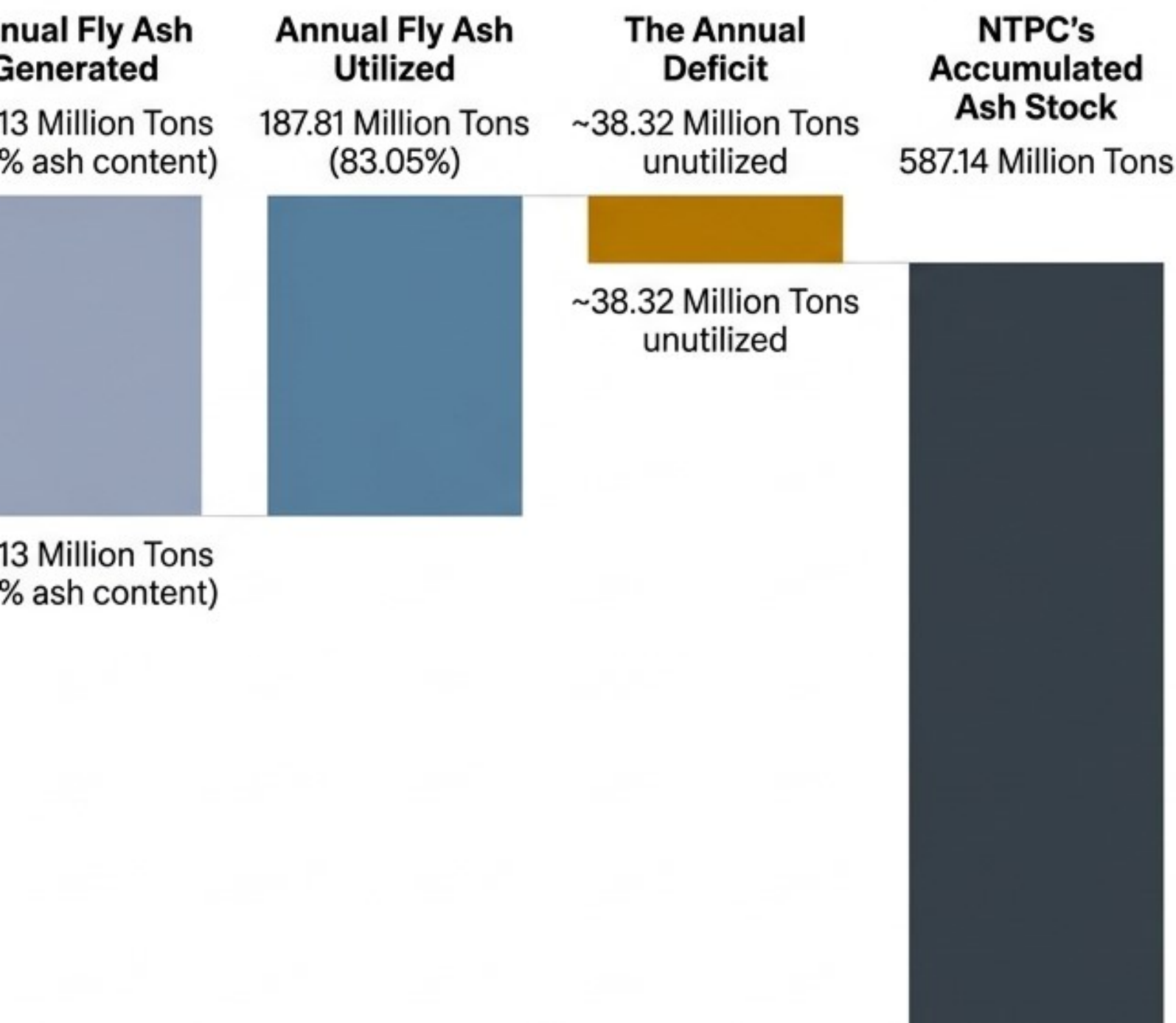
# The Synthetic Ore

*Transforming India's 65,000-Acre Coal Fly Ash Deficit into a Strategic Nation*



A Strategic Briefing on Bulk Utilization,  
Critical Minerals, and Carbon Sequestration.

# Enduring legacy of high-ash coal combustion paradigm shift in utilization.



In India  
65,000  
land is  
occupi  
ponds.

One ac  
require  
of powe

is no longer a hazardous waste byproduct;  
dimensional synthetic ore.

## Raw Coal Fly Ash (CFA)



### Strategic Minerals

Securing Clean Energy  
Supply Chains

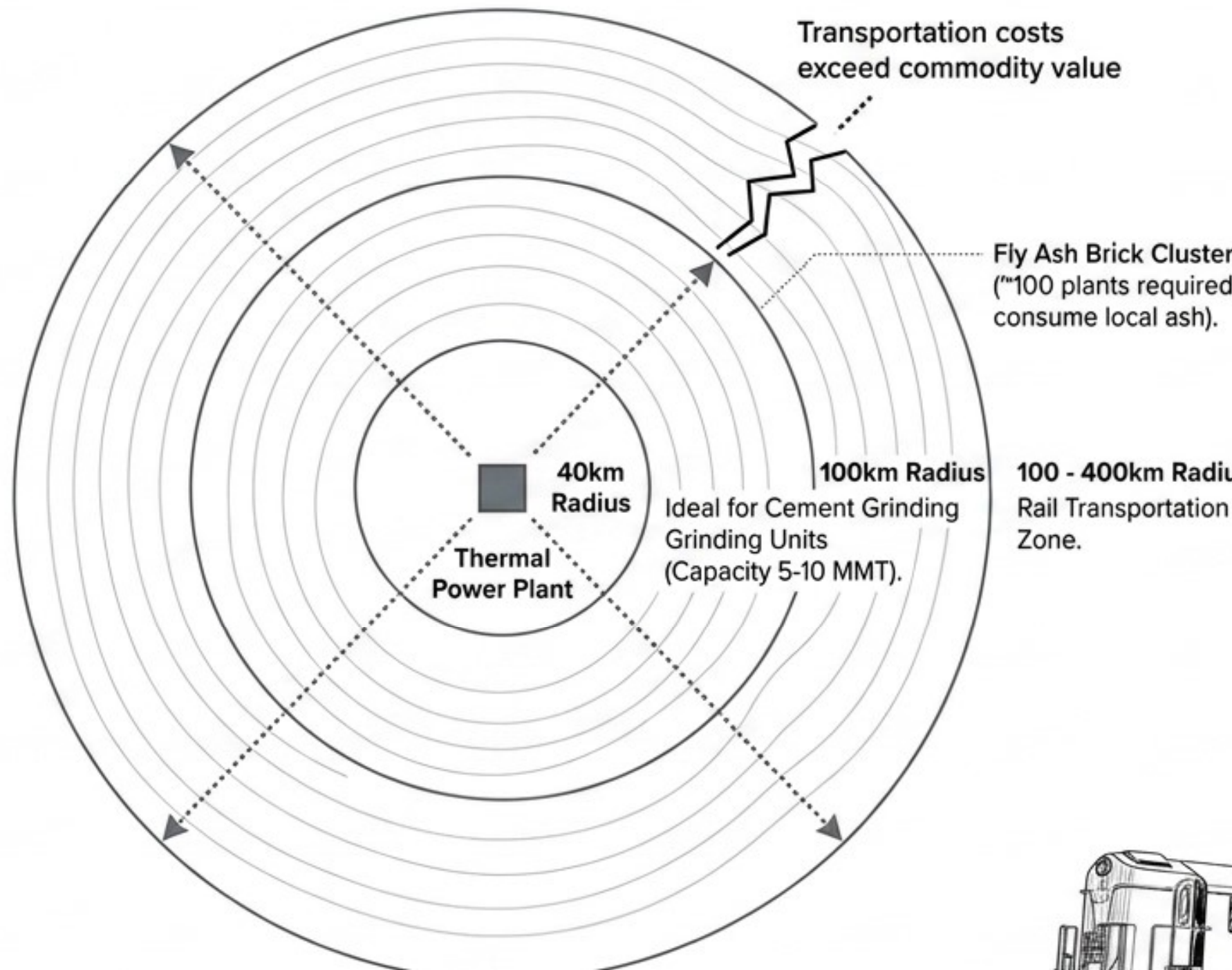
### Clima

Mineral C  
Sequ

ations mandate 100% utilization, but the ecosystem remains bottlenecked  
locking the chemical complexities of CFA—extracting Rare Earth Elements

| Value Spectrum dictates where capital and infrastructure is deployed. |                               |                                       |                              |   |
|-----------------------------------------------------------------------|-------------------------------|---------------------------------------|------------------------------|---|
|                                                                       | Volume Consumed               | Economic Value Per Ton                | Infrastructure Required      |   |
| nt                                                                    | High<br>(Millions of Tons)    | Low<br>(Commodity)                    | Ash Parks & Rail Wagons      |   |
| on                                                                    | Medium                        | Moderate<br>(Carbon Credits)          | Gas Injection Systems        |   |
| n                                                                     | Low<br>(Selective Processing) | Extremely High<br>(Critical Minerals) | ICP-MS & Leaching Facilities | A |
| Commodity                                                             |                               |                                       | Low Volume /                 |   |

barrier to bulk utilization is the geographical mismatch  
supply and demand.



100% bulk off-take requires a synchronized logistical stack.

## Mandates

Increase minimum permissible limit of fly ash in cement (currently capped at 35%).

Mandate fly ash use in roads) and Awas V (housing)

## Set-ups

Form long-term supply chain management contracts with cement units.

Deploy Mobile Fly Machines directly to c

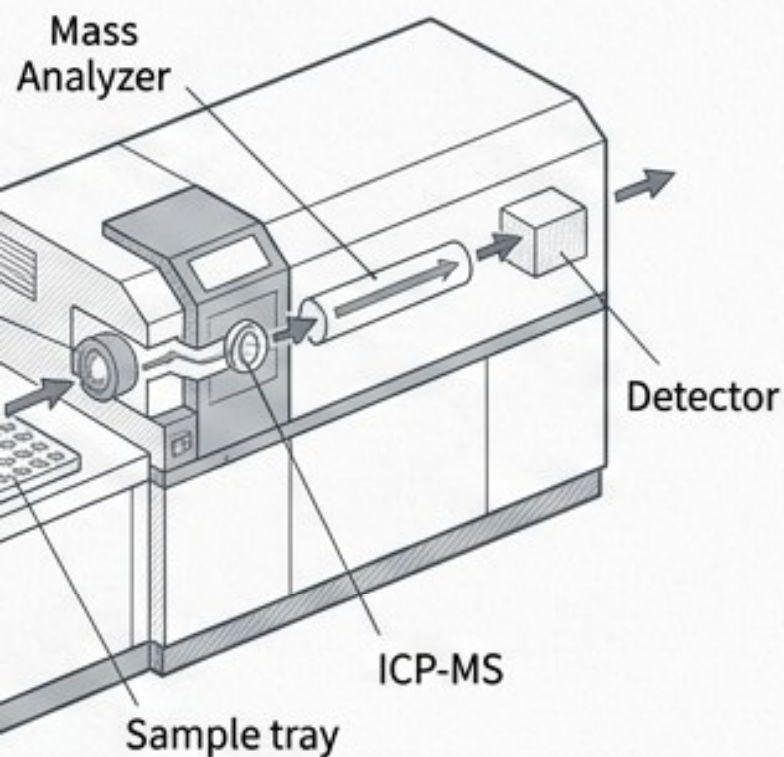
## Infrastructure

Establish Ash Parks/Depots near consumption centers (100-200 km away).

Expand Railway siding power plant

# Black material, Indian fly ash contains critical materials for global clean energy transitions

## The Catalyst



Technology Research Alliance (NETRA) is studying five graphically distinct plants (A-E) to identify the elemental signature of Indian CFA.

## The Application



EV



Wind turbine

The global supply of REEs is limited. By extracting REEs from existing coal residues, we bypass primary mining and resource utilization with risks.

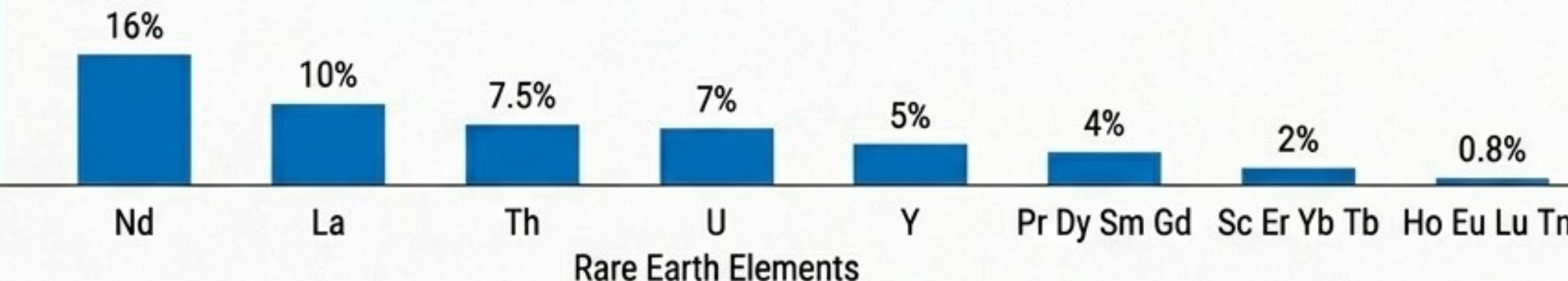
# ic Dashboard: Deconstructing the elemental we C ash samples.

th Elements (LREE) are highly concentrated. Ratio of LREE to HREE

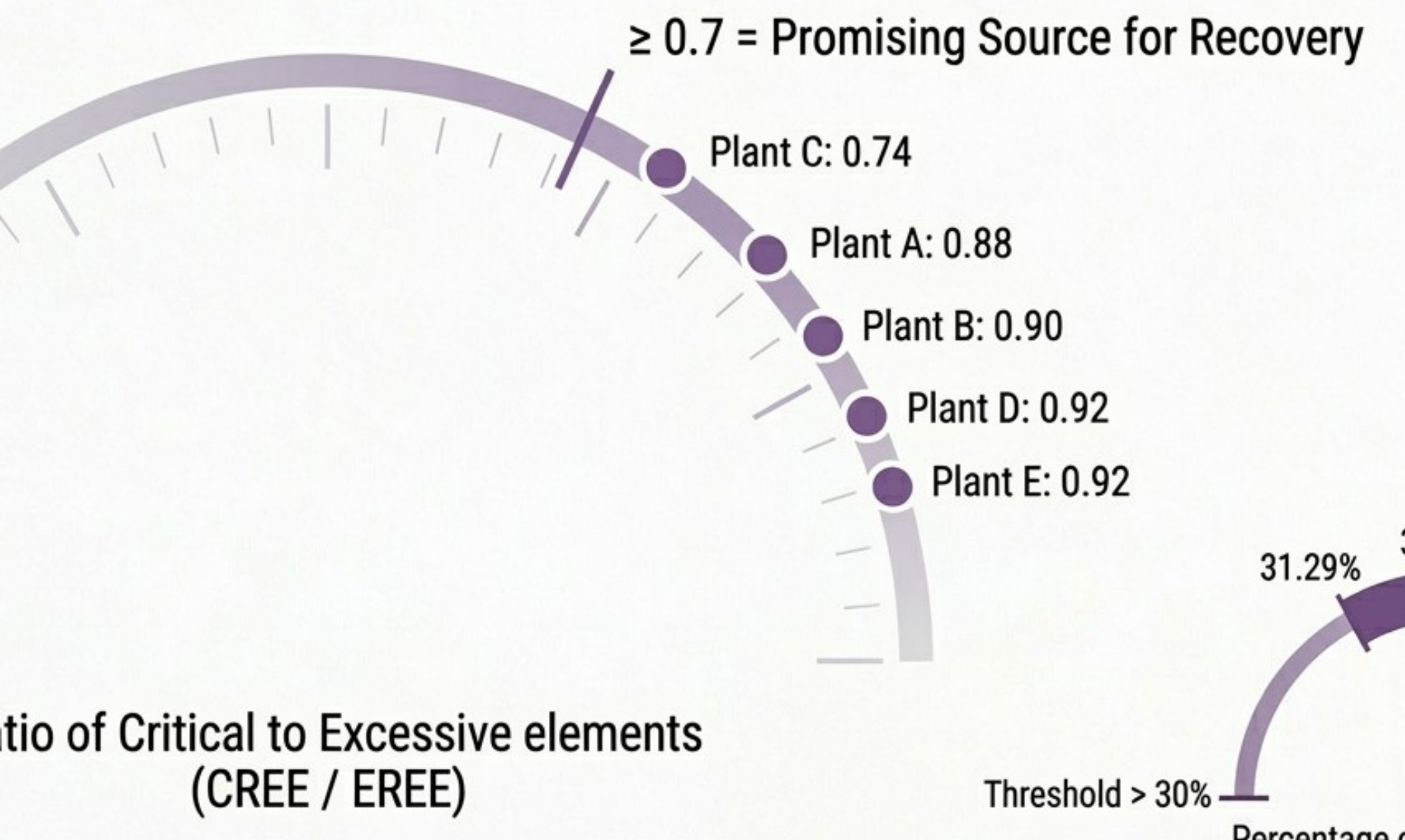
n (Ce)  
5  $\mu\text{g/g}$

Neodymium (Nd)  
67-165  $\mu\text{g/g}$

Lanthan  
34-13



...ples consistently clear the global threshold for recovery viability.

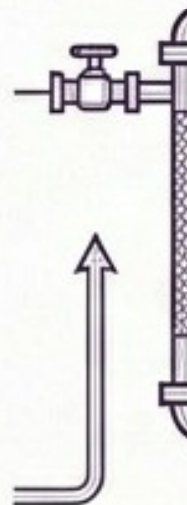
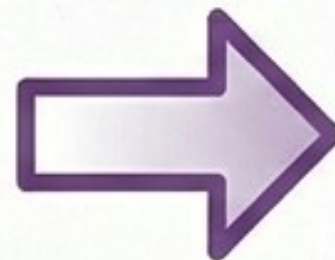
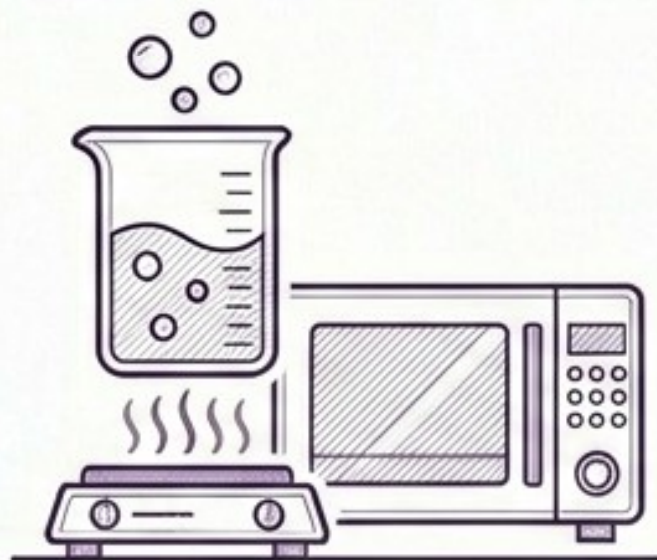
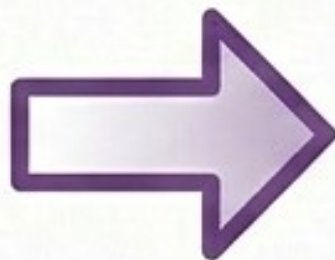


ash demonstrates formidable competitiveness  
Global ash profiles.

|    | Plant C<br>(India) | UK         | Spain      | USA     | China |
|----|--------------------|------------|------------|---------|-------|
|    | 325                | 86.6-176.5 | 64.7-113.0 | 124-246 | 266.4 |
| d) | 165                | 37.2-77.6  | 58.3-80.0  | 58-113  | 114.7 |
| )  | 137                | 41.9-85.7  | 21.0-42.0  | 57-115  | 134.4 |
|    | 22                 | 37.3-60.7  | 95-126     | 66-132  | 105.2 |
| E) | 834                | -          | -          | -       | -     |

total Rare Earth Element (TREE) content of 834 µg/g surpasses global  
establishing it as a highly effective backup source for strategic extraction

# Extraction Blueprint: From raw ash to refined rare earths.



## Step 1: Separation

Deploying silica-rich bulk  
material trace  
elements.

## Step 2: Acid Leaching

Deploying tetrafluoro boric  
acid digestion and microwave  
digestors (800°C) to isolate  
elements.

## Step 3: Resin Extraction

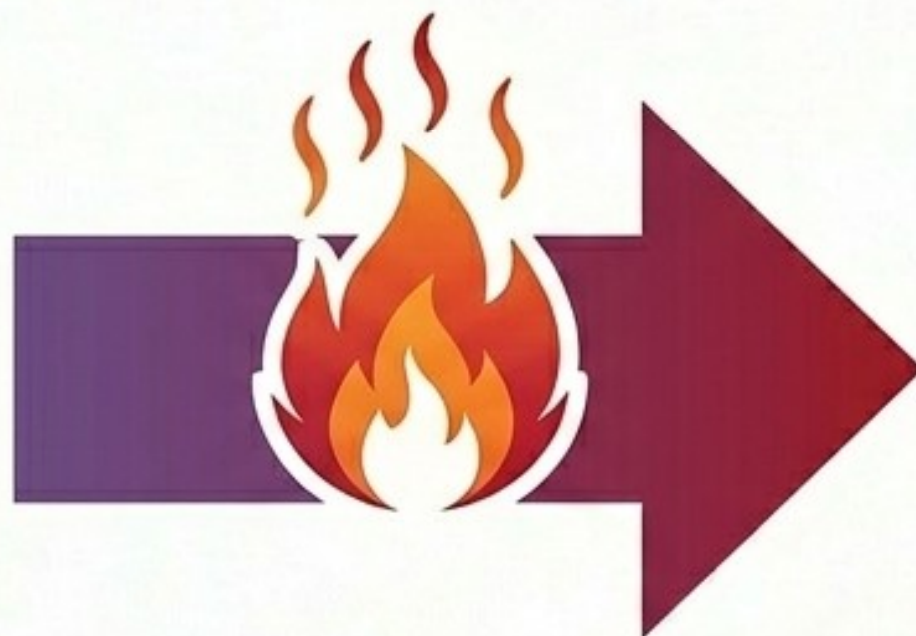
The ideal and efficient  
method to extract  
Heavy Rare Earths from  
massive sources.

on concentration reveals a secondary strat  
clear fuel precursors.



**Raw  
Coal**

**-4  $\mu\text{g/g}$   
(average)**



**Combustion**

Finer particle size and low volatility  
cause elemental enrichment.

**Coal  
Fly Ash**

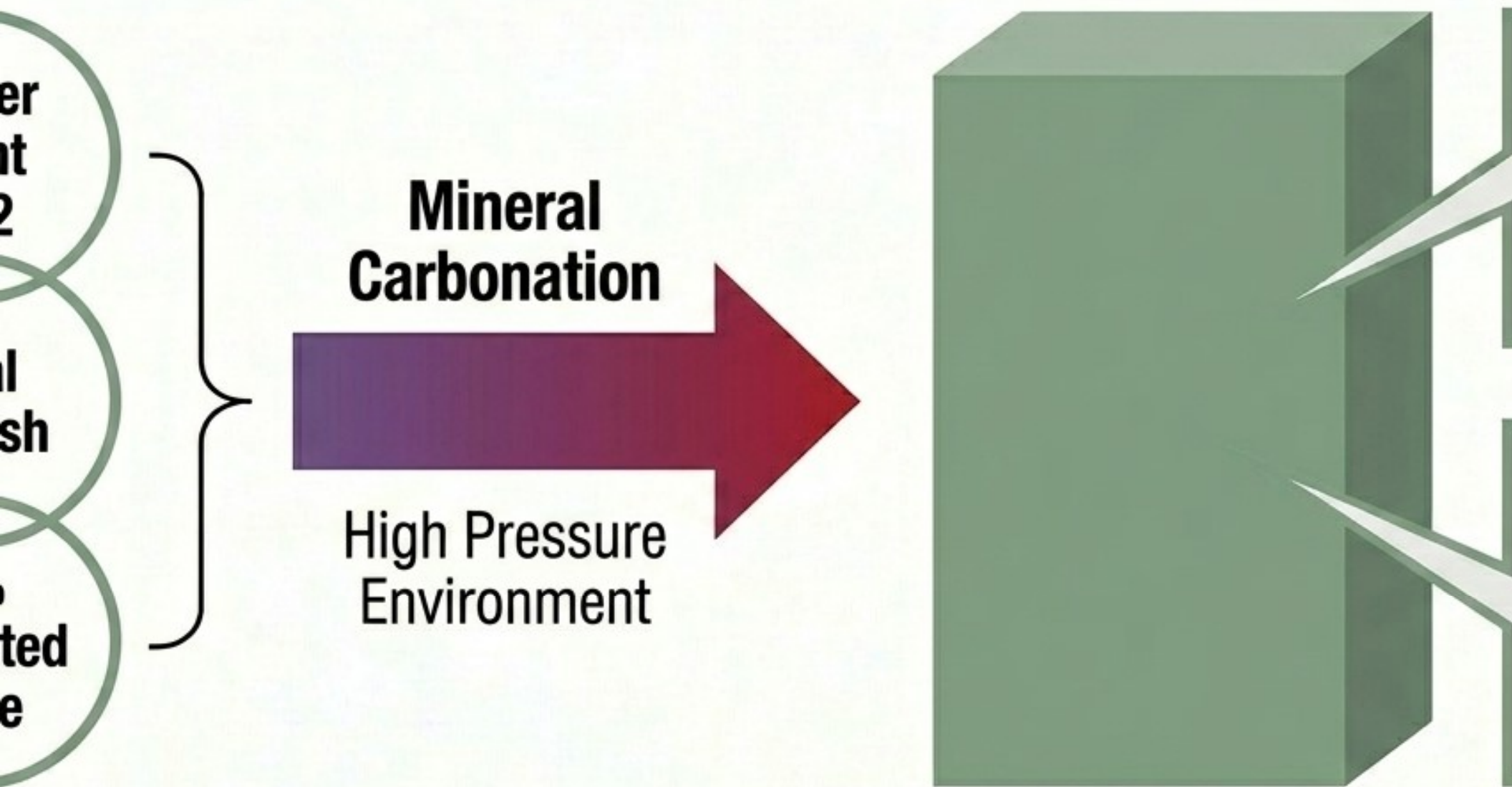


Uranium: Enrich

Thorium: Enrich

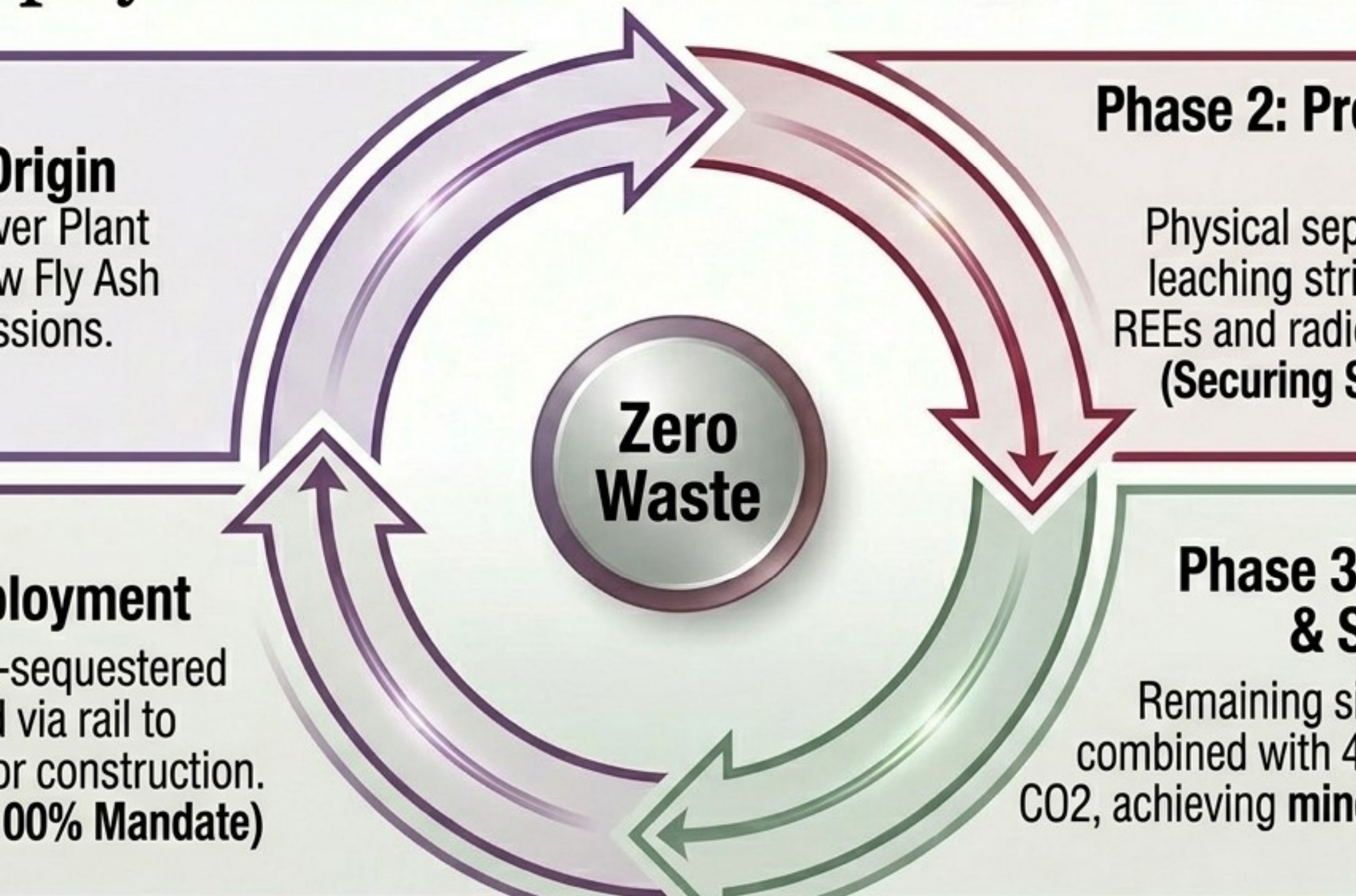
Future efforts must encompass uniformity testing of stockpiles.

Carbonation transforms industrial emissions into construction materials.



By reacting anthropogenic CO<sub>2</sub> with the alkaline earth metals in CFA, we

# ular Ash Economy: A zero-waste, multi- op system.



# g the Alchemy: Strategic imperatives for ers.

## akers

imits in cement

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romoting 'R&D'  
as an  
ness sector.

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takeholder  
struction and

## For TPP Executives

Operationalize rail logistics  
within 400km zones to reach  
cement clusters.

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Map individual ash ponds for  
elemental uniformity to identify  
localized REE/Uranium hot-  
spots (e.g., Plant C).

## For R&D &

Scale up acid leach  
polymer adsorption  
technologies.

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Commercialize  
composite min  
for carbon crec