

1. Rare Earth Permanent Magnets- Economy

REPM scheme aims to build India's first integrated domestic manufacturing ecosystem for high-value magnets. India has launched a ₹7,280 crore scheme to establish a domestic manufacturing ecosystem for Sintered Rare Earth Permanent Magnets (REPM) to counter China's near-monopoly (~90%) over the supply chain. This move aims to secure critical components for strategic sectors like electric vehicles, defense, and renewable energy, thereby ensuring national energy security and self-reliance.

Scheme Overview- Promoting Manufacturing of Sintered REPM

The Government of India has approved a strategic initiative to secure the supply chain for critical components used in future technologies. This scheme is designed to boost domestic manufacturing capabilities and reduce reliance on foreign imports.

Launch Details & Administration

Approving Authority- The Government of India.

Nodal Ministry- The scheme is implemented and overseen by the Ministry of Heavy Industries (MHI).

Launch Timeline- The scheme was officially launched in December 2025.

Financial Framework & Objectives

Total Financial Outlay- A substantial budget of ₹7,280 crore has been allocated to support the industry.

Primary Objective- To build an end-to-end, integrated domestic manufacturing ecosystem specifically for Sintered Rare Earth Permanent Magnets, with a primary focus on the Neodymium-Iron-Boron (NdFeB) type.

Strategic Goals

Reduce Import Dependence- Currently, India imports nearly 100% of its REPM requirements, predominantly from China. This scheme aims to cut this dependency significantly.

Enhance Self-Reliance- It is a key step towards Atmanirbhar Bharat (Self-Reliant India) in the high-tech manufacturing sector.

Targets & Timeline

Production Capacity Target- The scheme aims to achieve an integrated production capacity of 6,000 Metric Tons per Annum (MTPA) of REPMs.

1. Scheme Duration- The tenure for each beneficiary is set at 7 years.
2. Gestation Period- 2 years allowed for setting up manufacturing facilities.
3. Incentive Period- 5 years provided for operational incentives.

Demand Context & Rationale

Projected Growth- The consumption of REPMs in India is projected to double by 2030 (compared to 2025 levels).

Demand Drivers- This surge is driven by rapid expansion in sectors such as Electric Vehicles (EVs), Renewable Energy (Wind Turbines), Consumer Electronics

Current Scenario- The current annual demand stands at approximately 4,000–5,000 tonnes, which is currently met entirely through imports.

India's Rare Earth Mineral Resource Base

India holds significant geological potential for the raw materials required for these magnets.

Primary Locations (Coastal)- Significant reserves are found in the beach sands and red sands of coastal states

1. Andhra Pradesh
2. Odisha
3. Tamil Nadu
4. Kerala
5. Gujarat
6. Maharashtra

Inland Locations- Alluvium deposits are also present in West Bengal, Jharkhand,

Understanding Rare-Earth Permanent Magnets (REPM)

REPMs

Definition- These are the strongest type of permanent magnets currently available in the commercial market.

Composition- They are engineered alloys created by combining rare-earth elements (from the group of 17 distinct metals) with transition metals like Iron and metalloids like Boron.

Sintered REPMs

Subcategory- Sintered REPMs are a specific, high-performance category of rare-earth magnets.

Manufacturing Process (Sintering)

1. Fine powders of rare-earth alloys are pressed into a shape.
2. The pressed powder is heated to a temperature just below its melting point.
3. This causes the particles to fuse together, forming a solid, dense, and highly durable magnet.

Advantage- This process yields magnets with the highest magnetic strength among all permanent magnet types.

Comparison- Neodymium (NDFEB) vs. Samarium Cobalt (SMCO)

Feature	Neodymium Magnets (NdFeB)	Samarium Cobalt Magnets (SmCo)
Composition	Neodymium, Iron, and Boron.	Samarium and Cobalt.
Magnetic Strength	Most Powerful- Highest magnetic field strength available.	Slightly less powerful than NdFeB.
Temperature Tolerance	Lower resistance to extreme heat compared to SmCo.	High Performance- Performs significantly better at high temperatures.
Corrosion Resistance	Prone to corrosion (usually requires coating).	Highly Resistant to corrosion.
Relevance to Scheme	Primary Focus of India's REPM scheme due to wide usage.	Used in specialized high-temp applications.

Key Properties of REPM

Rare-earth magnets are prized for specific physical capabilities that standard ferrite or alnico magnets cannot match.

Extremely High Magnetic Strength- They generate the strongest magnetic field relative to their size. A tiny REPM can lift an object weighing hundreds of times its own mass.

High Energy Product- They possess a high capacity to store magnetic energy. This "Energy Product" is the definitive metric for gauging magnet performance.

Compactness & Efficiency- Their immense strength enables miniaturization. Manufacturers can build smaller, lighter, yet more powerful motors for headphones, hard drives, and Electric Vehicles.

Key Applications of REPM

REPMs serve as the "heart" of many modern technological devices, essential for efficiency and green energy transitions.

Electric Vehicles (EVs)- Crucial for traction motors, where they ensure efficient conversion of electrical energy into mechanical power.

Renewable Energy- Used in the direct-drive generators of wind turbines to generate electricity efficiently without heavy gearboxes.

Consumer Electronics- Found in everyday items like hard disk drives (HDDs), high-fidelity speakers, headphones, and smartphone vibration motors.

Strategic & Industrial Uses- MRI Machines (Healthcare), Aerospace components, Defense systems, High-efficiency industrial motors and sensors

The Global Supply Chain Challenge

The rationale behind the Indian government's scheme is deeply rooted in geopolitical and supply chain risks.

Dominant Producer- China holds a near-monopoly, controlling approximately 90% of the global supply chain. This dominance spans the entire value chain Mining, Processing/Refining, Magnet Manufacturing

Strategic Vulnerability- This heavy concentration creates a single point of failure. It poses a major risk for other nations, particularly in critical sectors like defense and green energy infrastructure. India's REPM scheme is a direct counter-measure to mitigate this vulnerability.

Deep Dive- Rare Earth Minerals

To understand the magnets, one must understand the raw materials.

Definition & Constituents

The Group- Rare earth minerals consist of a group of 17 chemically similar elements.

The Elements- 15 Lanthanides- Elements from Lanthanum (La) to Lutetium (Lu). Scandium (Sc) & Yttrium (Y)- Included because they exhibit similar chemical properties to the Lanthanides.

Characteristics

1. **Unique Properties-** These elements possess specific magnetic, luminescent, and electrochemical traits that make them irreplaceable in high-technology applications.
2. **Principal Minerals-** They are rarely found as pure metals. They are extracted from minerals such as Monazite, Bastnäsite, Xenotime

"Rare Earth"

Misnomer of Scarcity- Contrary to their name, many of these elements are relatively abundant in the Earth's crust (some are more common than copper or lead).

Economic Rarity- They are called "rare" because they are seldom found in concentrated deposits that are economically viable to mine. They are often widely dispersed.

Historical Context- When first discovered, they were found in oxide forms, which 18th and 19th-century chemists referred to as "earths."

Source- <https://www.newsonair.gov.in/repm-scheme-aims-to-build-indias-first-integrated-domestic-manufacturing-ecosystem-for-high-value-magnets/#~~~text=To%20extract%20these%20rare%20earth,ecosystem%20for%20high%2Dvalue%20magnets.>

