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India's First NdFeB Rare Earth Magnet Pilot Plant — Breaking China's Monopoly

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WHY IN NEWS

The International Advanced Research Centre for Powder Metallurgy and New Materials (ARCI), Hyderabad, inaugurated India's first pilot plant for manufacturing Neodymium-Iron-Boron (Nd-Fe-B) sintered rare earth permanent magnets on March 20, 2026, marking a significant step toward reducing dependence on China for critical materials.

India Enters the Rare Earth Magnet Value Chain

What Are NdFeB Magnets?

Neodymium-Iron-Boron (Nd-Fe-B) magnets are the **strongest type of permanent magnet** commercially available. Invented by Japanese scientist **Dr. Masato Sagawa** in 1984, these magnets are critical components in:

APPLICATION	WHY NDFEB IS ESSENTIAL
Electric Vehicles (EVs)	Traction motors require high-energy-density permanent magnets
Wind Turbines	Direct-drive generators use 600 kg of NdFeB per MW of capacity
Defence Systems	Precision-guided munitions, radar, sonar, satellite systems
Electronics	Smartphones, hard drives, speakers, headphones
Medical Devices	MRI machines use superconducting magnets with NdFeB components

The China Monopoly Problem

China controls an overwhelming share of the global rare earth magnet supply chain:

STAGE	CHINA'S SHARE
Rare earth mining	~60%
Rare earth processing/refining	~90%
NdFeB magnet manufacturing	~90%+

This concentration creates a **critical strategic vulnerability** for countries pursuing the clean energy transition, defence modernisation, and advanced manufacturing. During the 2010 Japan-China dispute over the Senkaku/Diaoyu Islands, China briefly restricted rare earth exports, sending prices soaring 10x and triggering a global supply chain crisis.

The ARCI Pilot Plant

The facility at ARCI, Hyderabad, represents India's first indigenous capability to produce sintered NdFeB magnets from raw alloy to finished product.

Key technical features:

- **End-to-end process:** Strip-cast alloy → hydrogen decrepitation → jet milling → pressing → sintering → machining → finished magnets
- **Technology:** Dr. Masato Sagawa's **New Pressless Process (NPLP)** — reduces manufacturing complexity and improves yield
- **Collaboration:** ARCI worked with Japan's **Nihon Denji Sokki Co., Ltd.** for technology transfer
- **Supported by:** Department of Science and Technology (DST), Government of India

Government's Rs 7,280 Crore Push

The Cabinet has approved the **Scheme to Promote Manufacturing of Sintered Rare Earth Permanent Magnet** with:

PARAMETER	DETAIL
Total outlay	Rs 7,280 crore
Target capacity	6,000 MTPA (Metric Tons Per Annum)
Implementation	Through private sector partnerships
Nodal ministries	DST + Department of Heavy Industry

The government has invited bids from the private sector to set up commercial-scale manufacturing units.

India's Rare Earth Reserves

India holds **~6% of global rare earth reserves** — the fifth-largest reserves after China, Vietnam, Brazil, and Russia. However, India currently produces only ~2,900 tonnes/year (vs. China's ~210,000 tonnes). Key Indian entities:

- **IREL (Indian Rare Earths Limited):** PSU under Department of Atomic Energy; mines monazite sand in Kerala, Tamil Nadu, and Odisha
- **ARCI:** Research and pilot-scale production
- **CSIR-NIIST (National Institute for Interdisciplinary Science and Technology):** Research on rare earth extraction and processing

Challenges Ahead

1. **Scale gap:** The pilot produces kilograms; commercial demand is in thousands of tonnes
2. **Processing infrastructure:** India mines rare earth ore but lacks large-scale separation and refining facilities
3. **Cost competitiveness:** Chinese magnets benefit from decades of scale economics and subsidies
4. **Skilled workforce:** NdFeB magnet manufacturing requires specialised metallurgical expertise
5. **Environmental compliance:** Rare earth processing generates radioactive thorium waste — needs careful management

UPSC RELEVANCE

NdFeB magnets, ARCI, rare earth elements, IREL, Dr. Masato Sagawa.

MAINS GS-3:

India's strategy for critical mineral self-reliance, supply chain vulnerabilities in the clean energy transition, S&T developments with industrial applications.

MAINS GS-2:

India-Japan collaboration on strategic technologies.

📌 FACTS CORNER — KNOWLEDGEPEDIA

NDFEB (NEODYMIUM-IRON-BORON) MAGNETS:

Strongest permanent magnets commercially available

Invented by: Dr. Masato Sagawa (Japan), 1984

Manufacturing process: Strip-casting → hydrogen decrepitation → jet milling → pressing → sintering

ARCI pilot plant technology: New Pressless Process (NPLP)

Applications: EVs, wind turbines, MRI machines, defence, electronics

ARCI (INTERNATIONAL ADVANCED RESEARCH CENTRE FOR POWDER METALLURGY AND NEW MATERIALS):

Location: Hyderabad, Telangana

Established: 1997

Under: Department of Science and Technology (DST)

Japanese partner: Nihon Denji Sokki Co., Ltd.

INDIA'S RARE EARTH PROFILE:

Global reserves share: ~6% (5th largest)

Annual production: ~2,900 tonnes (vs China's ~210,000 tonnes)

Key PSU: IREL (Indian Rare Earths Limited), under Dept. of Atomic Energy

Rare earth elements: 17 elements (15 lanthanides + scandium + yttrium)

India's monazite deposits: Kerala, Tamil Nadu, Odisha coast

GOVERNMENT SCHEME:

Scheme to Promote Manufacturing of Sintered Rare Earth Permanent Magnet

Outlay: Rs 7,280 crore

Target: 6,000 MTPA capacity

Nodal: DST + Department of Heavy Industry

OTHER RELEVANT FACTS:

China controls >90% of global rare earth magnet production

2010 China-Japan dispute: China restricted rare earth exports, prices rose 10x

Critical Minerals Mission (India): Announced in Budget 2024-25 with Rs 600 crore

> KABIL (Khanij Bidesh India Limited): JV of NALCO, HCL, MECL for overseas critical mineral sourcing
>
> US, EU, Australia, Japan have also launched rare earth supply chain diversification initiatives

Sources: Business Standard , PIB , InsightsIAS , Organiser

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