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EDITORIAL ANALYSIS

Helium Crisis — India's Semiconductor Dream and the Supply Chain Reality

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Helium Crisis — India's Semiconductor Dream and the Supply Chain Reality

The Economic Times 26 March 2026 GS3 Save

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INTERVIEW ANGLE

"India's Rs 76,000 crore semiconductor mission depends on materials it does not produce domestically. How should India approach strategic mineral and gas security for advanced manufacturing?"

WHY IN NEWS

Iran's March 2 attack on Qatar's Ras Laffan LNG hub disrupted 33% of global helium supply. India's semiconductor fabrication projects and hospital MRI services face rising costs and potential delays.

The Editorial Argument

The Economic Times editorial argues that India's ambitious semiconductor mission was designed assuming stable global supply chains — an assumption the helium crisis has shattered. The editorial calls for a parallel "strategic materials mission" that maps every critical input for chip fabrication and builds domestic alternatives or strategic reserves.

Helium — Why It Cannot Be Substituted

Helium (He, atomic number 2) has unique physical properties that make it irreplaceable in semiconductor manufacturing:

PROPERTY	VALUE	WHY IT MATTERS
Boiling point	-268.93°C (4.22 K)	Lowest of any element — essential for superconducting magnets
Atomic radius	31 pm	Smallest noble gas — ideal for leak detection
Chemical reactivity	Zero (noble gas)	Will not contaminate chip fabrication chambers
Thermal conductivity	High	Efficient heat transfer in cooling systems

No other element combines all four properties. Hydrogen is lighter but explosive. Nitrogen is inert but liquefies at -196°C (too warm for superconducting applications). Argon is inert but has a much larger atomic radius (71 pm), making it useless for leak detection.

The Supply Concentration Problem

Global helium production is dangerously concentrated:

PRODUCER	SHARE	STATUS POST-ATTACK
United States	~40%	Operating but export restrictions tightening
Qatar (Ras Laffan)	~33%	**Disrupted** — hub damaged March 2, 2026
Algeria	~10%	Operating at capacity
Russia	~5%	Sanctions limit trade
Australia	~5%	Expanding but 2-3 years from full capacity

The destruction of Ras Laffan's helium extraction facility created an immediate **60 million cubic metre annual shortfall** — equivalent to one-third of global supply.

Impact on India Semiconductor Mission

PROJECT	LOCATION	PARTNER	HELIUM DEPENDENCY
Tata Electronics Fab	Dholera, Gujarat	PSMC (Taiwan)	High — full fab requires continuous helium for CVD, lithography, leak testing
Micron ATMP	Sanand, Gujarat	Micron (US)	Moderate — ATMP uses helium for packaging leak detection
HCL Fab	Greater Noida, UP	—	High — planning stage; supply contracts not yet signed
CG Power OSAT	Sanand, Gujarat	Renesas (Japan)	Moderate — testing and packaging

The Tata-PSMC fab at Dholera is India's flagship semiconductor project. A full-scale fab consumes approximately **1,500–2,000 cubic metres of helium per month** for CVD processes, EUV lithography environments, and leak detection alone. Without secure supply, commissioning timelines could slip by 12-18 months.

Healthcare Fallout

India's MRI infrastructure is equally vulnerable:

- ~7,000 MRI machines operational across India
- Each requires ~1,700 litres of liquid helium
- Helium refill cost: Rs 15-25 lakh per machine (pre-crisis); now surging to Rs 30-40 lakh
- Smaller diagnostic centres may shut MRI services temporarily
- Government hospitals face acute budget pressure

What India Should Do

Immediate Actions

1. **Strategic helium reserve:** India has no helium stockpile. Build a 6-month buffer (~3 million cubic metres) through emergency procurement from the US and Algeria
2. **Price controls:** NPPA-style ceiling on helium for healthcare use
3. **Recycling mandate:** Helium recycling systems recover 95%+ of used helium in labs — mandate installation in all new fabs

Structural Actions

1. **Domestic exploration:** ONGC's natural gas fields in KG Basin and Rajasthan contain trace helium (0.01-0.1%). Economically marginal but strategically critical — ONGC should invest in helium extraction R&D
2. **Bilateral agreements:** Long-term supply contracts with the US (Bureau of Land Management manages the Federal Helium Reserve in Amarillo, Texas) and Australia (which is expanding production at Darwin)
3. **Critical materials mapping:** Every input for semiconductor fabrication — neon, krypton, xenon, high-purity chemicals, rare earths — must have a supply security assessment

The Broader Lesson

The helium crisis is a microcosm of a larger problem: India's industrial ambitions outpace its supply chain sovereignty. The semiconductor mission, the green hydrogen mission, the EV battery ecosystem — all depend on imported materials with concentrated supply chains. A single geopolitical disruption can cascade across multiple sectors simultaneously.

UPSC RELEVANCE

Helium properties (atomic number 2, noble gas, lowest boiling point), Ras Laffan, CVD process, EUV lithography, ISM budget

Supply chain security for strategic industries; India Semiconductor Mission challenges; critical mineral and material dependency

📌 FACTS CORNER — KNOWLEDGEPEDIA

HELIUM — KEY PROPERTIES:

Atomic number: 2; symbol: He; Group 18 (noble gas)

Boiling point: -268.93°C (4.22 K) — lowest of any element

Second most abundant element in universe; rare on Earth

Non-renewable: Extracted from natural gas; escapes atmosphere if released

Global production: ~180 million cubic metres/year

INDIA SEMICONDUCTOR MISSION:

Launched: 2021 under MeitY

Budget: Rs 76,000 crore (~$10 billion)

Capital subsidy: Up to 50% for fab units

Design support: Up to Rs 15 crore per chip design

Managed by: ISM under Digital India Corporation

SEMICONDUCTOR FABRICATION — HELIUM USES:

Cooling: Fab chambers and cryogenic systems

CVD: Chemical Vapour Deposition carrier gas for thin film deposition

Leak detection: Helium's small atomic radius (31 pm) detects micro-leaks

EUV lithography: Prevents contamination in extreme ultraviolet environments

Purging: Flushes oxygen and moisture from process chambers

OTHER RELEVANT FACTS:

Ras Laffan: World's largest LNG industrial city; Qatar's northeast coast

EUV lithography machines: Made only by ASML (Netherlands); cost ~$150 million each

US Federal Helium Reserve: Amarillo, Texas (being privatised)

MRI machines in India: ~7,000; each uses ~1,700 litres liquid helium

Helium recycling: Can recover 95%+ of used helium; standard in advanced labs

Sources: Economic Times , MeitY , Business Standard

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