

MASTER DOSSIER: Luminarit-GreenRAM V2

The world's first rare-earth-free, environmentally friendly high-speed RAM

1. Introduction & Vision

Luminarit-GreenRAM V2 is built on a clear set of principles:

- **0% rare earth elements**
- **maximum environmental responsibility**
- **full CMOS compatibility**
- **DRAM-class speed**
- **non-volatile, energy-efficient, long-lived**

This creates a memory technology that is not only technically competitive, but also sets new ecological and geopolitical standards.

2. Why GreenRAM Protects the Environment

2.1 No Refresh → Drastically Lower Energy Consumption

DRAM requires constant refresh cycles.

GreenRAM does not.

Refresh power:

$$P_{\text{refresh}} = U \cdot I_{\text{refresh}}$$

For GreenRAM:

$$P_{\text{refresh}} = 0$$

→ **Up to 90% energy savings in idle operation.**

2.2 Manufactured Without EUV → Massive CO₂ Reduction

GreenRAM uses:

- **65–90 nm DUV lithography**
- **no EUV scanners**
- **no gigafabs**
- **existing 200/300 mm fabs**

This reduces:

- energy consumption
 - water usage
 - chemical waste
 - infrastructure emissions
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2.3 0% Rare Earth Elements → Geopolitically Clean

Materials used:

- HfO₂
- TiOx
- TiN
- Graphene
- Copper
- Nitrogen

All globally available, with no rare-earth mining, no toxic by-products, and no geopolitical monopolies.

3. Technical Architecture

3.1 1T1R Cell (Transistor + RRAM)

Each cell consists of:

- one access transistor
- one resistive memory element (RRAM)

Filament resistance states:

$$R_{\text{ON}} \ll R_{\text{OFF}}$$

Switching voltage:

$$V_{\text{set}} \approx 1.2 - 1.8 \text{ V}$$

Switching time:

$$t_{\text{switch}} < 10 \text{ ns}$$

3.2 Ultra-Fast Material Stack

Layer	Material	Function
Top Electrode	TiN / Graphene	Highly conductive, stable
Speed Buffer	TiO _x	Ion accelerator
Active Medium	HfO ₂ :N	Nitrogen-doped, fast filament formation
Bottom Electrode	TiN	CMOS-compatible

4. Performance Data

Parameter	GreenRAM V2	DDR4/DDR5
Latency	< 10 ns	10–15 ns
Idle Power	≈ 0 W	High (refresh required)
Endurance	≥ (10 ⁹) cycles	Practically unlimited
Retention	≥ 10 years	0 seconds
Rare Earth Content	0%	Often present
Manufacturing	65–90 nm	10–14 nm EUV

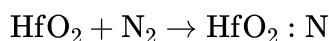
5. Manufacturing Process

5.1 CMOS Front-End

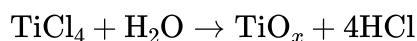
- Oxide formation
 - Gate stack creation
 - Source/drain implantation
 - Metal layers
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5.2 RRAM Backend-of-Line Integration

Step 1: ALD deposition of HfO₂:N



Step 2: ALD deposition of TiO_x speed layer



Step 3: Electrode deposition (TiN / Graphene)

Step 4: Contact formation & metallization

Step 5: Multi-bank layout + integrated SRAM cache

This increases effective bandwidth and masks write latency.

6. Environmental Benefits

6.1 Energy Savings During Operation

Total energy:

$$E_{\text{total}} = \int P(t) dt$$

Since:

$$P_{\text{refresh}} = 0$$

→ overall system energy consumption drops dramatically.

6.2 Longer Lifetime → Less Electronic Waste

RRAM is non-volatile and robust.

Systems last longer and require fewer replacements.

6.3 No Rare Earth Elements → No Environmental Damage

Avoids:

- acid leaching
 - groundwater contamination
 - radioactive by-products
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7. Final Statement

Confident Closing Line

“We understand: performance alone is no longer enough.

Technology must protect the environment — and GreenRAM delivers exactly that.”

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