



GALLIUM NITRIDE ECOSYSTEM ENABLING CENTRE AND INCUBATOR

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# Building and Powering the GaN Ecosystem in India

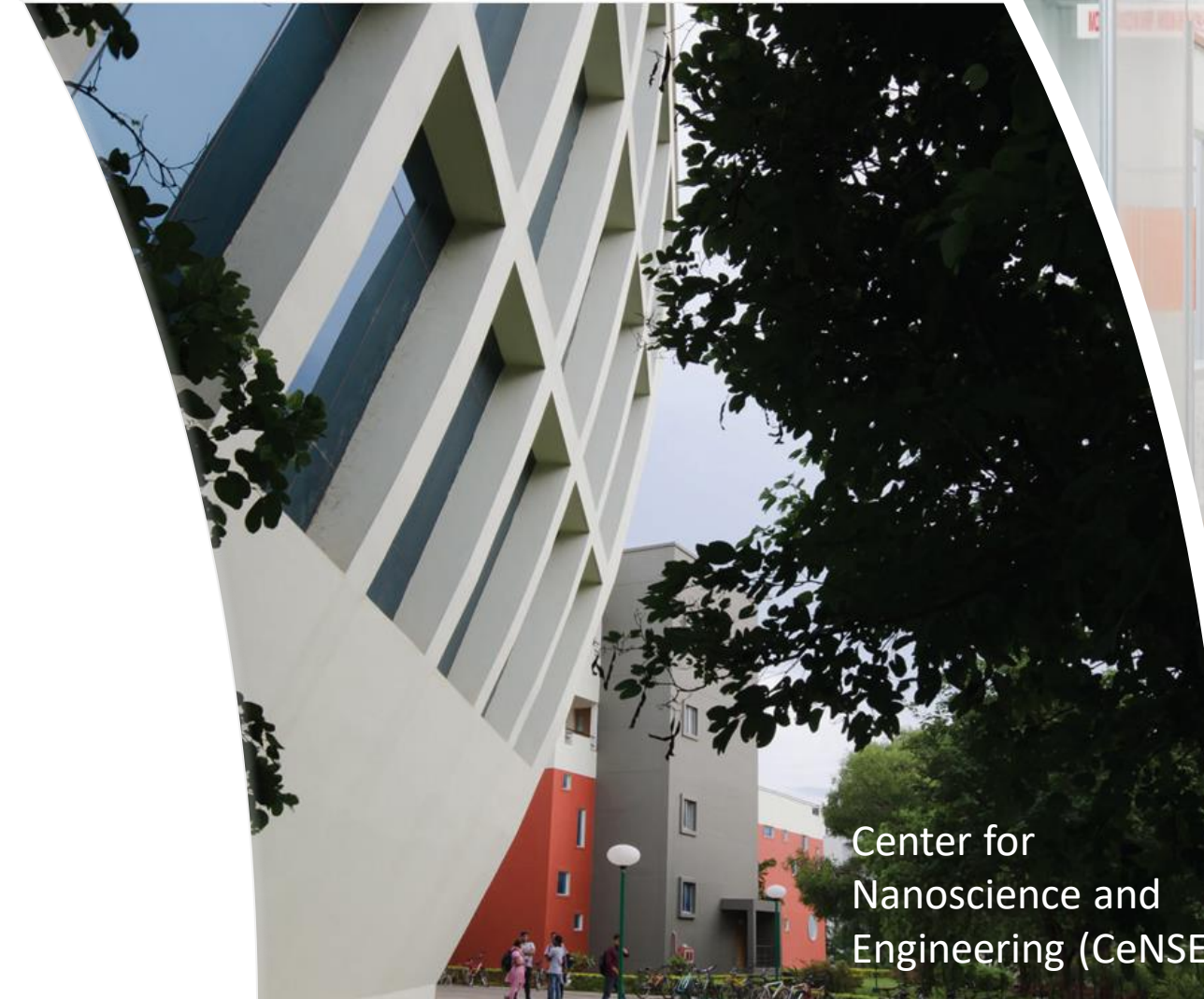


# GEECI Overview

Small-volume commercial GaN foundry

Startup Incubator

Located at CeNSE, IISc Bangalore



Indian Institute of Science, Bangalore, India

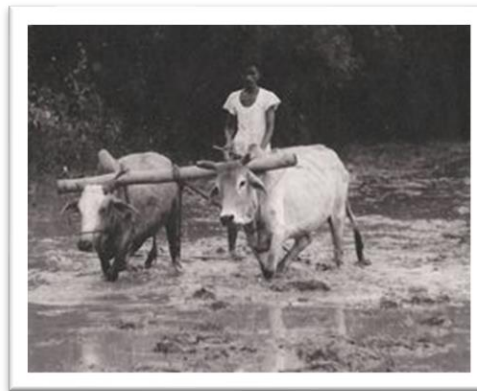


# Outline

- India semiconductor context
- GaN market overview
- GEECI overview
- Building a GaN ecosystem

# Semiconductor Manufacturing in the Indian Context

## Inflection Points in Evolution of Indian Economy



Agriculture

Pre-1940s



Heavy Industry

1950s-80s



IT, Biotech,  
Pharma

1990s-2010s



High Tech  
Manufacturing (?)

2020s+

## Critical Enablers in Evolution of Indian Economy

Natural Resources

Top Academic Institutions

STEM Talent

Market Opportunity

# Indian Semiconductor Market Drivers

820M

Active Internet Users

1.1B

Cellular Connections

40X

EVs by 2030

500M

5G subscribers (2027)

146M

Smartphones Sold  
(2023)

14M

PCs Sold (2023)

3.5X

Renewables Capacity  
(2030)

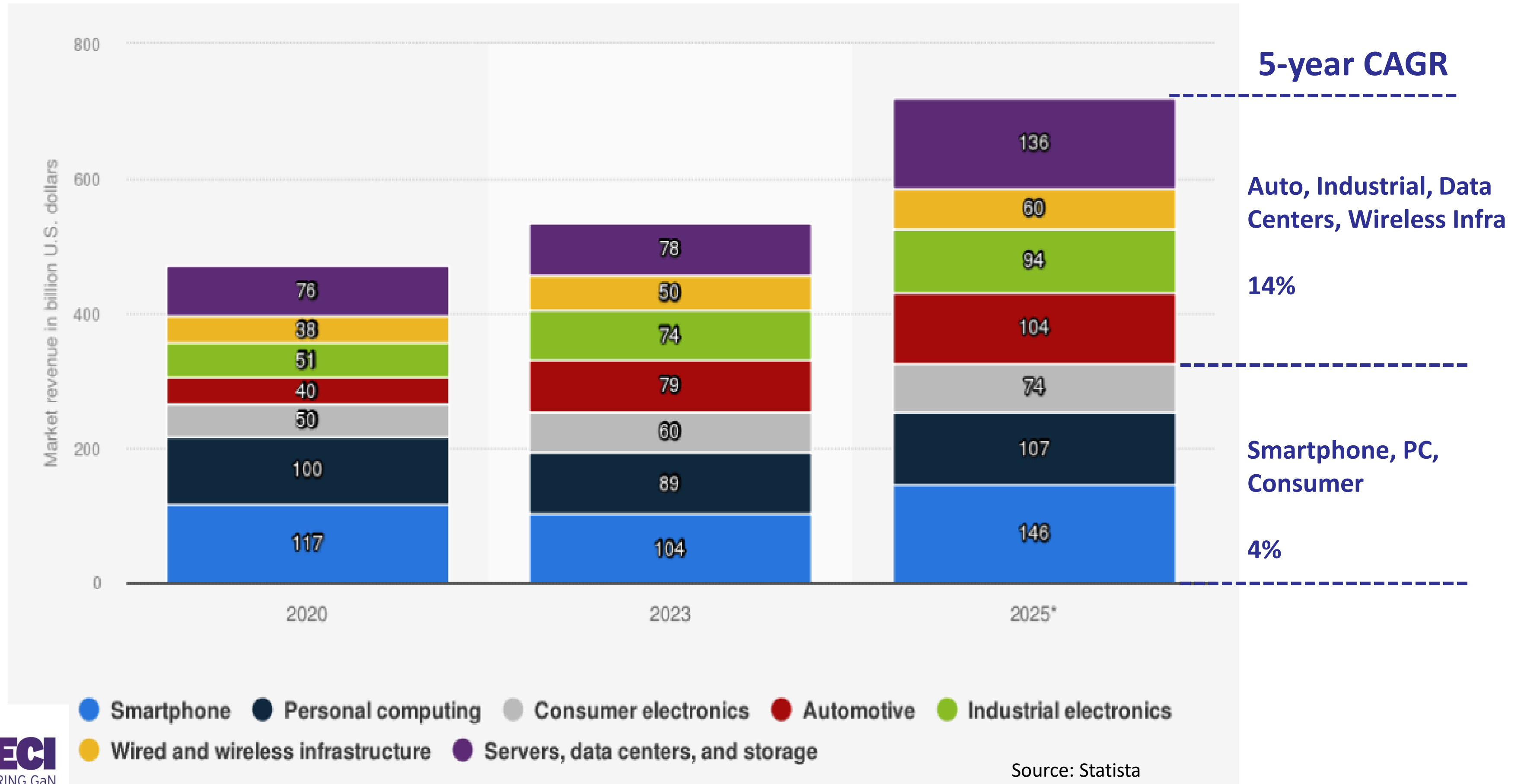
2.5X

Data Center Capacity  
(2030)

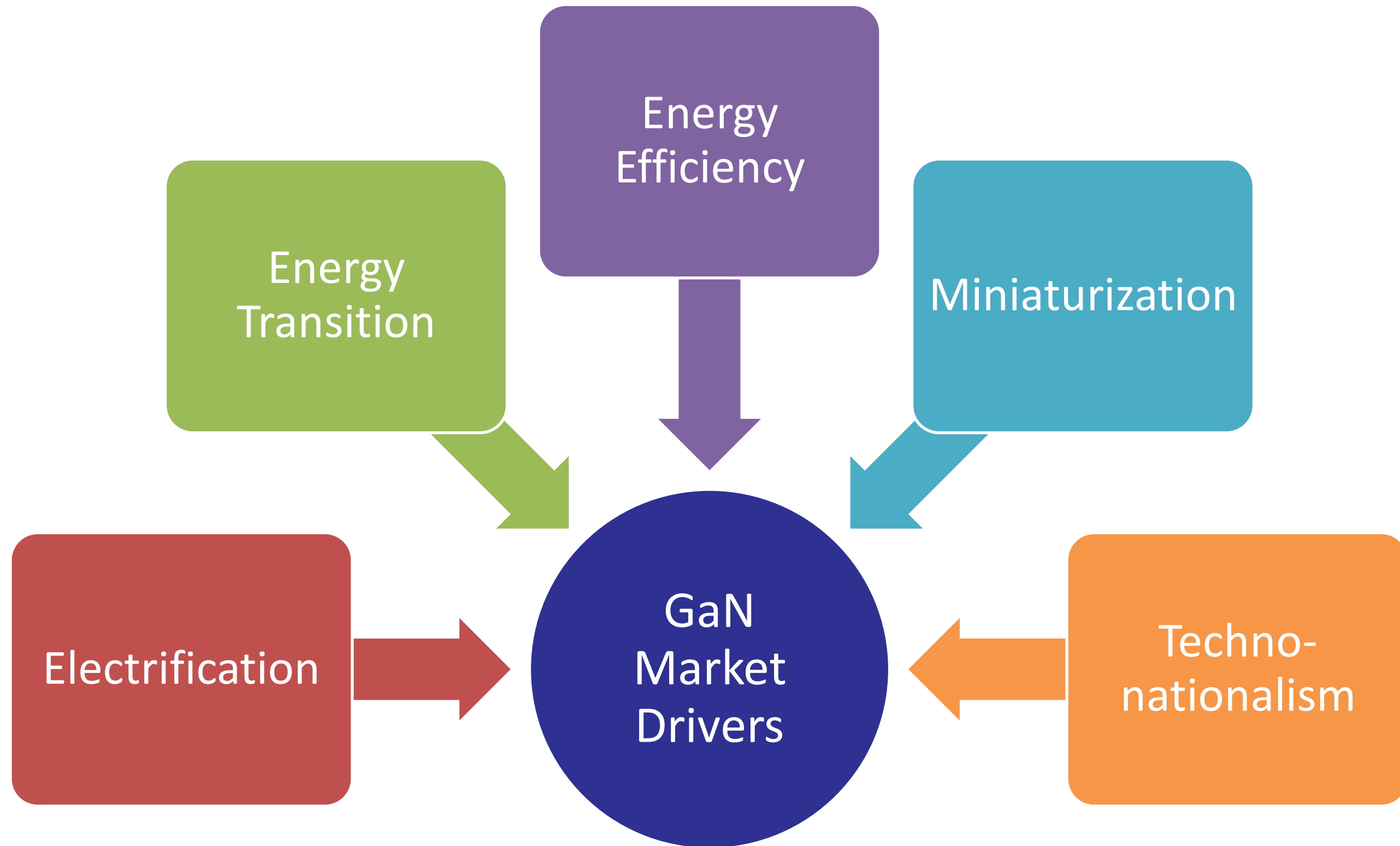
- Advanced semiconductor nodes
- Limited capability in India

- WBG opportunity
- Core technical capability exists in India

# Key Global Growth Markets for Semiconductors are Shifting



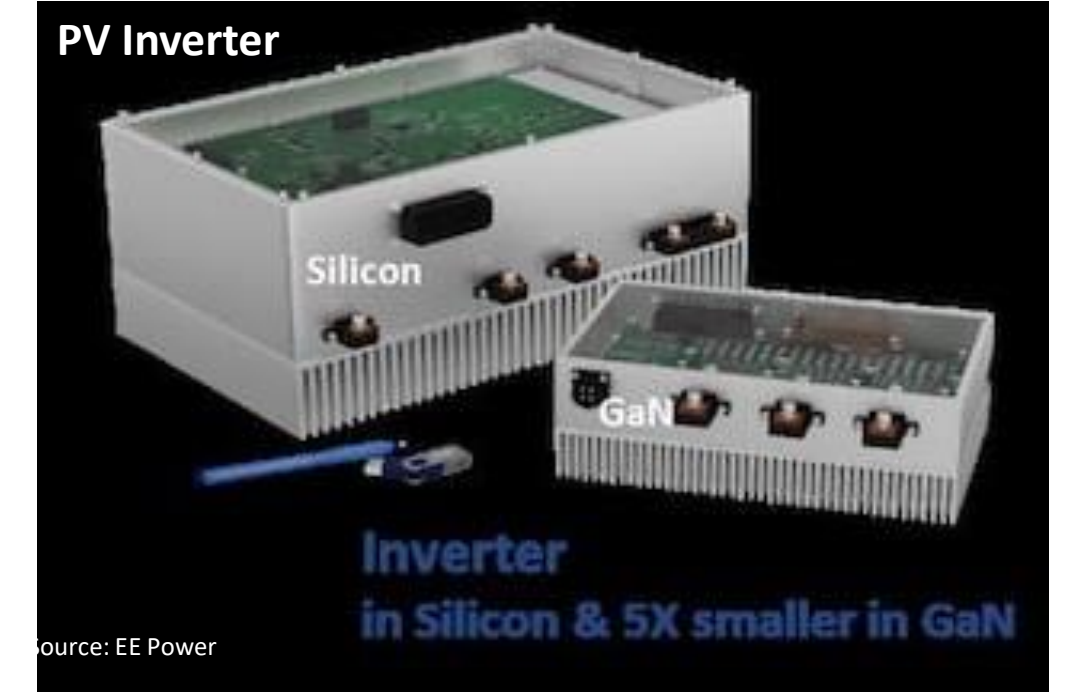
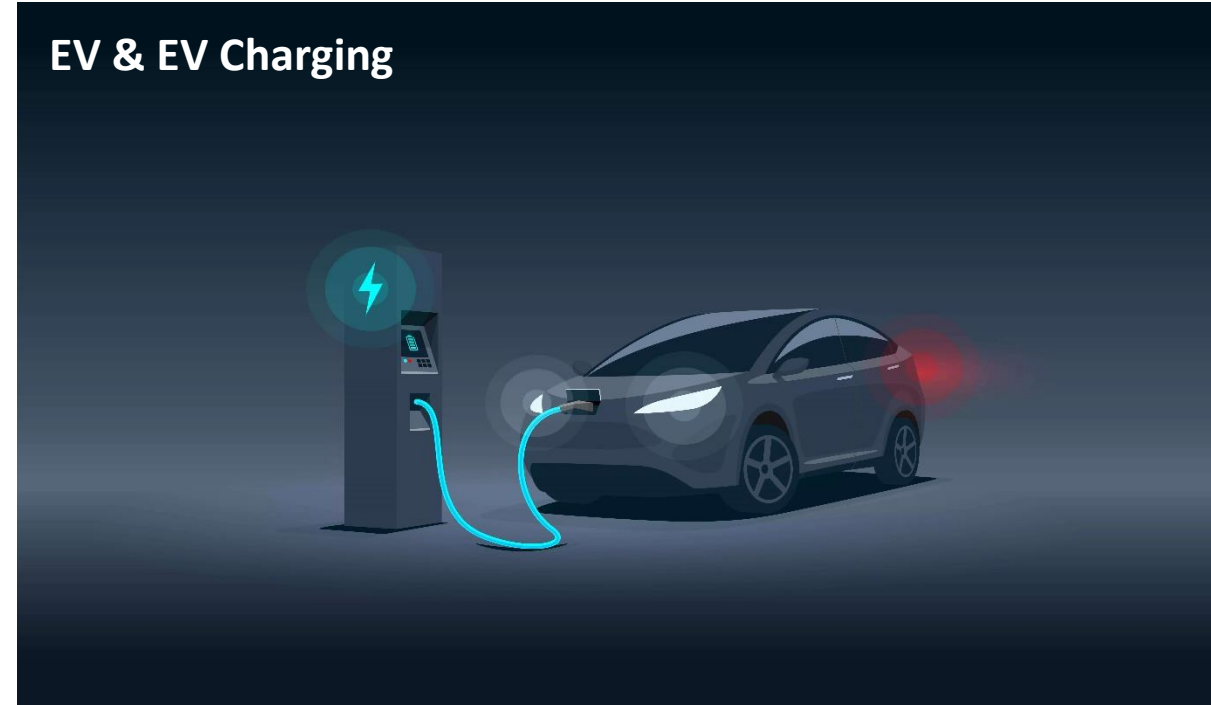
# Secular Global Trends Underpinning GaN Adoption





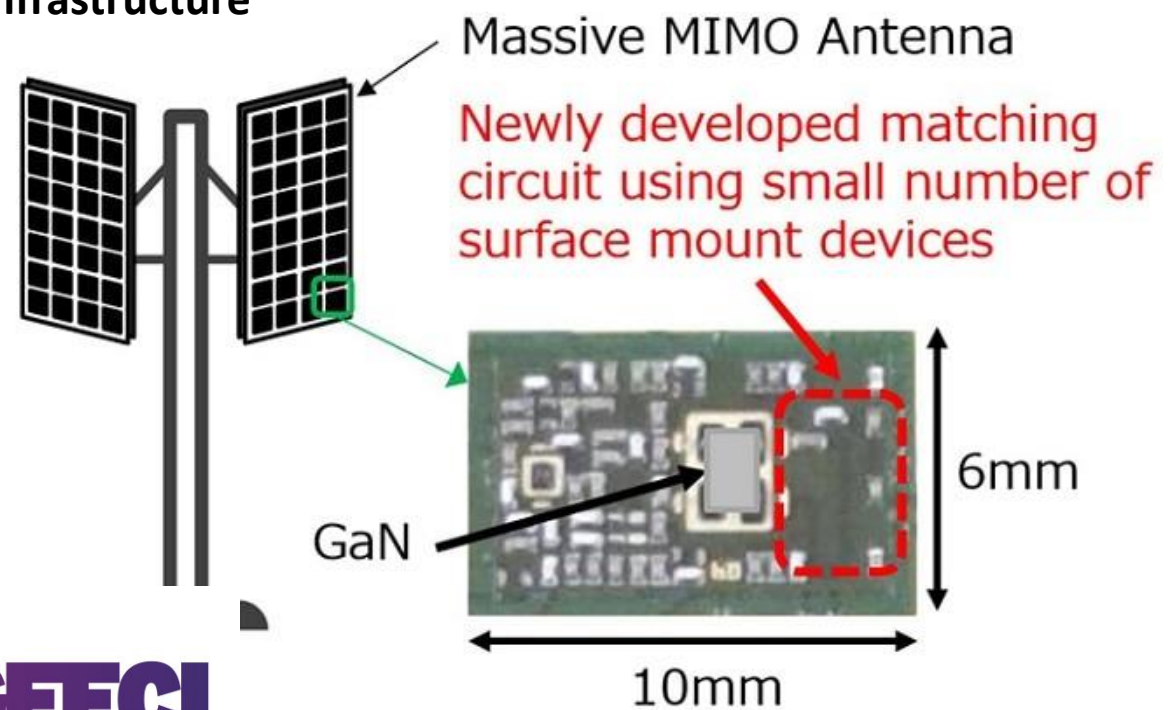
# Key Applications Driving GaN Adoption

## Power GaN



## RF GaN

### 5G Infrastructure



Source: Mitsubishi



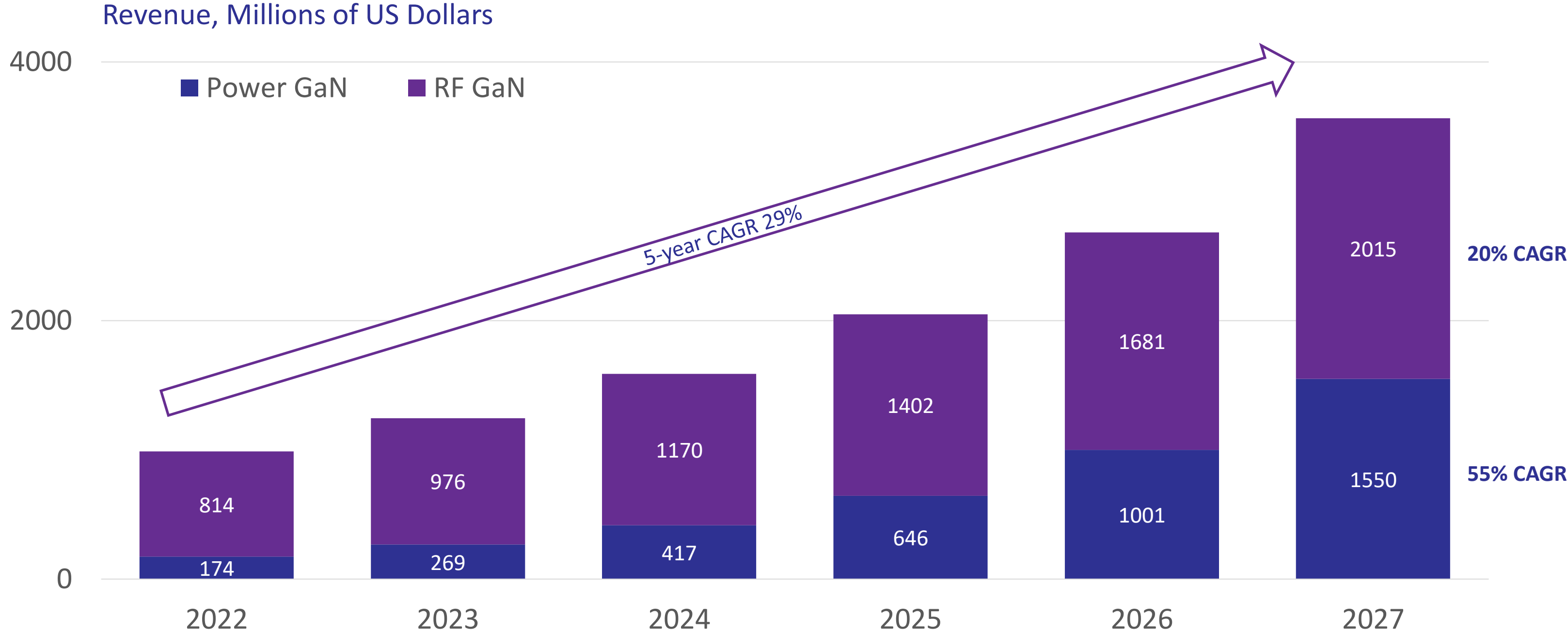
### Solid State Microwave Generator



Source: RFHIC



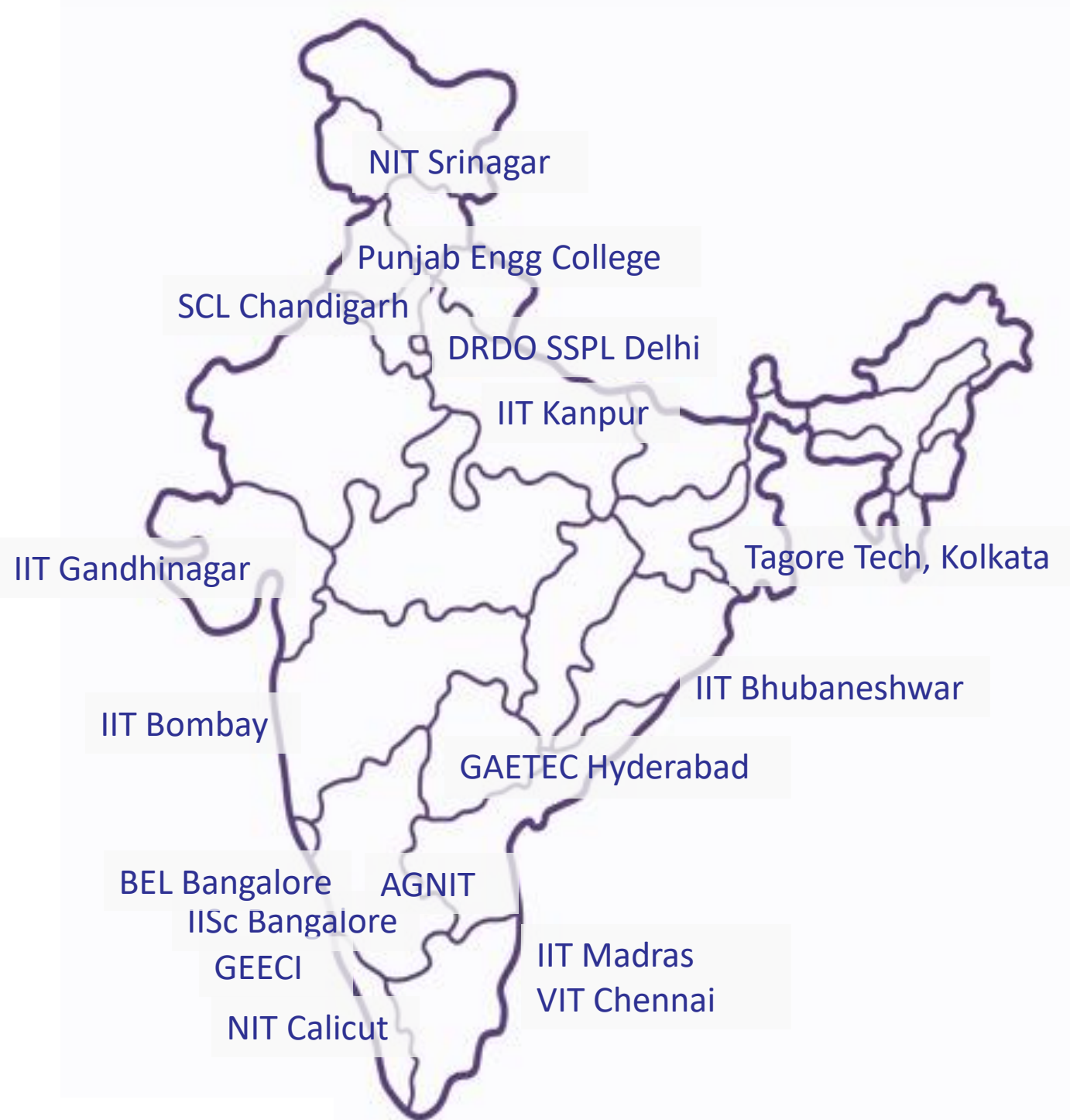
# GaN HEMT Market Will Reach \$3.5B by 2027



Based on: Public Information, GEECI Internal Projections

# Investments, Tech Breakthroughs & Market Pull Drive Indian GaN Landscape

## GaN Development Landscape\*



\*Representative list. Not exhaustive

## Deep tech investments in India doubling every three years, crossed \$1 billion between 2021-23: Report

AI and biotechnology lead deep tech funding in India, material science gathering momentum in recent years, says the newly-released report by VC firm Ankur Capital

Ministry of Defence

## Aatmanirbhar Bharat: iDEX-DIO signs 300th contract for Defence Innovation in the niche field of Design and Development of Advanced Gallium Nitride Semiconductors

Posted On: 01 DEC 2023 5:10PM by PIB Delhi

## New technology for High Electron Mobility Transistor will make India self-reliant in power transistor technology

Scientists from Bangalore have developed a highly reliable, High Electron Mobility Transistor (HEMTs) that is a normally OFF device and can switch currents up to 4A and operates at 600V. This first-ever indigenous HEMT device made from gallium nitride (GaN) is useful in electric cars, locomotives, power transmission and other areas requiring high voltage and high-frequency switching would reduce the cost of importing such stable and efficient transistors required in power electronics.

Power electronic systems demand high blocking voltage in OFF-state and high current in ON-state for efficient switching performance. Specific transistors called HEMTs made of aluminium gallium nitride/

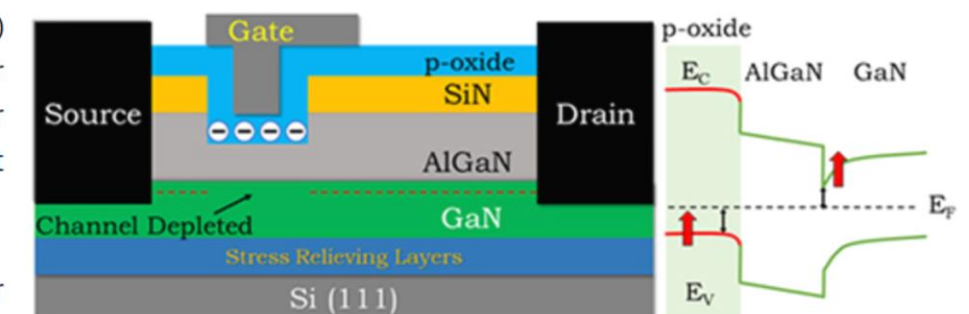


Fig. 1. Device structure depicting proposed novel aluminium titanium oxide, which acts as n...



# Market GAP

1. Growing end markets in India but limited access to manufacturing
2. Supply chain restrictions on GaN HEMTs and Ga-compounds
3. Few foundries supporting prototyping

# Target Customers

1. Startups
2. Academia
3. R&D Organizations
4. Incubators
5. GaN Device Manufacturers
6. Consumables Suppliers
7. OSATs
8. OEMs/ Tier 1s

# Business MODEL

- **Academic Fab**

non-material-specific



- **Prototype Fab**

material-specific + small volume



- **Industrial Fab**

material-specific + large volume





# Mission

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GEECI's mission is to accelerate the pre-incubation and incubation of GaN technology startups as well as provide players in the GaN technology value chain a platform and network to aid the global transition of the semiconductor industry from Si to GaN.

GEECI's vision is to create an ecosystem of startups, established industry organizations, supply chain companies, equipment manufacturers, and academic institutions to cater to the developing markets of GaN wafers and electronic devices in the power electronics, RF communication, and nitride MEMS sectors.

# Vision

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# LEADERSHIP



**Dr. Sridhar Srinivasan**  
Chief Executive  
Officer



**Prof. Srinivasan Raghavan**  
Founder and Board  
Member



**Prof. Shankar Selvaraja**  
Founder and Board  
Member



**Prof. Mayank Shrivastava**  
Founder and Board  
Member



**Dr. Muralidharan R**  
Founder and Board  
Member



**Prof. Digbijoy N. Nath**  
Founder and Board  
Member



**Dr. Madhusudan Atre**  
Founder and Board  
Member



# Our Diverse Team

- 250+ years of combined GaN/fab experience
- Experienced and young engineers
- 25% PhDs + 25% with  $\geq 10$  years of industry experience
- > 50% Women





# Production Line Capabilities

## WAFER DEPOSITION

- Upto 8-inch GaN MOCVD

## DEVICE FABRICATION

- 100 kV e-beam Litho (4-6 inch)
- DUV Stepper
- Etch and Depo Tools (Upto 8 inch)

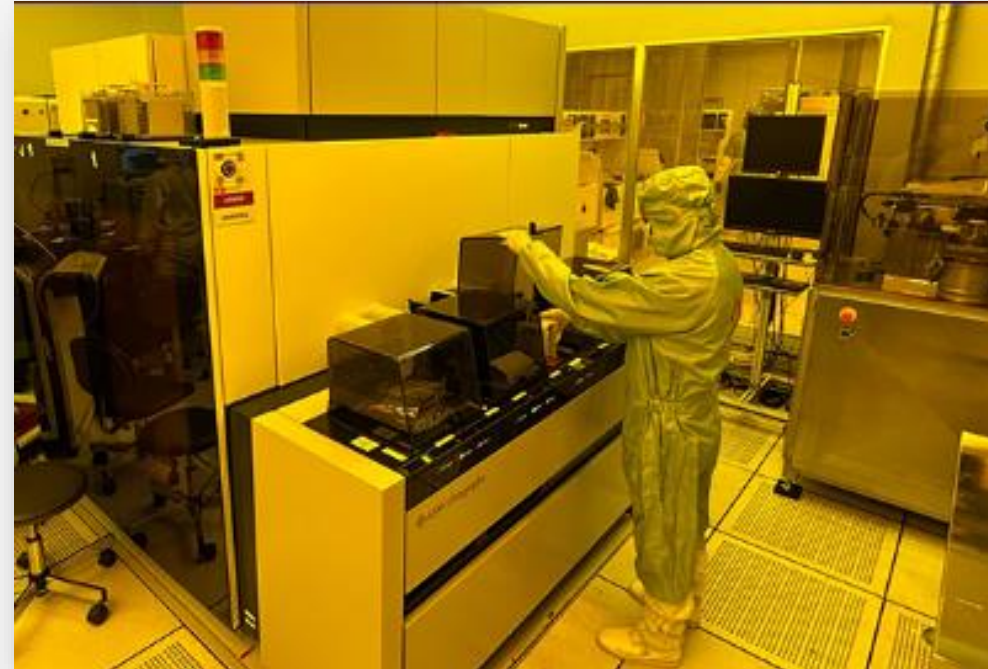
## RF & POWER DEVICE CHARACTERIZATION

- RF Load Pull (up to 67 GHz)
- High Power Probe Station (up to 3 kV, 100A)
- + Other RF and Power Characn Tools

## DEVICE PACKAGING

- Wafer Dicing and Grinding (upto 8 inch)
- Automatic Die Bonder
- Automatic Wirebonder

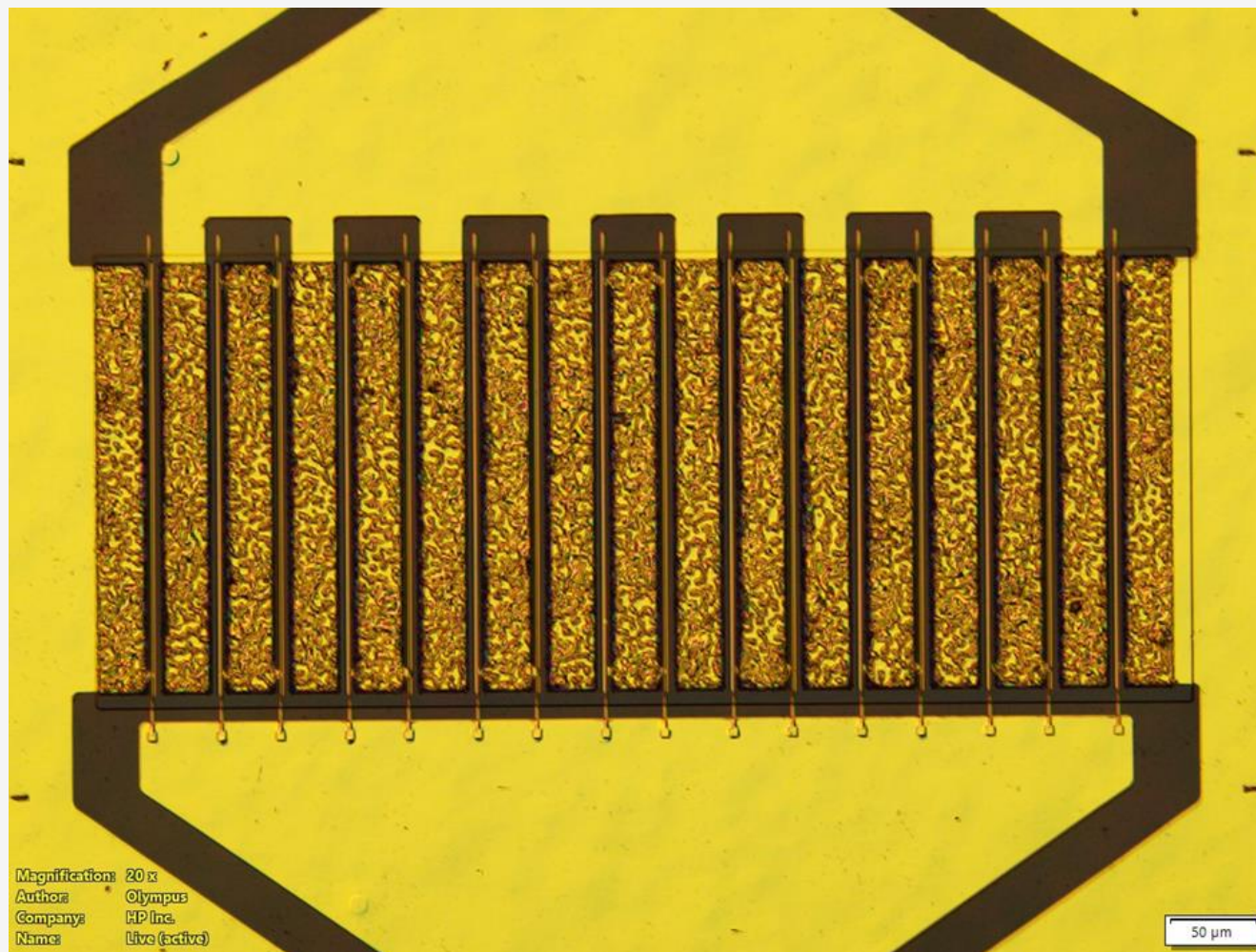
## DEVICE AND CIRCUIT DESIGN



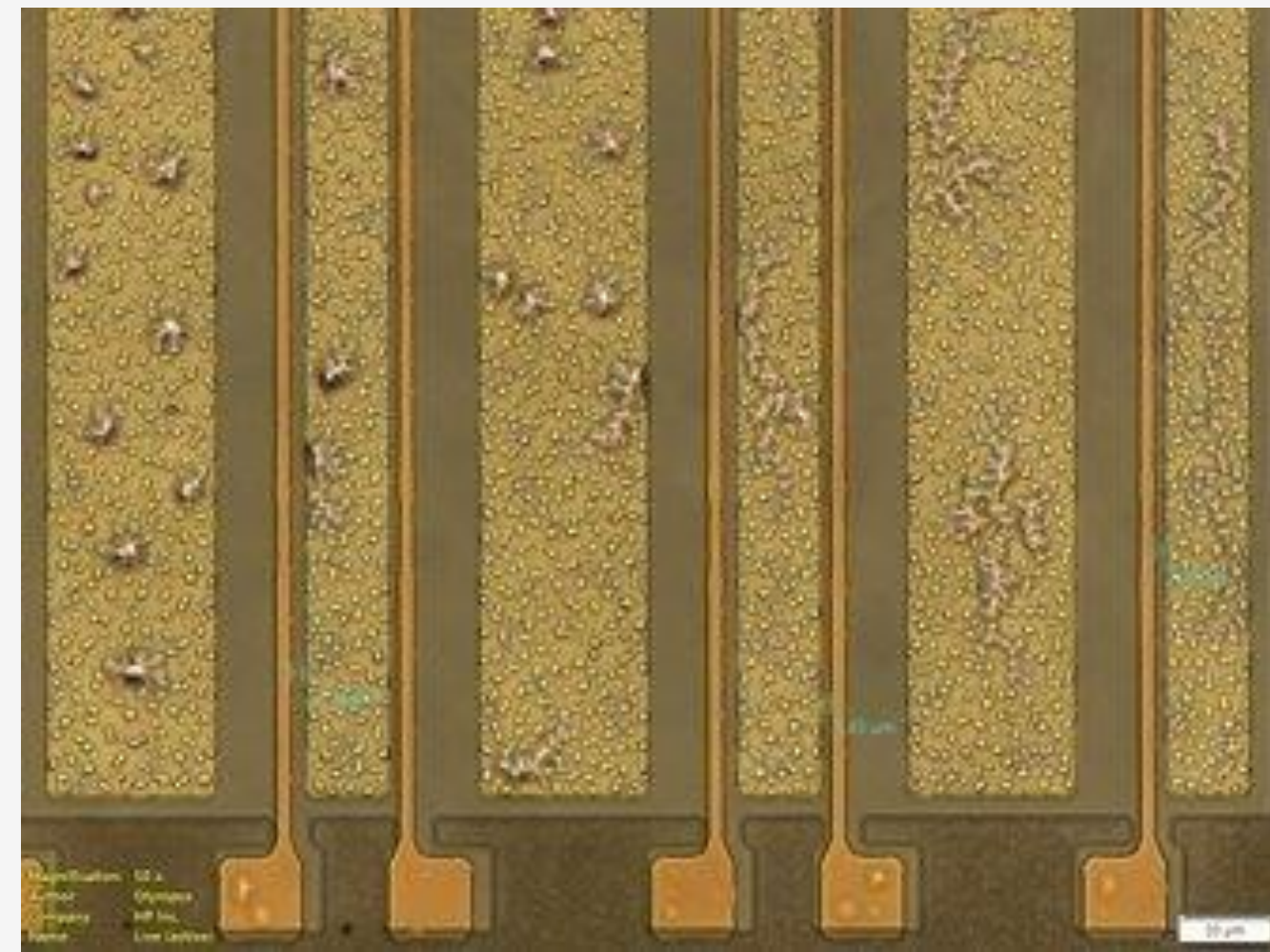


# GaN Device Development

3.5 GHz 15 W RF GaN HEMT \*

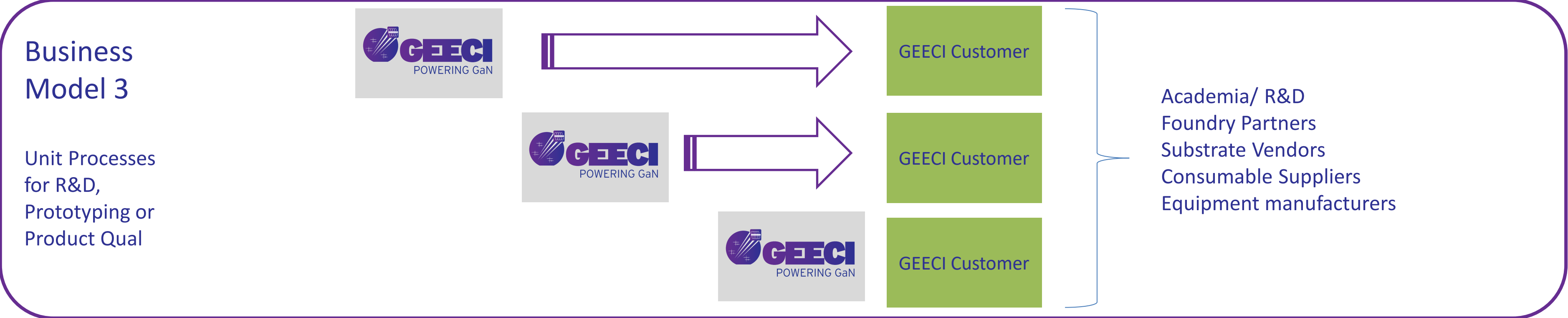
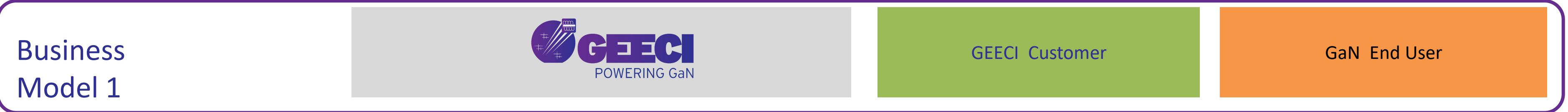


650 V, 30 A E-mode Power GaN HEMT\*



\*Demonstrated at R&D scale. Currently porting to commercial line

# GaN Ecosystem & Business Models





# OUR ECOSYSTEM PARTNERS

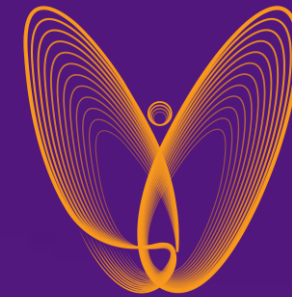
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**Ministry of Electronics & Information Technology**  
Government of India



**Indian Institute of Science**  
भारतीय विज्ञान संस्थान



Foundation for Science  
Innovation and Development  
established by AICTE



+ A Growing Network of Equipment Providers, Consumable Suppliers, Packaging Partners, and OEMs

# Startup Incubation

## Incubation Support:

- Office Space
- Discounted access to tools
- 3-year ramp

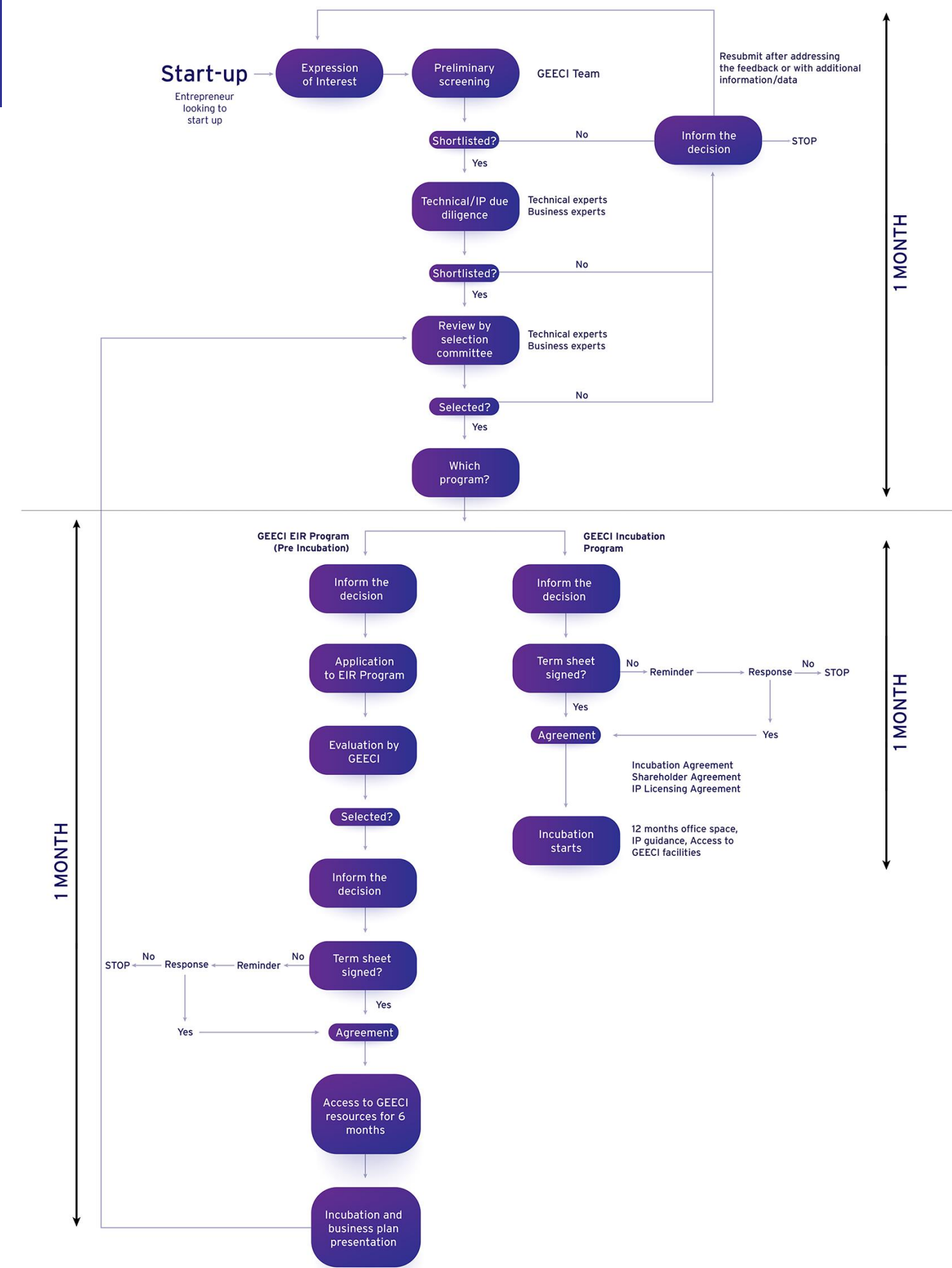
## EIR Support:

- Office space
- Stipend & Health Insurance
- 1-year ramp

One GaN device startup incubated

Two more in discussion

Flow Chart of the Incubation Process





# Broader Ecosystem at IISc

The GEECI tool line is hosted in the NNFC, MNCF, and packaging facilities of its sister organization, the Centre for Nanoscience, IISc.

Led by highly experienced nano scientists, including the founders of GEECI, CeNSE and the extended IISc ecosystem offer partnerships and support through deep personal and professional ties in the semiconductor electronics space.





# Thank You

## Contact

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