Inc42
Datalabs

THE RISE OF INDIA'S

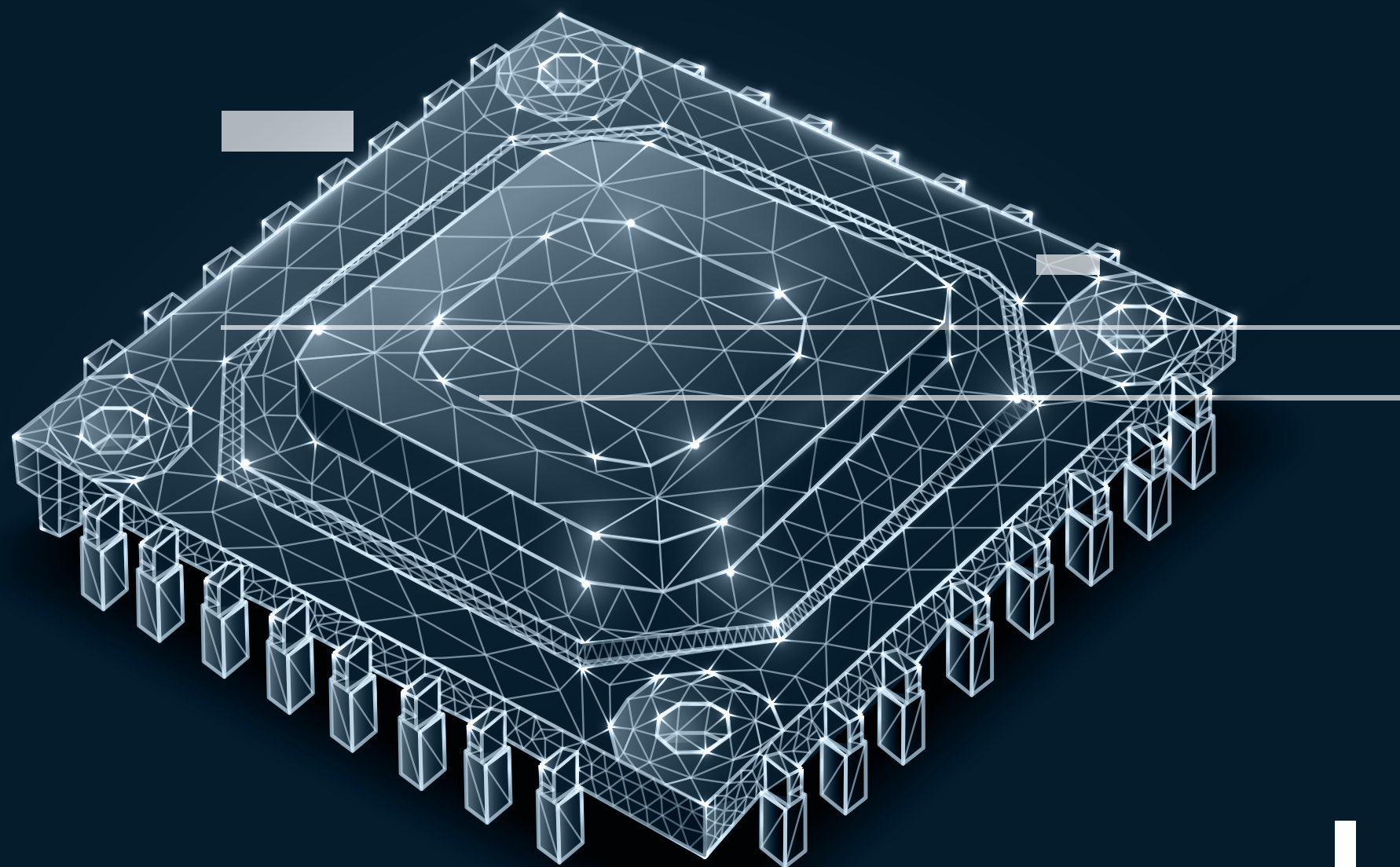## SEMICONDUCTOR STARTUPS

REPORT 2024

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India's Semiconductor Future: A Blueprint For Triumph

$150 Bn+ Total Market Opportunity For Semiconductors In India By 2030

$21 Bn+ AI Semiconductor Market Opportunity In India By 2030

50% Of Semiconductor Manufacturing Cost Setup To Be Fulfilled By The Central Government

100+ Semiconductor Startups In India

Two-Third* Of Indian Semiconductor Startups Operate Out Of Bengaluru

2.4x YoY Growth In Indian Semiconductor Startup Launches Since 2014

20% Of Global Semiconductor Integrated Circuit (IC) Design Workforce Is From India
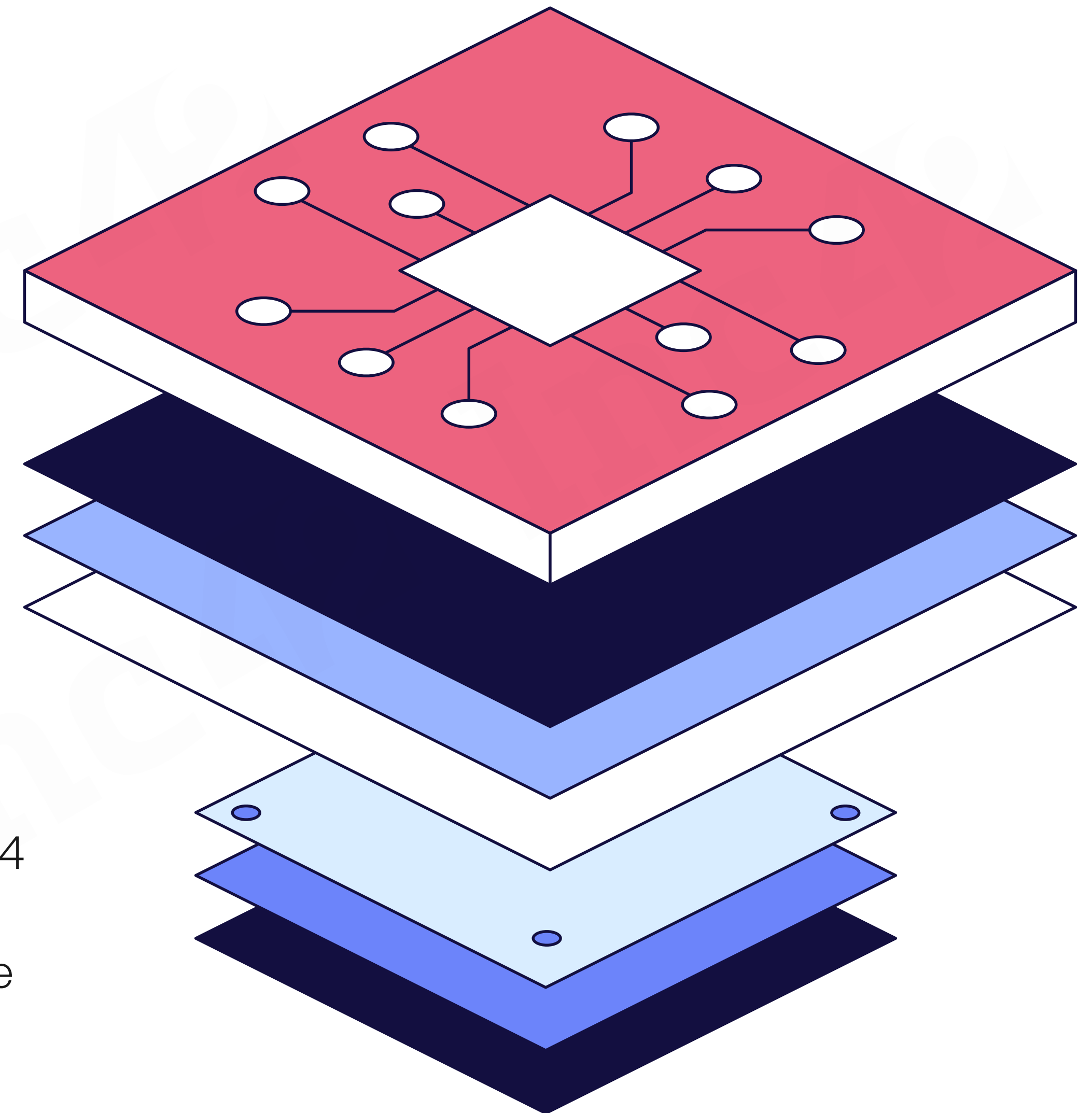
Source: Inc42, Semicon India (2022)
Note: *This is an approximate value, the exact share of Bengaluru in total semiconductor startups is about 64%.

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The Global Semiconductor Market Opportunity To Exceed $1 Tn+ By 2030

A major chunk of this growth will come from markets such as US, India, and China
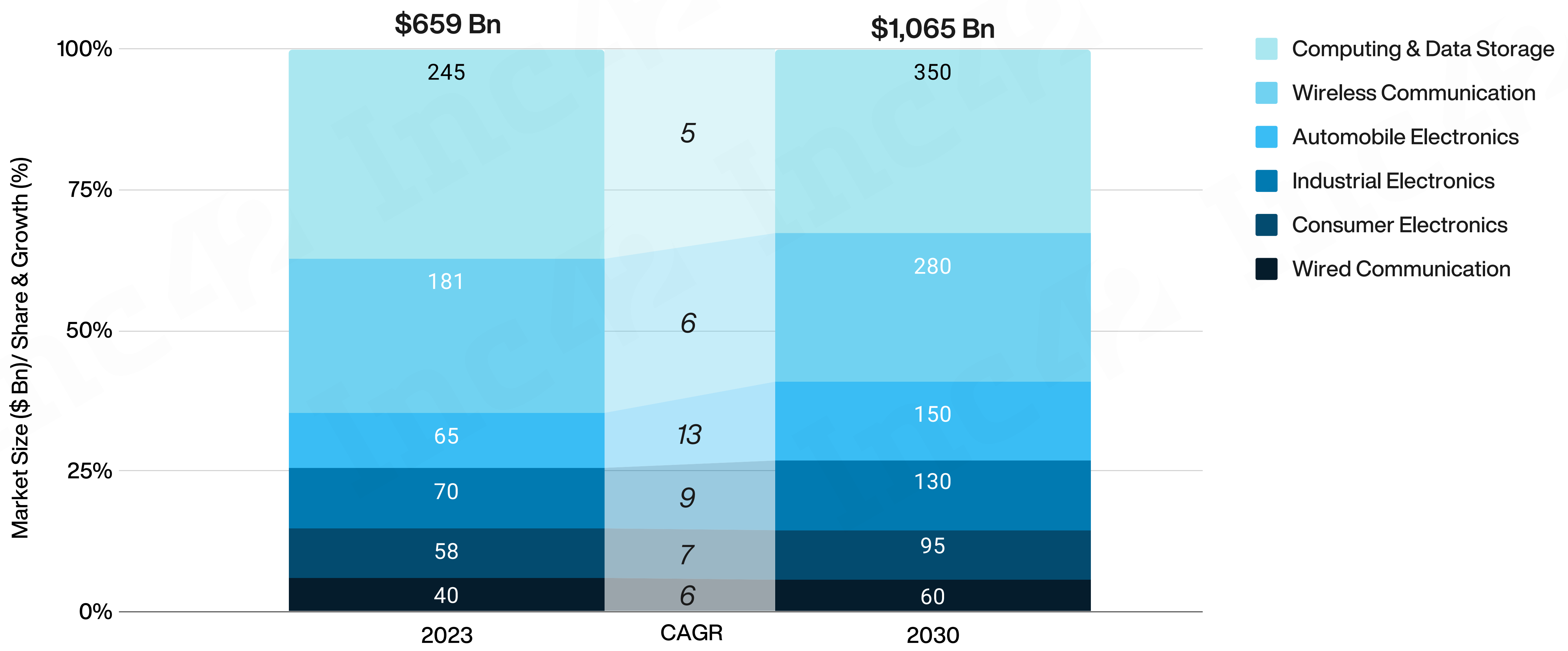
Source: McKinsey, Inc42 Analysis

India's Semiconductor Market Opportunity Will Surge To $150 Bn+ By 2030
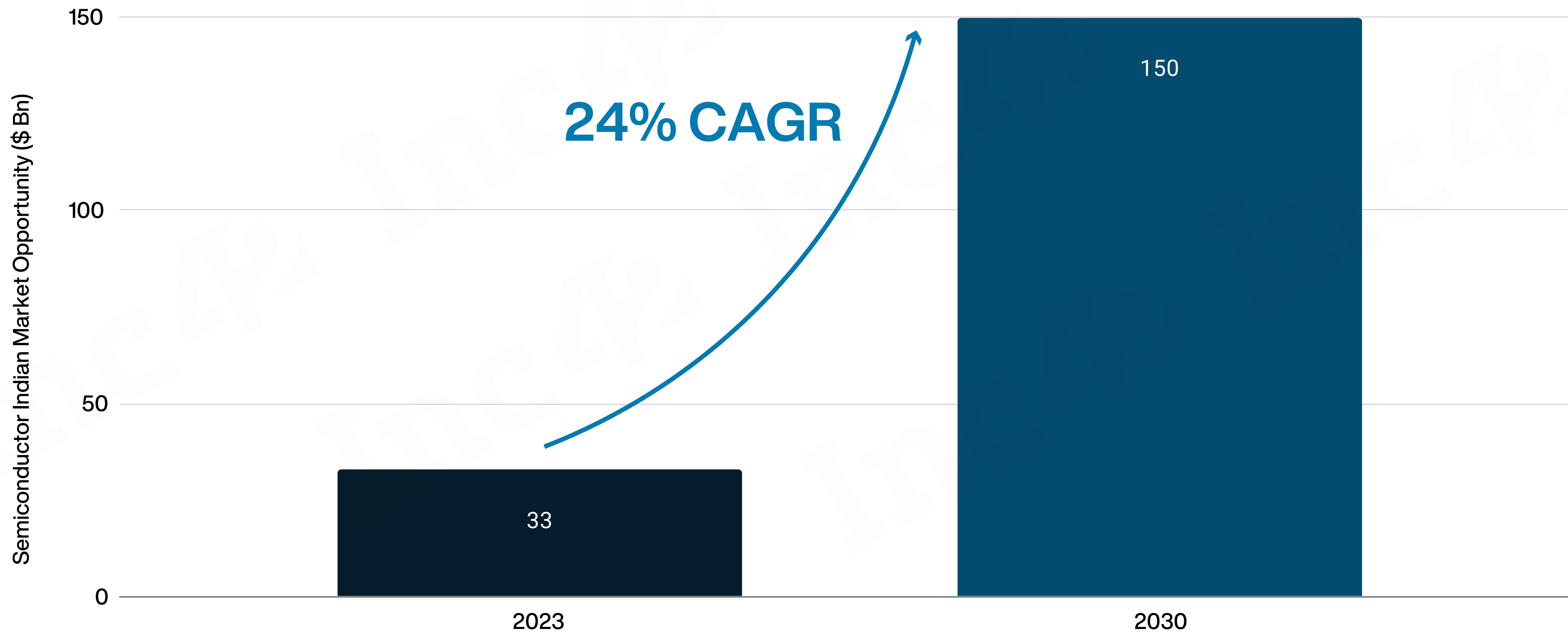
24% CAGR

Semiconductor Indian Market Opportunity ($ Bn)

150	
100	
50	
0	

2023 — 33

2030 — 150

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Leaders Speak: Unlocking India's Semiconductor Potential

From space to semiconductor, digital to drones, AI to clean energy, 5G to Fintech, India has today reached the forefront of the world

Shri Narendra Modi

Made in India chips manufactured in India will help create a strong and significant presence for India in global value chains — it will make India a semicon hub for the world

Shri Rajeev Chandrasekhar

This is absolutely the right time to be in the semiconductor industry and we've very rapidly gained the confidence of the entire global industry

Shri Ashwini Vaishnaw

India, in my opinion, has almost everything you need to have a successful semiconductor industry in the country. We have talent, we have democracy, the largest democracy in the world. We have a market. The population is the market. We are 1.4 Bn now bigger than even China. And language is a big plus. Virtually everybody speaks English. Plus, we comply with international laws. So what more do you need, you have everything to really attract industry's equal ecosystem

Shri Ajit Manocha

Source: Inc42, Secondary Sources

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Silicon Dreams: Mapping India's Semiconductor Startup Landscape

AI SEMICONDUCTOR

KRUTRIM · KALATRONICS Semiconductors Private Limited
BLUEBERRY · SEMICONSOUL™
Netrasemi · SENSE SEMI

CONSUMER ELECTRONIC

SION Semiconductors · CIREL SYSTEMS Inspired by Innovation
Vervesemi · BHIVE-DESIGN INNOVATIVE MINDS AT WORK
SIGNALCHIP

INDUSTRIAL AUTOMATION

SEMICONSOUL™
BHIVE-DESIGN INNOVATIVE MINDS AT WORK
incore

AUTOMOTIVE AND AUTONOMOUS VEHICLE

MINDGROVE SILICON · cientra · wafer space
MAXVY® MAXimum Value for You · Digicomm Semiconductor
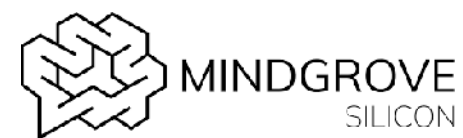
TELECOM & WIRELESS COMMUNICATION

Saankhya Labs · SIGNALCHIP · FERMIONIC
cientra · Vervesemi · Digicomm Semiconductor
KALATRONICS Semiconductors Private Limited · AGNIT

Source: Inc42
Note: This not an exhaustive list of all semiconductor startups in India. Startups mentioned in each segment are not mutually exclusive. Some of these startups might operate in multiple segments

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Major Players In Semiconductor Ecosystem In India

The current semiconductor ecosystem in India is largely dominated by global MNCs and Indian corporates

DESIGN/VIRTUAL FAB ECOSYSTEM LED BY FOREIGN MNCs

intel · Qualcomm · AMD · Micron

NXP · GlobalFoundries · Infineon

ST life.augmented · NVIDIA · Texas Instruments

BROADCOM · MEDIATEK

EDA & IP CORE

cadence · arm · Mentor A Siemens Business

Synopsys

MANUFACTURING SUPPLIER ECOSYSTEM

EQUIPMENT & TOOL

APPLIED MATERIALS · Lam RESEARCH · KLA

STRATEGIC FACILITIES

DRDO · SCL SEMI-CONDUCTOR LABORATORY · SITAR · GAETEC

FAB CONSUMABLES

INOX · INOX AIR PRODUCTS · Linde · Air Liquide

PHOENIX Fuels Life · FINAR · IFFCO

Source: Semicon India

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The Semiconductor Startup Ecosystem In India: Key Enablers

INTERNATIONAL CORPORATES

- NVIDIA
- AMD
- arm
- Micron
- intel
- Qualcomm
- NXP
- Texas Instruments
- GlobalFoundries
- Mentor — A Siemens Business
- Cognizant

INDIAN UNIVERSITIES / INCUBATORS

- IIT Hyderabad (आई आई टी हैदराबाद)
- Indian Institute of Technology Madras
- Indian Institute of Technology Roorkee
- Indian Institute of Technology
- Indian Institute of Technology
- National Institute of Technology Calicut
- Birla Institute of Technology & Science, Pilani
- MANIPAL INSTITUTE OF TECHNOLOGY, MANIPAL — A Constituent Institution of Manipal University
- Indian Institute of Science — भारतीय विज्ञान संस्थान

INDIAN CORPORATES

- TATA
- vedanta — transforming for good
- HCL
- Dixon — The brand behind brands
- LARSEN & TOUBRO
- भारत इलेक्ट्रॉनिक्स — BHARAT ELECTRONICS
- wipro
- CG Power and Industrial Solutions Ltd.
- Natronix
- MOSCHIP

INVESTORS (VC, ANGELS, INCUBATORS, ACCELERATORS)

- peak xv
- SPECIALE INVEST
- IndiaQuotient
- Whiteboard CAPITAL
- SFAL — Semiconductor Fabless Accelerator Lab — K-Tech CoE for Fabless
- Fabless Chip Design INCUBATOR
- N. LAKSHMI NARAYANAN
- ASHWINI ASOKAN
- NISCHAY GOEL

GOVT ORGANISATIONS

- इलेक्ट्रॉनिकी एवं सूचना प्रौद्योगिकी मंत्रालय — MINISTRY OF ELECTRONICS AND INFORMATION TECHNOLOGY — सत्यमेव जयते
- #startupindia
- इंडिया सेमीकंडक्टर मिशन — India Semiconductor Mission — Catalyzing India's Semiconductor Ecosystem
- SCL — SEMI-CONDUCTOR LABORATORY

Source: Inc42
Note: This is not an exhaustive list

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Growth Of Semiconductor Industry In India: A Timeline

◆ Government initiates semiconductor policy

◆ Inauguration of India's first semiconductor fabrication plant (fab) by SCL in Mohali, Punjab.

◆ Increase in semiconductor design services companies

◆ Growth of electronics manufacturing clusters

◆ India's emergence as a key player in the global semiconductor industry

◆ India Semiconductor Mission (ISM) events promoting domestic ecosystem.

◆ Micron Technology to set up testing and packaging plant (ATMP) in Sanand, Gujarat.

◆ Tata Group, in collaboration with PSMC, to establish fab in Gujarat

◆ CG Power and Renesas to establish semiconductor plant in Gujarat's Sanand

◆ Tata to set up chip assembly and testing unit in Assam

1980s

1990s

Early 2000s

Mid-2000

Late 2000s

2020s

◆ Formation of semiconductor associations and societies

◆ Entry of multinational companies into Indian market

◆ India's first semiconductor policy

Source: Inc42, Secondary Sources

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How India's Semiconductor Industry & Startups Stand To Gain

THE OPPORTUNITY

$150 Bn+ Market Opportunity By 2030

Advance Manufacturing

Large Consumer Base

20% Global Design Chip Talent

CHALLENGES

Capital Intensive Nature

Knowledge Gap

Talent Acquisition & Retention

Supply Chain

Low R&D

High Competition

KEY FOCUS AREAS

Fabless Startups & IP Creation

Manufacturing & Testing Services

Knowledge Transfer

Incubator & Accelerators

Investor & Funding

IP Protection

GOVERNMENT INITIATIVES & POLICIES

Make In India Campaign

Electronics Manufacturing Scheme

Designed Linked Scheme

Modified Programme For Semiconductors & Display Fab Ecosystem

Source: Inc42, Secondary Sources

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The IP Gap: Only One-Third Of Indian Semiconductor Startups Are Working On Intellectual Property (IP)

Semiconductor IP
8.6%

Startups that create and design their own proprietary semiconductor technologies and designs.

Seimiconductor IP & Service
25.9%

Startups that possess their own semiconductor IP and also offer a range of semiconductor-related services.
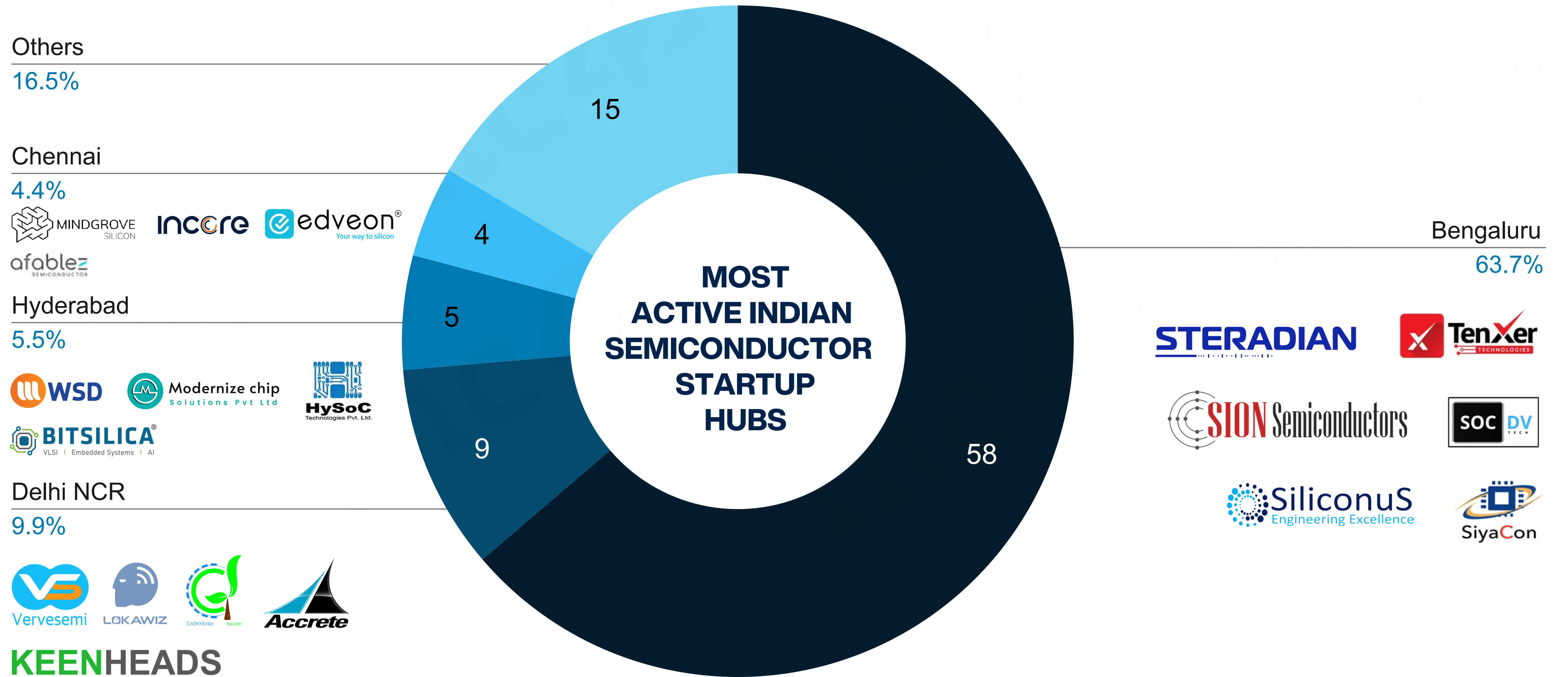
Semiconductor Service Startups In India

8.6%

25.9%

65.5%
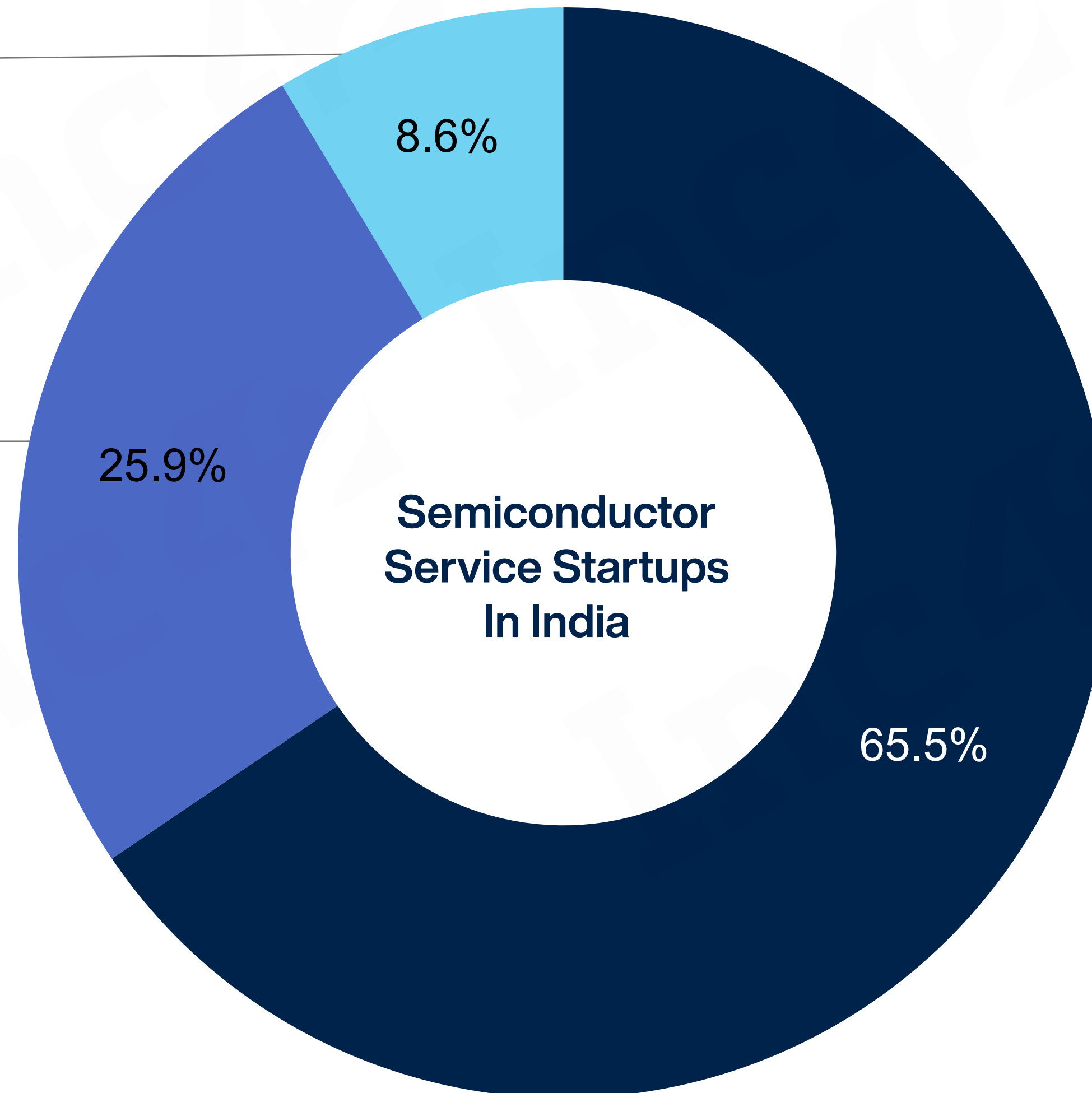
Pure Play Semiconductor Services
65.5%
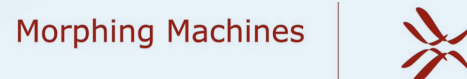
Startups that provide semiconductor-related services without owning or developing their own IP.

Source: Inc42, Secondary Sources

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Bengaluru Takes Center Stage In India's Semiconductor Startup Arena

MOST ACTIVE INDIAN SEMICONDUCTOR STARTUP HUBS

Others
16.5%
15

Chennai
4.4%
4

Hyderabad
5.5%
5

Delhi NCR
9.9%
9

Bengaluru
63.7%
58

Notable Indian Semiconductor Startups

Startup	Founded In	Headquarter	Target Industries	Description
AGNIT	2019	Bengaluru	Telecommunication, Drone, Power Electronics	Specialising in GaN materials and electronic components for radio-frequency applications, AGNIT's products hold prominence in drone and telecommunications sectors, offering tailored solutions for critical requirements.
incore	2018	Chennai	Automotive, Storage, Security, Edge AI	Incore, a processor design company, is revolutionising industries with its innovative RISC-V-based solutions.
MINDGROVE	2021	Chennai	Security, Smart Watch, Thermal Printer, Biometric Module	Mindgrove designs, scalable, and reliable System-on-Chips (SoCS) in India. These high-performance RISC-V chips can be leveraged in power-constrained environments such as consumer electronics, defense.
Morphing Machines	2005	Bengaluru	AutoMobile, Telecommunication, Geno Analytics	Morphing Machines is a fabless semiconductor IP products and solutions company focusing on innovations centered around REDEFINE™, a runtime reconfigurable many-core processor.
Oakter ADVANCED INDIAN ODM	2019	Delhi NCR	Consumer Electronics, AutoMobile	Oakter is an Original Device Manufacturer (ODM) that designs and produces electronic smart devices. In 2019, the company made a strategic shift to contract manufacturing. Since then, Oakter has successfully fulfilled numerous B2B contract manufacturing orders.

Source: Inc42, Secondary Sources
Note: This not an exhaustive list

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Notable Semiconductor Plants In India

| Company	Year	Location	Value	Use Case
Micron Technology, Inc.	2023	Sanand, Gujarat	INR 22,000 Cr	Testing, and packaging plant (ATMP)
Tata Group, PSMC	2024	Dholera, Gujarat	INR 91,000 Cr	Semiconductor fab
Tata Semiconductor Assembly and Test Pvt Ltd (TSAT)	2024	Jagiroad, Assam	INR 27,000 Cr.	Assembly and test facility
CG Power, Japan's Renesas	2024	Sanand, Gujarat	INR 7,600 Cr	Semiconductor plant

Source: Inc42, Secondary Sources
Note: These are most recent semiconductor plants In India| This is not an exhaustive list

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A Deep Dive Into Semiconductor Value Chain: Global & India
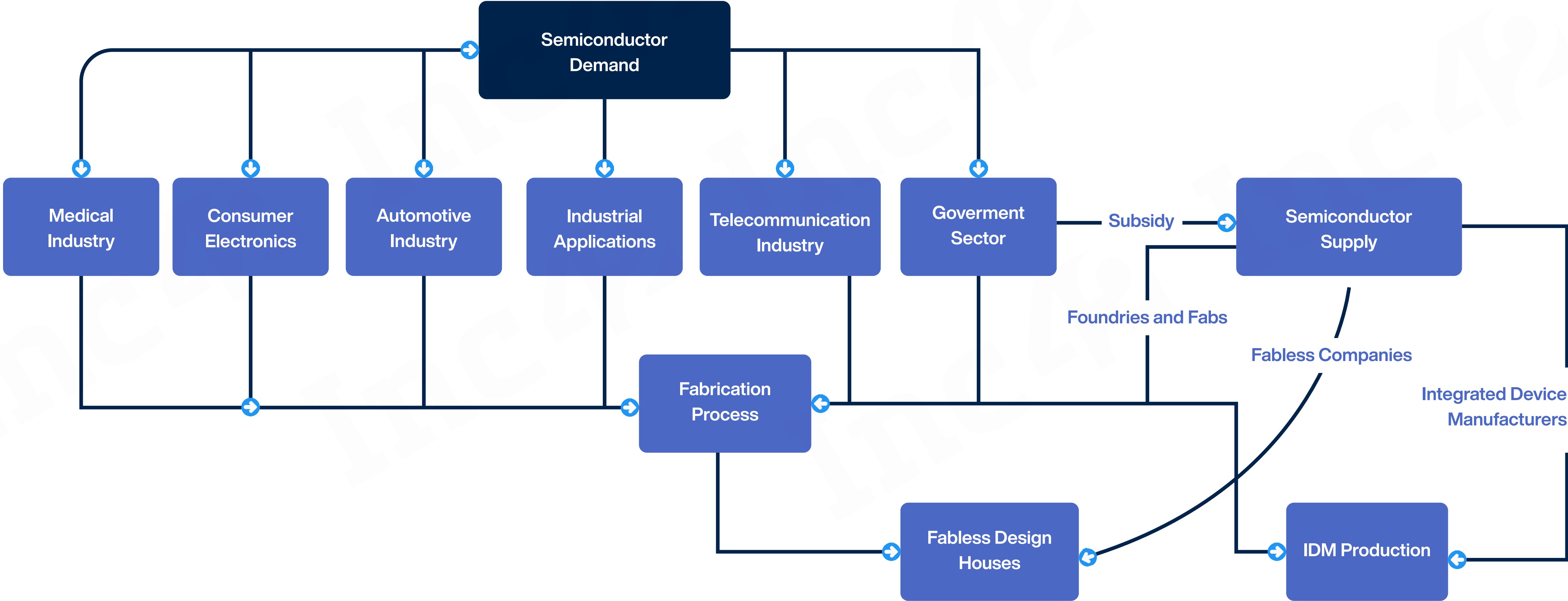
The Global Semiconductor Value Chain
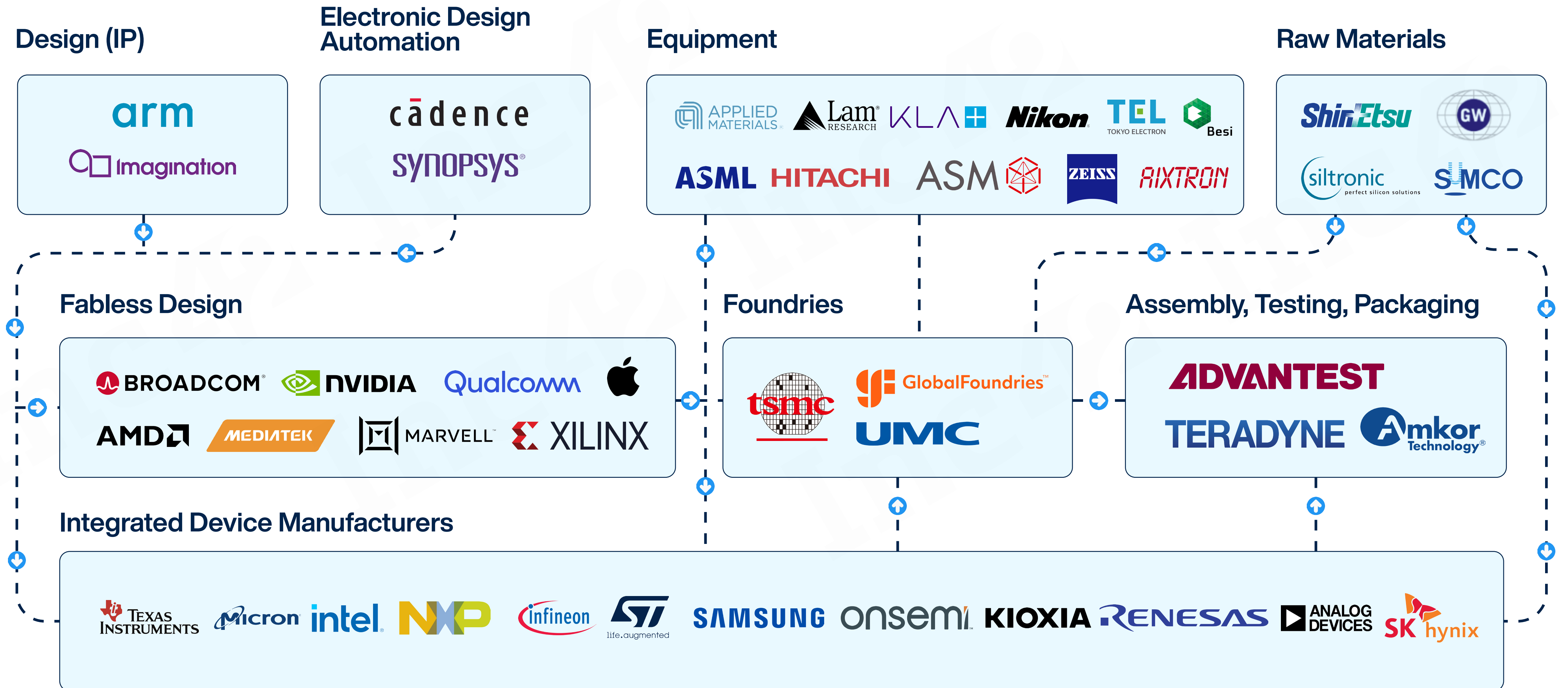
Source: Quartr

The Demand & Supply Value Chain

Source: Inc42, Secondary Sources

The Semiconductor Use Cases

MEMORY

Memory chips function as temporary storage units for data, facilitating the transfer of information

MICROPROCESSORS

Microprocessors, also known as CPUs, power computing devices with multiple cores, serving as the primary computation units for various applications.

GPUs

GPUs, responsible for rendering graphics on computer screens, have evolved beyond their initial purpose. Today, they serve as versatile processors, involved in tasks such as cryptocurrency mining and supporting AI applications

COMMODITY INTEGRATED CIRCUITS

Commodity integrated circuits (CICs) handle repetitive processing tasks, while Application-Specific Integrated Circuits (ASICs) are tailored for specific functions. System on a Chip (SoC) represents the latest advancement, integrating all necessary electronic components for an entire system into a single chip.
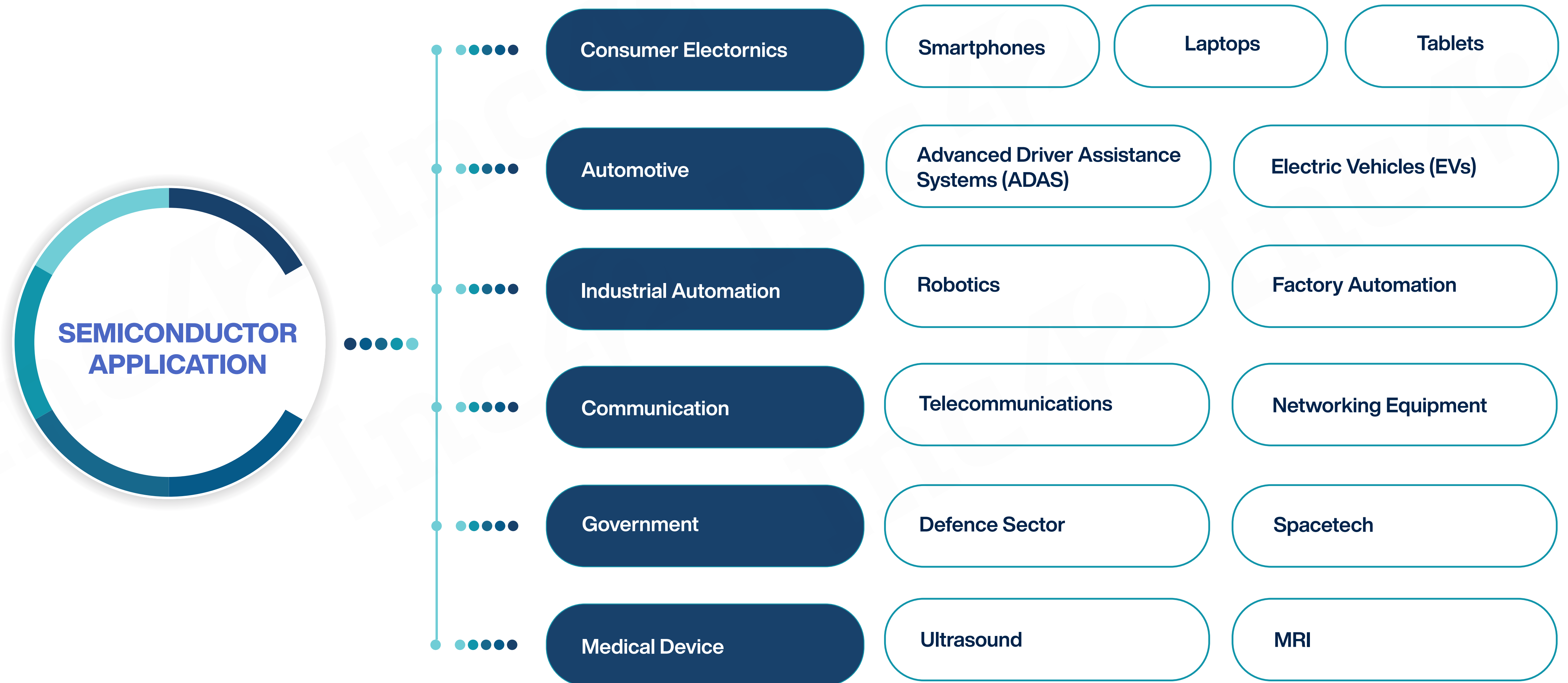
ANALOG CHIP

Analog chips, though somewhat replaced by digital ones, are still vital for handling certain signals and acting as sensors due to their continuous voltage and current variations.
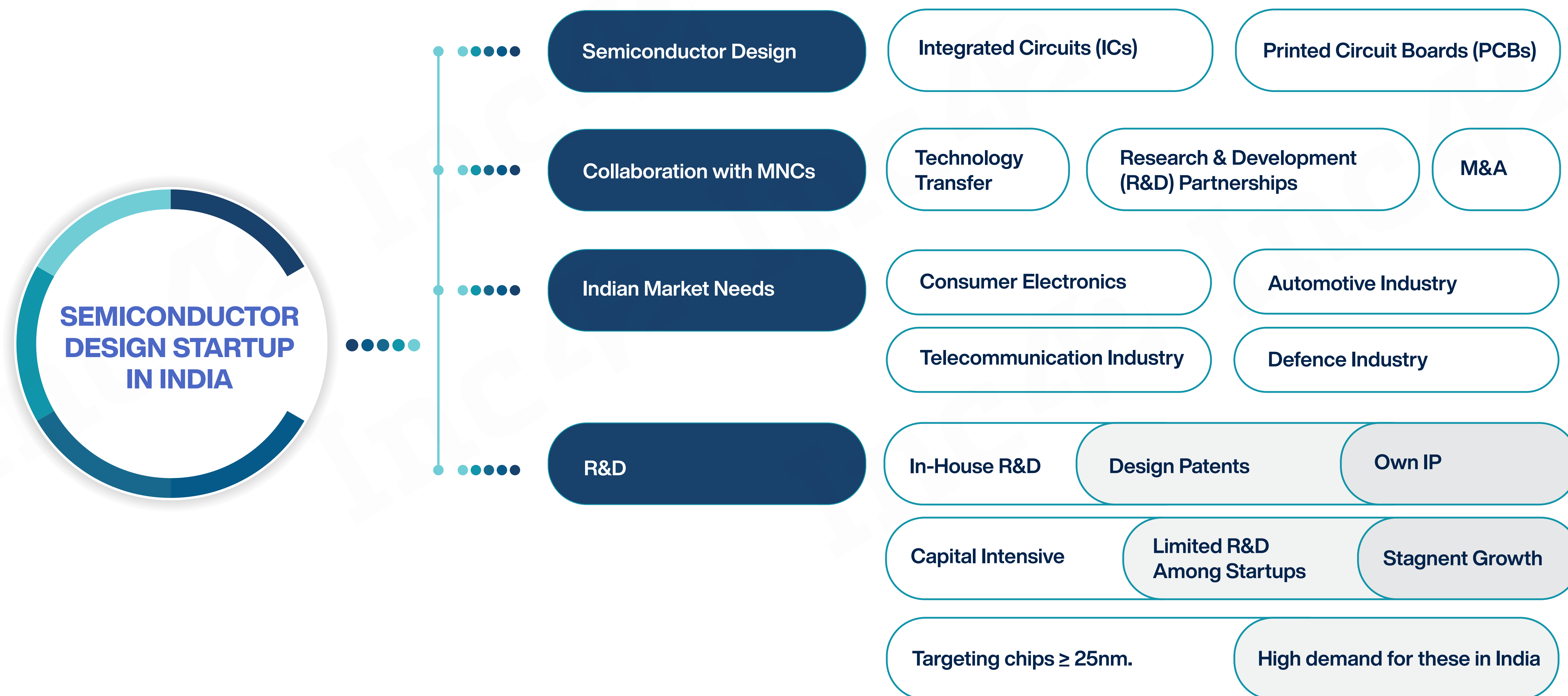
MIXED CIRCUIT

Mixed-signal semiconductors are primarily digital chips enhanced with technology to accommodate both analog and digital circuitry.

Source: Inc42, Secondary Sources

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Key Applications Of Seminconductors In India

SEMICONDUCTOR APPLICATION

| Consumer Electornics | Smartphones | Laptops | Tablets |

| Automotive | Advanced Driver Assistance Systems (ADAS) | Electric Vehicles (EVs) |

| Industrial Automation | Robotics | Factory Automation |

| Communication | Telecommunications | Networking Equipment |

| Government | Defence Sector | Spacetech |

| Medical Device | Ultrasound | MRI |

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Semiconductor Design Startup Ecosystem In India

SEMICONDUCTOR DESIGN STARTUP IN INDIA

Semiconductor Design
- Integrated Circuits (ICs)
- Printed Circuit Boards (PCBs)

Collaboration with MNCs
- Technology Transfer
- Research & Development (R&D) Partnerships
- M&A

Indian Market Needs
- Consumer Electronics
- Automotive Industry
- Telecommunication Industry
- Defence Industry

R&D
- In-House R&D
- Design Patents
- Own IP
- Capital Intensive
- Limited R&D Among Startups
- Stagnent Growth
- Targeting chips ≥ 25nm.
- High demand for these in India
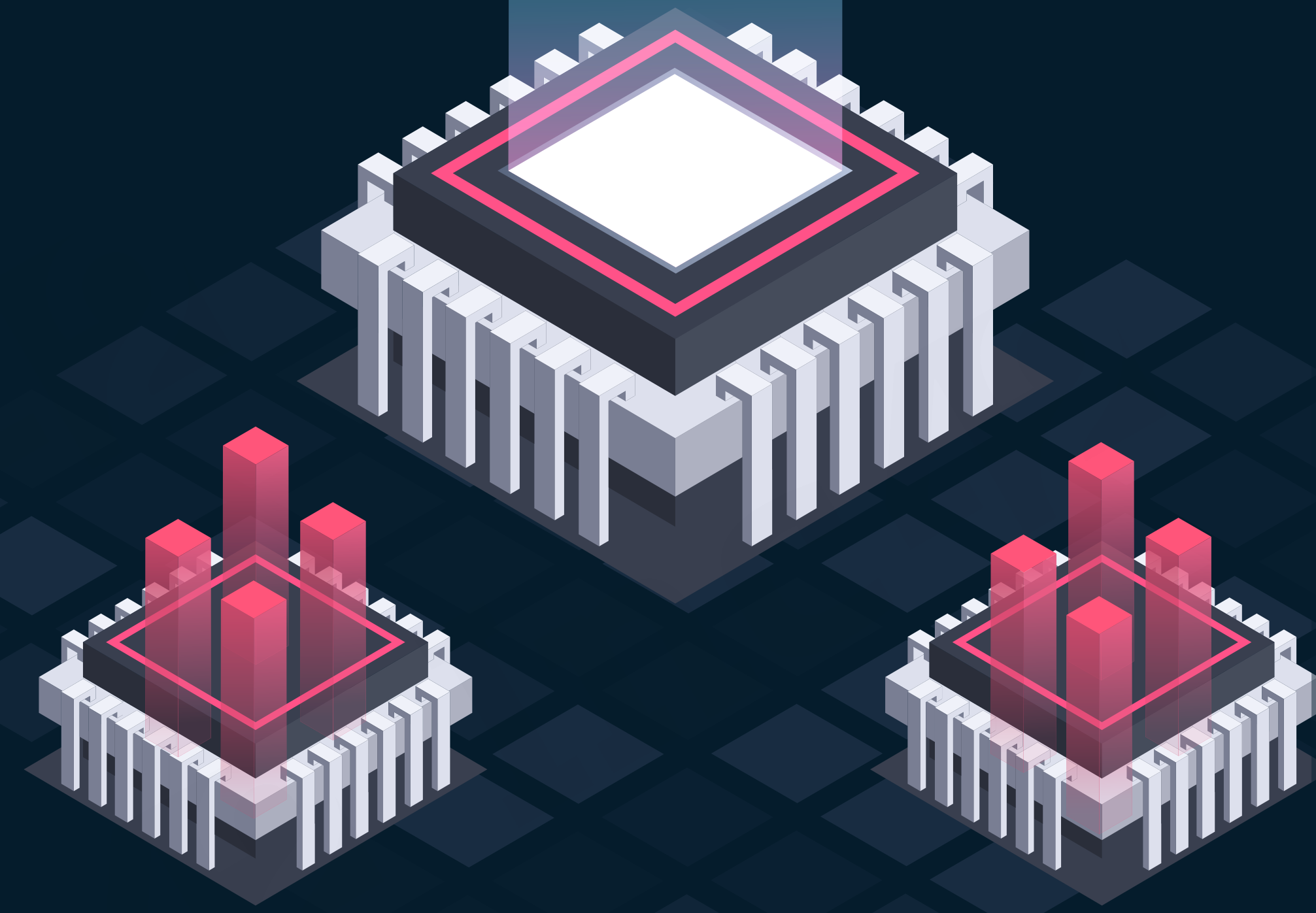
Source: Inc42, Secondary Sources

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India Opens More Opportunity For Semiconductor Startups In Design

BOTTLENECKS IN FABRICATION & ASSEMBLY

* Semiconductor fabrication and assembly is primarily a capital intensive area, and is largely dominated by taiwanese players

* New opportunities are mostly emerging for Indian corporates, and foreign companies

* Razor thin margins

* Need for collaboration since knowledge gap is very high

* Supply chain issue

ADVANTAGES IN DESIGNING SEMICONDUCTOR

* Designing semiconductors often doesn't require significant capital investment

* Offers more customisation opportunities

* India has more than 20% design workforce and labour is available for affordable prices

* High profits margins

Source: Inc42, Secondary Sources

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Semiconductor Services In India & Opportunities For Indian Startups

India's Silicon Symphony: India's Path In The Semiconductor Services Supply Chain

		In Brief	Key Players	Challenges
1	**Design & Development**	Design and development of semiconductor chips and systems	TATA ELXSI, wipro, HCLTech	Limited domestic demand, high capital costs
2	**Fabrication**	Manufacturing of semiconductor devices	इसरो isro, HSMC	Limited number of fabrication plants, dependence on imports
3	**Packaging & Testing**	Packaging and testing of semiconductor devices	TATA ELXSI, wipro, HCLTech	Limited number of packaging and testing facilities, high capital costs
4	**Assembly & Manufacturing**	Assembly and manufacturing of electronic devices	FOXCONN, Dixon The brand behind brands	High labor costs, competition from other EMS providers
5	**Logistics & Distribution**	Distribution and logistics of electronic devices	DHL, FedEx, BLUE DART	High logistics costs, complexity of supply chain management

Source: Inc42, Secondary Sources

Semiconductor Services In India: The Use Cases & Opportunities

Design Services

- ASIC/SoC/FPGA Design
- Embedded Software Design
- Analog, Digital & Mixed-Signal Design
- IP Core Integration

Verification & Validation

- Design Verification
- Functional Verification
- Validation
- Simulation (virtual model)

Assembly & Testing

- Assembly Services (Die Bonding, Wire Bonding, Encapsulation)
- Advanced Packaging
- Wafer Level Test
- Package Level Test
- Design for Test (DFT)
- Post-Silicon Validation
- Automated Test Equipment (ATE) Development
- In-Circuit Test (ICT)

Source: Inc42, Secondary Sources

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Semiconductor Services Startup Landscape In India

India's Path To Tech Sovereignty: The Importance Of Semiconductor Services

Self-reliance: Mitigate Risks and Gain Control

Reduced Vulnerability:
- Supply Chain Disruptions.
- Price Fluctuations.
- Geopolitical Tensions

Empowerment:
- Control Chip Production
- Negotiate from a Stronger Position

Security: Protecting Critical Infrastructure

National Security:
Defense systems and weaponry
Communication networks
Power grids and other vital infrastructure
Reduced Reliance on Foreign Technology

Economic Boost: Jobs, Investment, and Innovation

High-Value Jobs
- Chip designers
- Chip Development Engineers
- Researchers

Investment Magnet:
- MNC collaboration and access to Indian innovation.
- Increased domestic investment in R&D and manufacturing infrastructure.

Innovation Engine
- chip designs tailored to India's specific needs and applications.
- Advancements in related fields like electronics, computing, and communication technologies.

Semiconductor Intellectual Property (IP) commands significantly greater financial resources compared to fabrication or Outsourced Semiconductor Assembly and Test (OSAT). For instance, NVIDIA, a leading semiconductor IP company, boasts a market capitalization of approximately $2.37 Tn+, while TSMC, the world's largest semiconductor fabrication company, holds a market cap of $806 Bn+.Given this discrepancy, there is a prevalent consensus among the Indian intellectual community that Indian firms should focus on establishing their intellectual property in semiconductors rather than simply becoming an outsourced manufacturing hub.

Source: Inc42, Secondary Sources

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The Dawn Of AI Semiconductor & The Opportunity For India
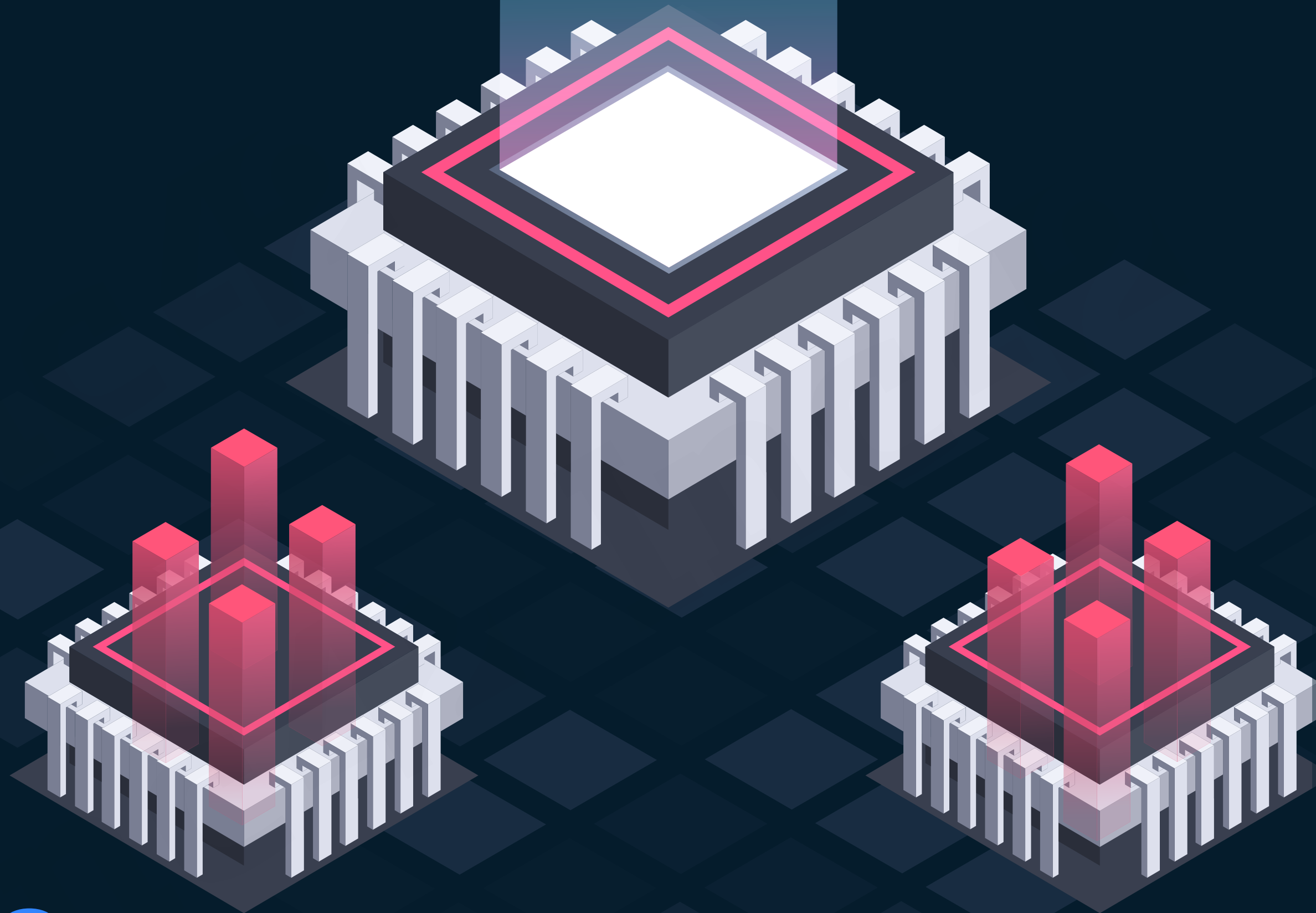
From CPUs To AI Processors: A New Era Of Computing

Year	Milestone	Description	Impact on AI Industry
1947	Invention of Transistor	First commercial semiconductor, replacing vacuum tubes	Enabled smaller, faster, and more efficient computing systems
1971	First Microprocessor (Intel 4004)	Enabled development of personal computers	Paved the way for AI computing
1985	Early Mover In AI Chip (Intel 80170)	Designed specifically to compute neural functions	Early beginnings of AI-specific semiconductors
1990s	AI Winter	Decline in AI research funding and interest	Slowed AI development, but led to renewed focus on AI in the 2000s
1999	NVIDIA GeForce 256 GPU	Emergence of GPUs as key component in AI computing	Accelerated AI development, particularly in computer vision and machine learning
2008	IBM TrueNorth Neurosynaptic System	Custom-designed chip for AI workloads	Marked the beginning of specialised AI semiconductors
2016	Google Tensor Processing Unit (TPU)	Custom ASIC for machine learning workloads	Demonstrated the potential of custom AI semiconductors
2017	NVIDIA Volta GPU	Featured dedicated Tensor Core for AI acceleration	Further accelerated AI development, particularly in deep learning
2020s	NVIDIA Ampere GPU	Featured dedicated Tensor Core for AI acceleration	Continued advancements in AI computing, particularly in datacenter and edge applications
2020s	Emergence of Neuromorphic Chips (e.g., Intel Loihi 2, BrainScaleS)	Inspired by biological neural networks, promising efficient AI computing	Potential to revolutionise AI computing, particularly in edge devices
2020s	Development of New AI-specific Architectures (e.g., Spiking Neural Networks, Analog AI)	Exploring new approaches to AI computing, promising improved efficiency and scalability	Potential to further accelerate AI development and adoption

Source: Inc42 Analysis, Secondary Sources
Note:This is not an exhaustive list of milestones in the AI semiconductor business.

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Global AI Semiconductor Market To Reach $190 Bn+ By 2030

Market Opportunity ($ Bn) / % Share Of Total Market

Year	2023	2024	2025	2026	2027	2028	2029	2030
Global AI Semiconductor ($ Bn)	49	64	83	109	125	144	166	192
% Share In Total Semiconductor Market	7%	9%	11%	13%	14%	15%	17%	18%

- Global AI Semiconductor ($ Bn)
- % Share In Total Semiconductor Market
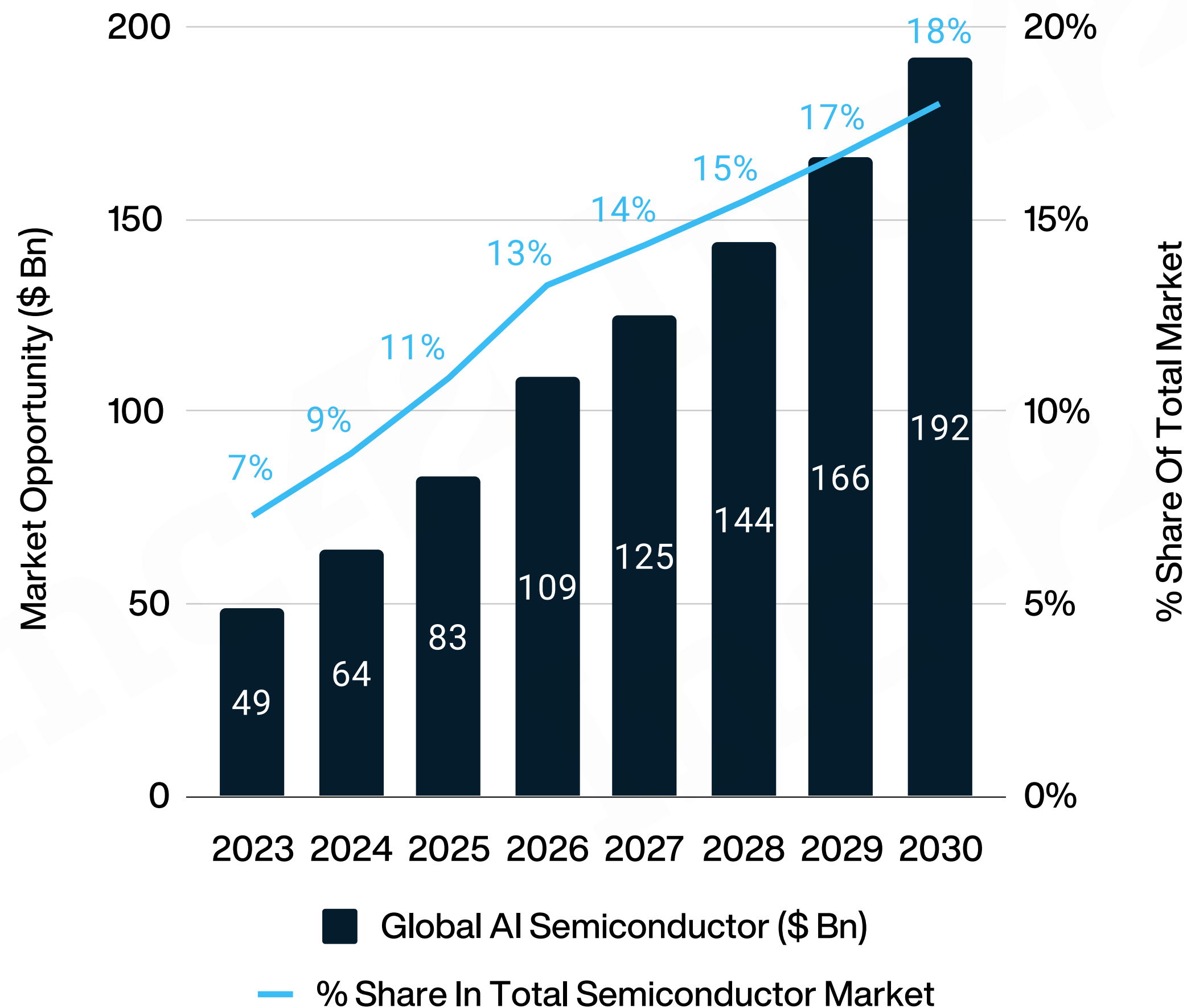
Key Growth Drivers

Surge In Edge AI Processing Demand
The escalating requirement for real-time data processing at the edge, as opposed to centralised cloud servers, propels the demand for edge AI processing. This trend is anticipated to persist, fueling the necessity for specialised AI semiconductors capable of managing intricate computations essential for edge AI processing.

Advancements In Deep Learning & Neural Networks
Rapid progressions in deep learning and neural networks facilitate the creation of sophisticated AI applications, necessitating more potent and efficient AI semiconductors. With AI applications becoming increasingly intricate, the call for high-performance AI semiconductors is set to surge.

Proliferation Of AI-Powered Devices
The prevalence of AI-driven devices like smart speakers, smart home gadgets, and autonomous vehicles propels the demand for specialised AI semiconductors. As AI technology permeates various sectors, the requirement for high-performance, energy-efficient AI chips is poised to escalate, driving the demand for AI semiconductors.

Source: Inc42 Analysis, McKinsey
Note: The distinction of AI and non-AI semiconductors is based on McKinsey's definition.

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$21 Bn+ The Market Opportunity For AI Semiconductor In India By 2030

Market Opportunity ($ Bn)

- 25
- +7x
- 21 (2030)
- 20
- 15
- 10
- 5
- 3 (2023)
- 0

2023   2030
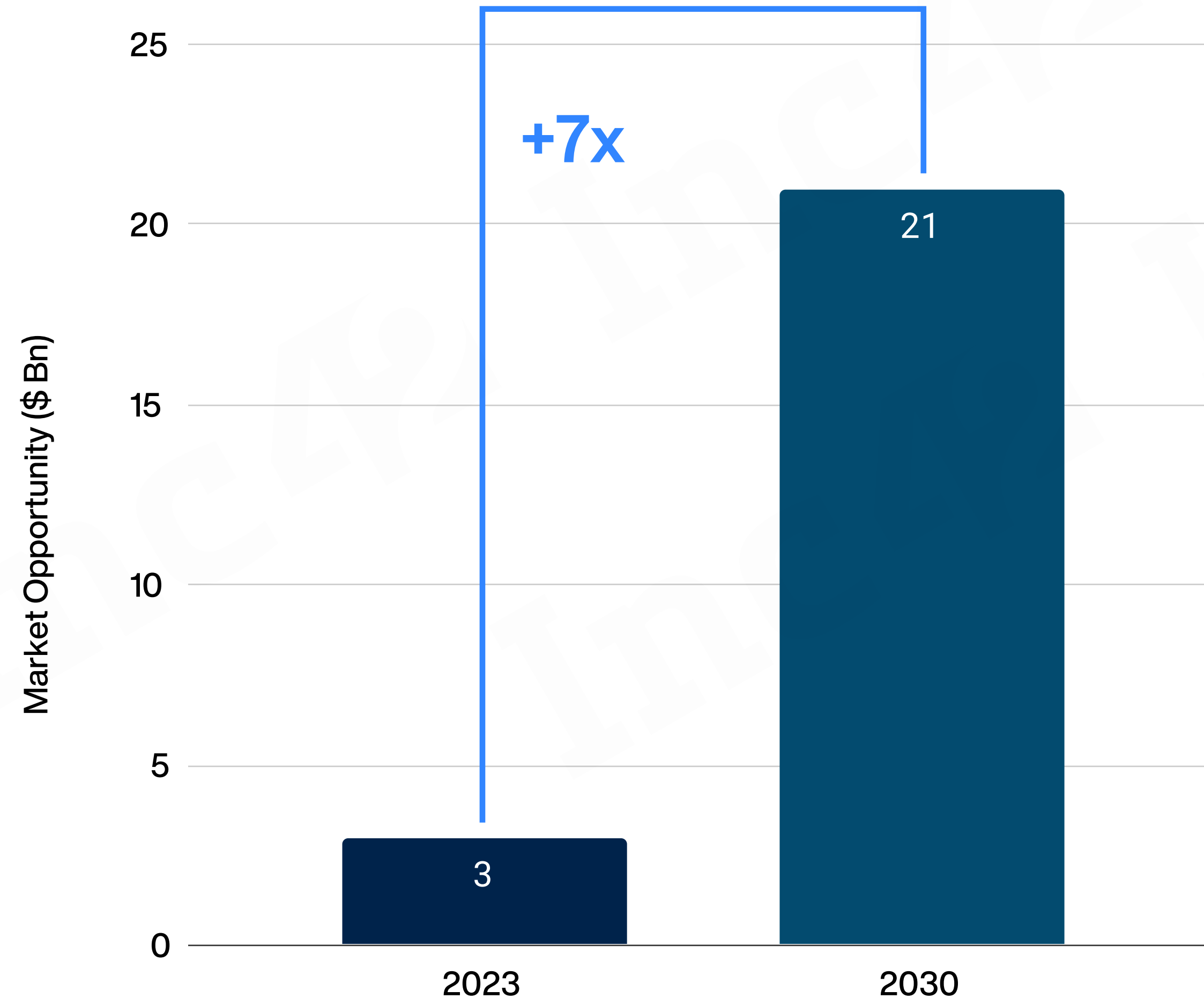
Key Growth Drivers

US-China Relations

Amid escalating tensions between the US and China, India emerges as a favored destination for American semiconductor companies. Initiatives like Make In India and Design Linked Incentive (DLI) have piqued the interest of giants like Micron Technology, Microchip Technology, and Texas Instruments, prompting them to contemplate establishing manufacturing facilities in the country.

Focus On Smart Cities & Infrastructure Development

AI is set to play a pivotal role in realising the Indian government's vision of developing fully integrated smart cities. AI technology is anticipated to underpin crucial functions such as connectivity, traffic management, and crime response, among others, facilitating the transformation of urban infrastructure.

Growing Adoption Of AI-Powered Consumer Devices

The Indian consumer electronics market is experiencing a surge in demand for AI-powered devices, including smart speakers, smart home gadgets, and autonomous vehicles. This upward trend is projected to persist, thereby fueling the demand for AI semiconductors across the Indian market.

Source: Inc42 Analysis, McKinsey
Note: The total addressable market (TAM) is estimated based on the share of global AI semiconductor market that Indian enterprises can tap in the given time intervals.

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Types Of AI Chipset & Their Applications

Types Of AI Chipset & Their Applications	Description	Applications
GPU (Graphics Processing Unit)	High-performance, parallel processing for machine learning and deep learning	Computer Vision, Natural Language Processing, Autonomous Vehicles
TPU (Tensor Processing Unit)	Custom-built for machine learning and deep learning, optimised for TensorFlow	Cloud-based AI, Data Centers, High-Performance Computing
ASIC (Application-Specific Integrated Circuit)	Custom-designed for specific AI applications, optimised for performance and power efficiency	Edge AI, IoT Devices, Autonomous Vehicles
FPGA (Field-Programmable Gate Array)	Reconfigurable hardware for adaptive AI applications, optimised for flexibility and performance	Edge AI, IoT Devices, Aerospace and Defense
Neuromorphic Processor	Inspired by the human brain, mimics neural networks for efficient AI processing	Edge AI, Robotics, Autonomous Systems
AI Accelerator	Specialised hardware for accelerating AI workloads, optimised for performance and power efficiency	Data Centers, Cloud Computing, High-Performance Computing
Edge AI Chip	Optimised for low-power, high-performance AI processing at the edge	Smart Home Devices, IoT Devices, Autonomous Vehicles
Neural Network Processor	Designed for efficient processing of neural networks, optimised for performance and power efficiency	Computer Vision, Natural Language Processing, Robotics

Source: Inc42
Note: This is not an exhaustive list, and new types of AI specialised semiconductors are emerging as the technology advances.

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AI's Secret Sauce: Tensor Chips Vs. General Purpose Semiconductors

	AI Tensor Chips (TPUs/GPUs)	Traditional CPU/GPU Chips
Application	Specialised for machine learning, AI, and deep learning	General-purpose computing, gaming, and graphics processing
Architecture	Custom-designed architecture for matrix multiplication and tensor operations	Sequential processing, completing one calculation at a time.
Memory Hierarchy	Optimised for large, sparse matrices and tensor storage	Cache-based memory hierarchy
Processing Units	Custom-designed processing units for matrix multiplication and tensor operations	General-purpose CPU cores or GPU cores
Memory Bandwidth	High-bandwidth, low-latency memory interfaces (e.g., HBM2)	High-bandwidth memory interfaces (e.g., PCIe)
Specialised Instructions	Custom-designed instructions for matrix multiplication, convolution, and pooling	Not Applicable
Notable Products	NVIDIA H100, NVIDIA A100, AMD Alveo V70, AMD Instinct MI300 Series	Intel CPUs, AMD 7000 series GPUs (Gaming product line), NVIDIA RTX 40 series GPUs (Gaming product line)

Source: Inc42

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Opportunities For Indian Startups In AI Semiconductors

Opportunities	Description
AI Inference Hardware (IP)	Indian startups can focus on designing and developing low-power, high-performance AI chips for edge devices, such as smart home devices, autonomous vehicles, and wearables. Ola Krutrim is an early mover in this segment.
AI-Specific SoC (System-on-Chip) Design	AI-specific SoCs are custom-designed integrated circuits optimised for specific AI workloads, such as machine learning, computer vision, or natural language processing. AI-specific SoCs contain fixed-function hardware blocks, which are optimised for specific AI algorithms and models.
AI-Enabled Semiconductor Packaging	Startups can focus on developing AI-enabled solutions for optimising semiconductor packaging, including 3D stacking, wafer-level packaging, and fan-out wafer-level packaging.
Cloud Based AI Infrastructure	Indian startups can tap the AI cloud infrastructure opportunity by creating tailored solutions for local businesses. These include scalable AI platforms, efficient resource management tools, and cost optimisation. By doing so, they can drive AI adoption, enhance efficiency, and compete globally. Some notable startups working in this segment include: GPU.net and Models Lab.
FPGA (Field-Programmable Gate Array)	FPGAs are integrated circuits designed to provide high-performance computation with low power consumption. FPGAs' reprogrammability is anticipated to make them a preferred choice in fields such as data centres, autonomous vehicles, and computer vision, among others.

Source: Inc42
Note: This is not an exhaustive list of all applications

Inc42

Key Growth Drivers For Semiconductors In India

China Plus One Policy

Amidst the global restructuring marked by the persistent chip shortage and escalating geopolitical tensions, nations are increasingly recognising the need to diversify their supply chains. As countries actively seek alternatives to China, India's potential as an alternative destination gains prominence particularly in semiconductor sector

Growing Consumer Electronics Market

India stands out as a prominent player in the global electronics market, as evidenced by the establishment of manufacturing facilities by numerous prominent companies like Apple within its borders. It is projected that electronic manufacturing output will surpass $300 Bn by 2030 in India. Additionally, India ranks among the largest consumers of electronics globally, leading to a significant demand for semiconductors within the country.

Demand In Automobile Sector

The automotive sector is undergoing significant global transformations, marked by the rising prevalence of electric vehicles (EVs) and self-autonomous cars, driving a surge in semiconductor demand. India's automotive industry, valued at $222 Bn+ in 2022, anticipates further. These combined factors contribute to an increasing demand for semiconductors, which serve as essential components enabling advanced functionalities in modern vehicles, such as power management, sensor integration, and advanced driver assistance systems (ADAS).

The Rise Of Ai

AI has become ubiquitous worldwide, significantly impacting every sector with its continuous innovation, and its growth trajectory is poised to continue. This trend is mirrored in India, where AI adoption is substantial. The growth of AI is directly correlated with semiconductors, as semiconductor hardware is essential for AI utilization. The Indian AI semiconductor market is projected to reach $21 Bn by 2030. India is embracing AI across various industries, leveraging its transformative capabilities to enhance efficiency, productivity, and innovation.

Source: Inc42, Secondary Sources

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Government's Role In Fostering India's Semiconductor Boom

Semiconductor Fabs

The **Scheme for setting up Semiconductor Fabs in India** offers fiscal support to eligible applicants aiming to establish semiconductor wafer fabrication facilities in the country, attracting substantial investments. The fiscal support provided under this scheme varies based on the semiconductor technology node, with percentages of the project cost allocated accordingly: **Up to 50% for 28 nm or lower, up to 40% for above 28 nm to 45 nm, and up to 30% for above 45 nm to 65 nm.**

Display Fabs

The Scheme for setting up **Display Fabs in India** aims to attract investments for TFT LCD / AMOLED based display fabrication facilities, offering fiscal support of up to **50% of the project cost, capped at INR 12,000 Cr per Fab.**

Compound Semiconductor

The Scheme for setting up Compound Semiconductors / Silicon Photonics / Sensors Fab and Semiconductor Assembly, Testing, Marking, and Packaging (ATMP) / OSAT facilities in India provides fiscal support of **30% of the Capital Expenditure to eligible applicants for setting up such facilities.**

Design Linked Incentive (DLI) Scheme

This scheme offers financial incentives and design infrastructure support across various stages of semiconductor design development and deployment. This includes a **"Product Design Linked Incentive"** of up to 50% of eligible expenditure, **capped at INR 15 Cr per application**, and a "Deployment Linked Incentive" ranging from 6% to 4% of net sales turnover over 5 years, capped at INR 30 Cr per application.

Source: PIB

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Key Challenges In Semiconductor Sector In India

Fab Technology Gap & High Costs

India's semiconductor fabrication ecosystem predominantly relies on mature technologies such as 40 nm or older processes, while leading players operate at 5 nm and below. This creates a substantial performance and efficiency gap. Additionally, the high investment costs, typically ranging from $4 to $5 Bn or more, pose a significant hurdle in establishing fabs.

Competition To Enter The Global Semiconductor Market

The global semiconductor industry, dominated by established players, presents barriers for new entrants like India. India faces challenges in catching up with technological advancements, overcoming cost barriers, establishing credibility in a competitive market and shortage of skilled manpower in India's semiconductor manufacturing sector

Material Science Dependence And Supply Chain

High-end chip manufacturing relies heavily on specialised materials such as ultra-pure silicon wafers, most of which are currently imported, leaving India vulnerable to global supplier dynamics and price fluctuations.

R&D And Ip Protection

In this fast-paced sector, continuous innovation is imperative, demanding substantial R&D investment to address the technological gap. Moreover, the industry's reliance on innovation and robust IP protection poses challenges for India's IP regime. To attract companies and promote domestic R&D while safeguarding intellectual property rights, India must strike a delicate balance. Achieving this balance will be pivotal for India's competitiveness and growth in the semiconductor industry

Source: Inc42, Secondary Sources

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Key Trends In Semiconductor Sector In India

Trade Deficit & Self Reliance

India grapples with a pressing economic challenge stemming from its semiconductor trade deficit, with imports surging to $67.6 Bn in 2022. Semiconductors alone reached $15.6 Bn, nearly doubling from the previous year. The heavy reliance on imports, primarily from China, Hong Kong, and Singapore, highlights the critical need for increased domestic production. India aims to elevate local sourcing to 17% by 2026, with the goal of substantially reducing import dependency.The Indian government has prioritised initiatives like "Make In India" to address this issue.

Collaboration Between Indian And Foreign Companies

Indian corporations, multinational corporations (MNCs), and the government are collectively injecting significant investments into the semiconductor industry to fortify India's position in the global market. Major players such as Micron, Tata, and CG Power are leading this charge with substantial investments in semiconductor infrastructure.

Government Support

Government policies and initiatives are propelling India towards technological self-sufficiency and bolstering competitiveness in the semiconductor sector. With the central government committing to fulfilling 50% of semiconductor manufacturing setup costs, significant strides are being made. Additionally, several upcoming projects in the pipeline indicate a promising future for India's semiconductor industry, further solidifying its position on the global stage.

The Rise Of Design Startups

India contributes significantly to the global semiconductor integrated circuit (IC) design workforce, accounting for 20% of it. Moreover, there's a continuous rise in design startups in India, with over 100+ startups currently operating. The growth of these startups has surged by 2.4 times since 2014, and this trend is anticipated to continue upward. These startups cater to various industries such as automotive, electronics, and medicine,indicating a promising trajectory for India's semiconductor design landscape.

Source: Inc42, Secondary Sources

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