International activities in the field of Smart Sensors

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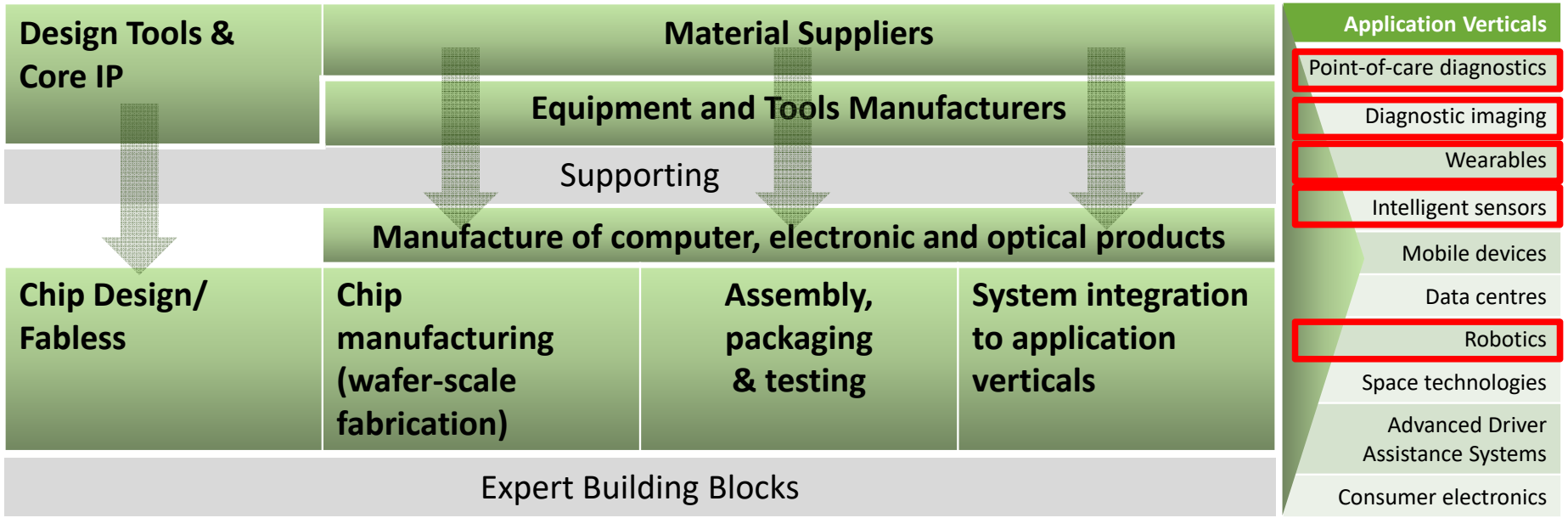
Problem Statement

- Review of the main EU and International activities and most promising technologies (targeting the leading semiconductor countries: USA, Japan, South Korea, Taiwan, Singapour, China, but other countries are also possible (e.g. Canada, India) in the field of Smart Sensors

- This will allow " Recommendations for international research cooperation" to be sent to the European Commission.

- Highlight the strengths of the main leading Institutions in each country/region (Universities, RTO, Industry in EU and leading Countries) in Smart Sensors.

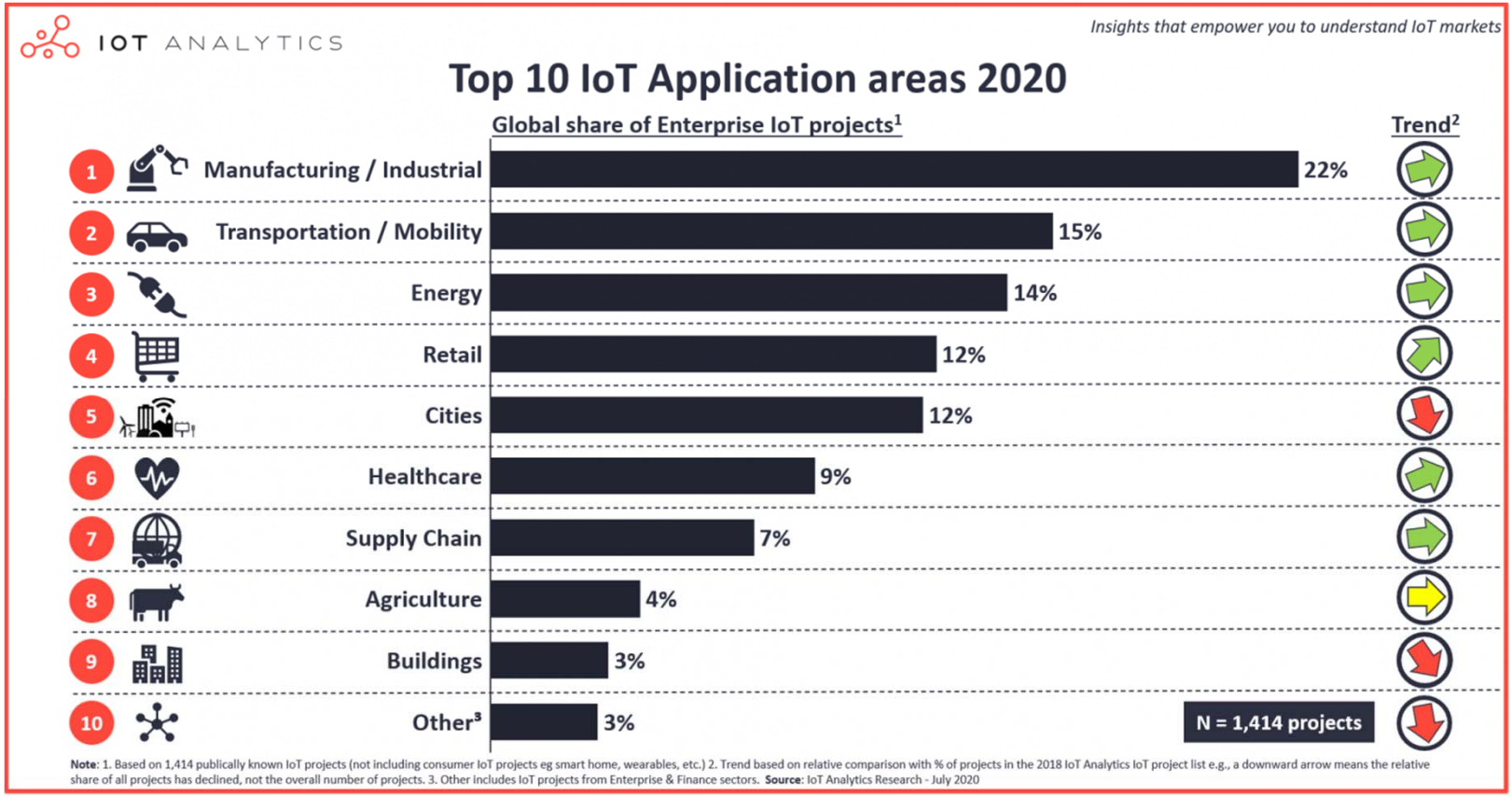
Semiconductor value chain and added value



Sensor Technologies

- MEMS
- CMOS
- ISFET, Electrochemical sensors, etc
- Optical Sensors (III-V, II-VI)
- Pressure, temp, motion, Flow…

Application Areas



Global Market

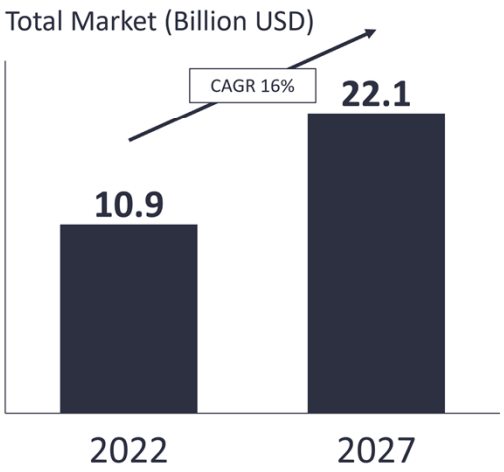
IOT ANALYTICS

January 2023

Your Global IoT Market Research Partner

Market Snapshot: IoT Sensor Market 2022

Market Size



Leading vendors (selection)

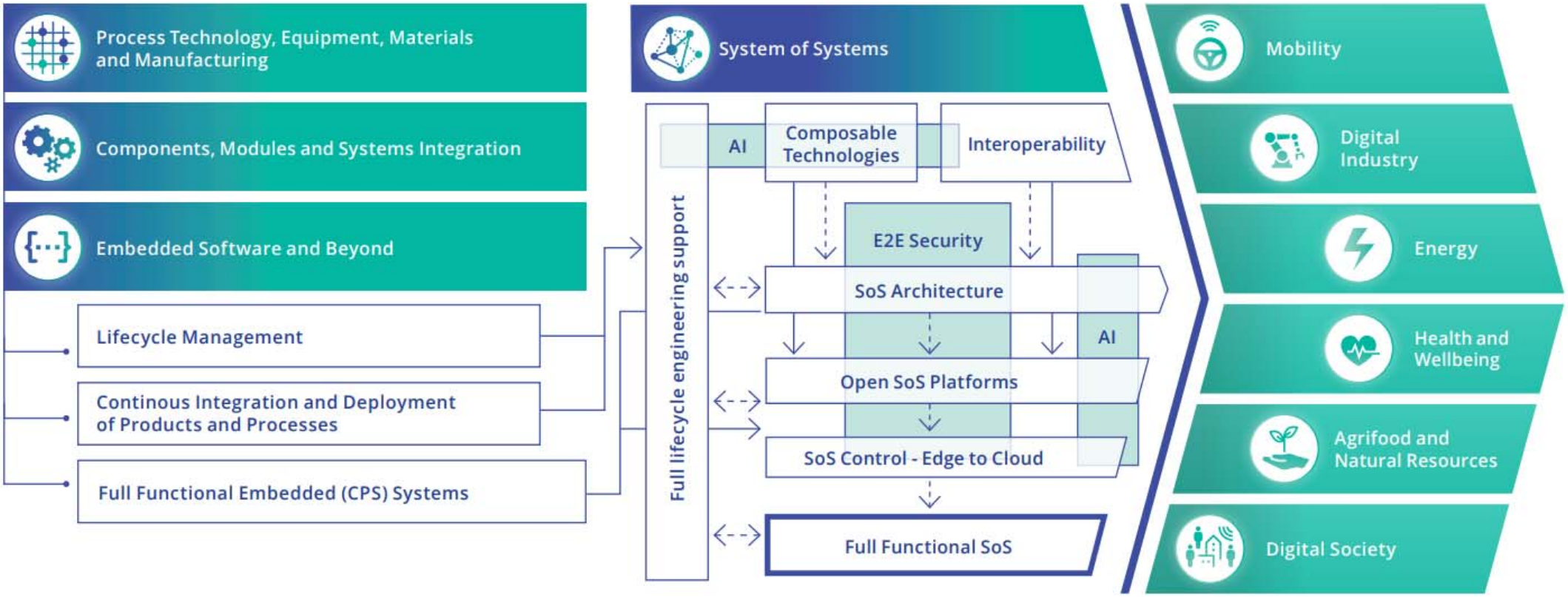
SONY, BOSCH Invented for life, ams, ST life.augmented, Teledyne Technologies Everywhere you look, OMNIVISION, Infineon + Cypress, SENSIRION, Sensata Technologies, ON, Honeywell, TE connectivity, muRata Innovator in Electronics, knowles, NXP, TDK, Analog Devices Ahead of what's possible, Amphenol, Broadcom, Texas Instruments, Renesas, AKM, SmartSens

5 trending technologies

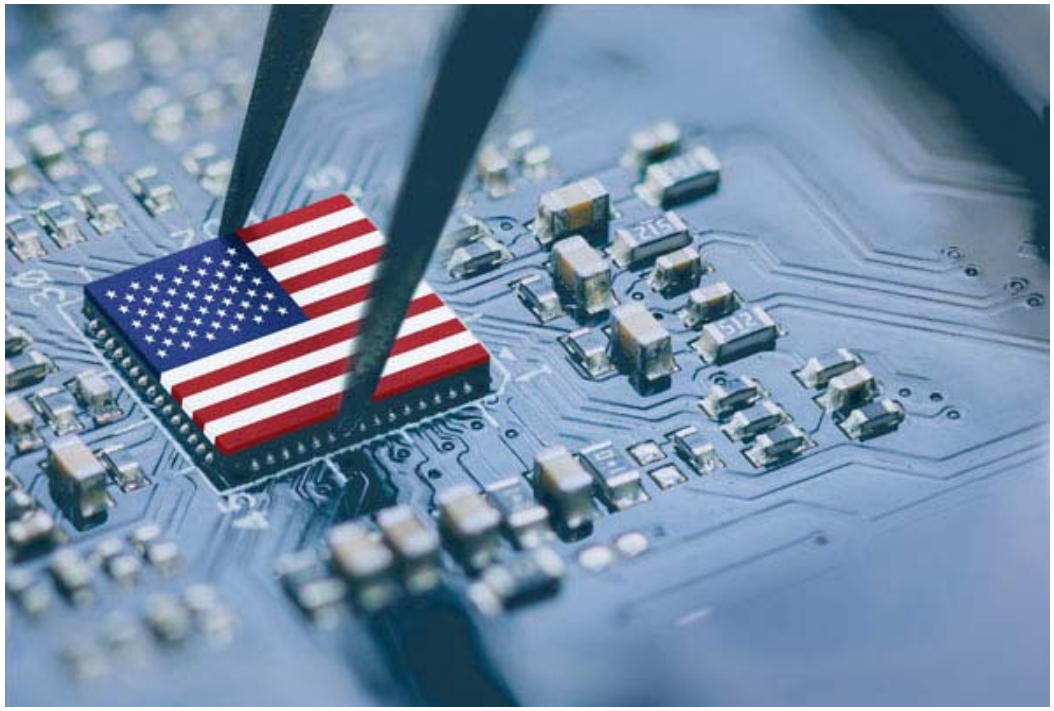
1	Smart sensors
2	Power-efficient sensors
3	Soft & Virtual sensors
4	Sensor fusion
5	Biosensors

Source: IoT Analytics Research, IoT Sensor Market Report 2022-2027. We welcome republishing of images but ask for source citation with a link to the original post and company website.

Major Challanges



U.S. Chips Act



U.S. Chips act

- Geopolitical - limit Beijing's capacity to develop cutting-edge chips and establish supremacy over strategic technology (This could lead to export controls for EU)
- The CHIPS Act, which provides $52 billion in subsidies to companies that manufacture chips in the US.
- The US is attempting to consolidate its pivotal role in the global semiconductor ecosystem and ensure that China is unable to create the most cutting-edge chips

U.S. Smart Sensor (academic)

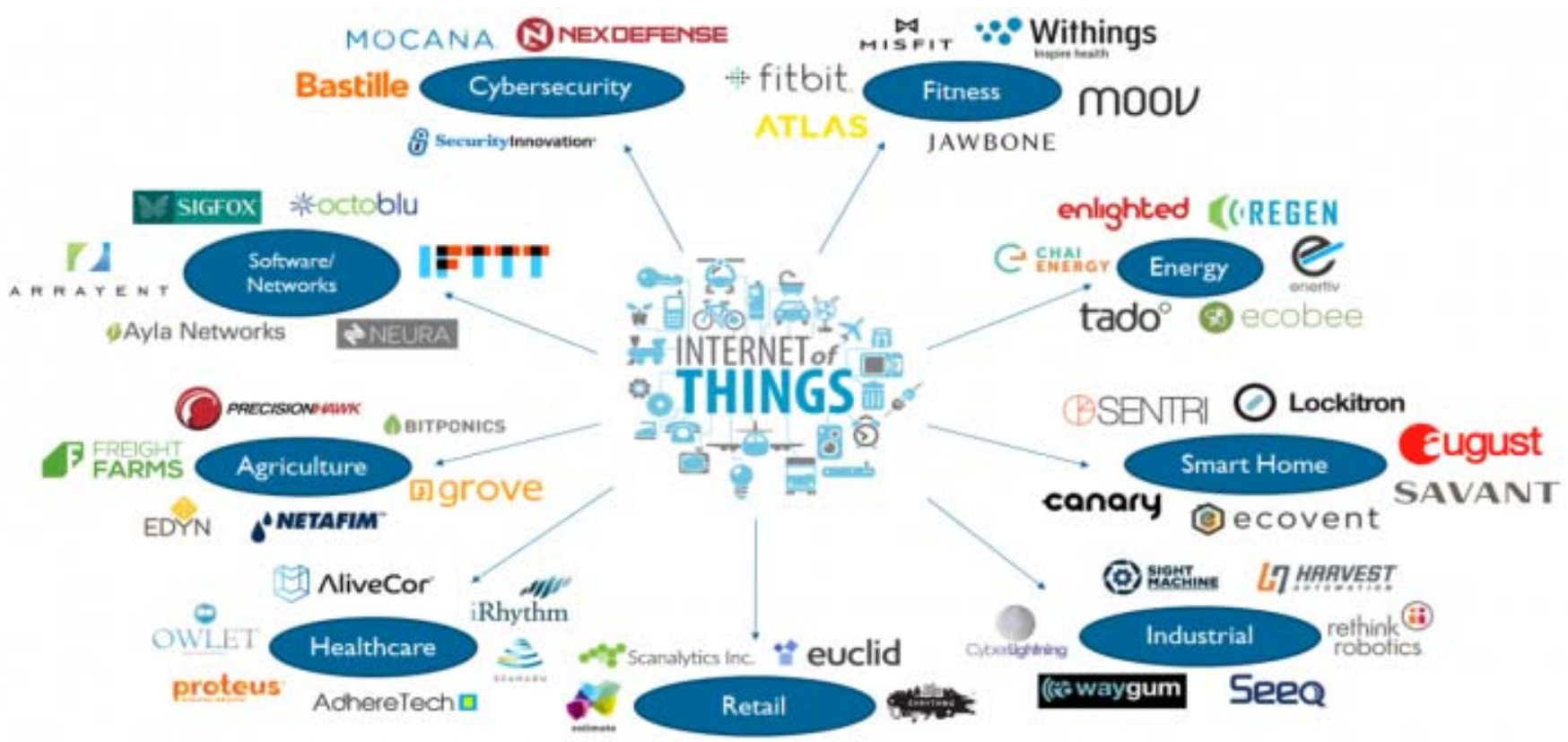
Key academic players – smart sensors

- Perdue University
- Ohio State University
- MIT
- Georgia Tech
- Stanford University
- University of California, Berkeley
- Carnegie Mellon University
- University of Michigan
- University of California, Los Angeles (UCLA)
- University of Texas at Austin
- University of Illinois at Urbana-Champaign
- University of Washington

- Sandia National Lab
- Oak Ridge National Laboratory (ORNL)
- Argonne National Laboratory
- Lawrence Berkeley National Laboratory (LBNL)
- Los Alamos National Laboratory (LANL)
- Pacific Northwest National Laboratory (PNNL)
- National Renewable Energy Laboratory (NREL)

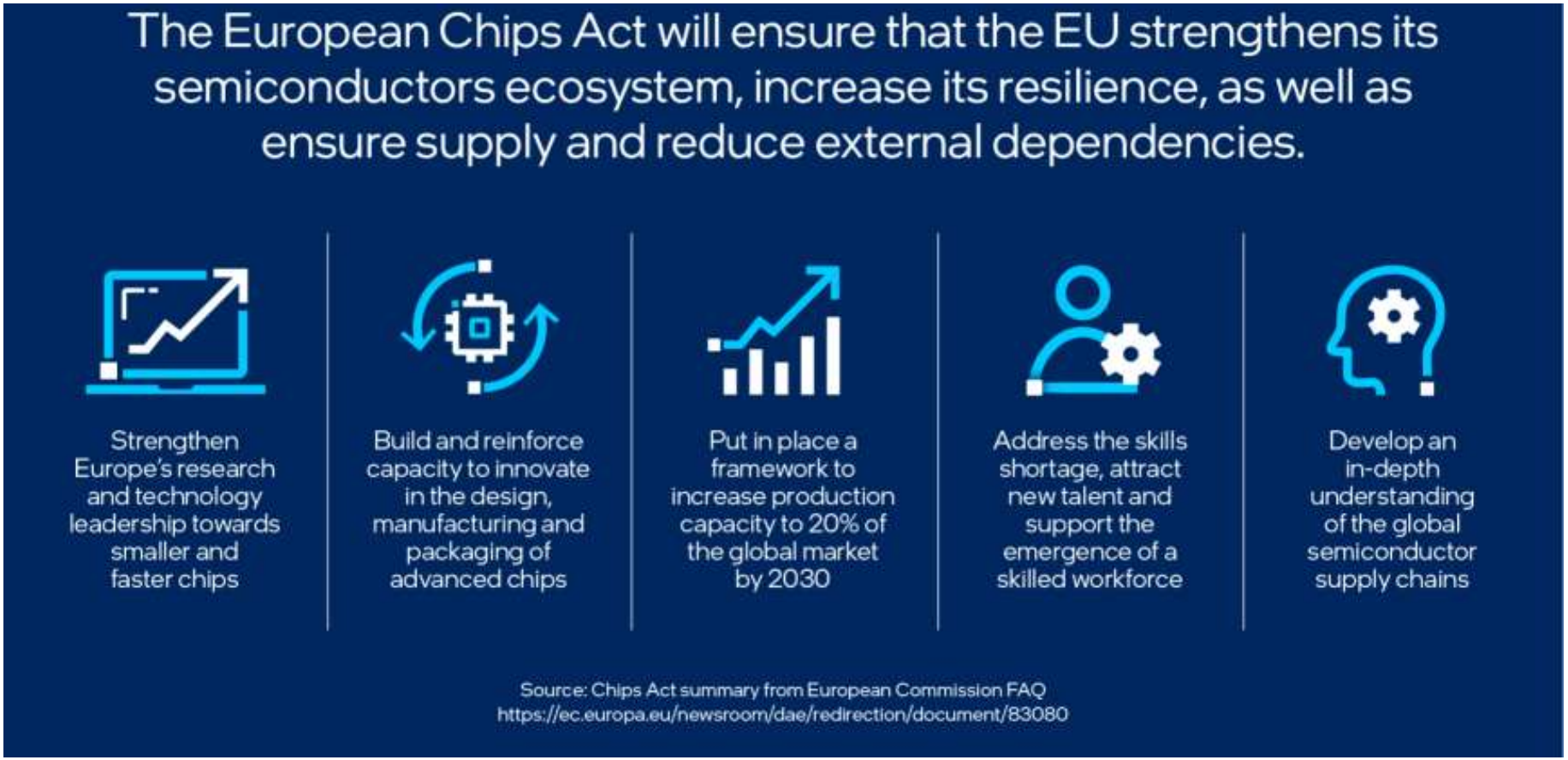
- National Institute of Standards and Technology (NIST)

Top IoT Leading Companies



Source https://www.iotnewsportal.com/

The EU Chips Act Objectives

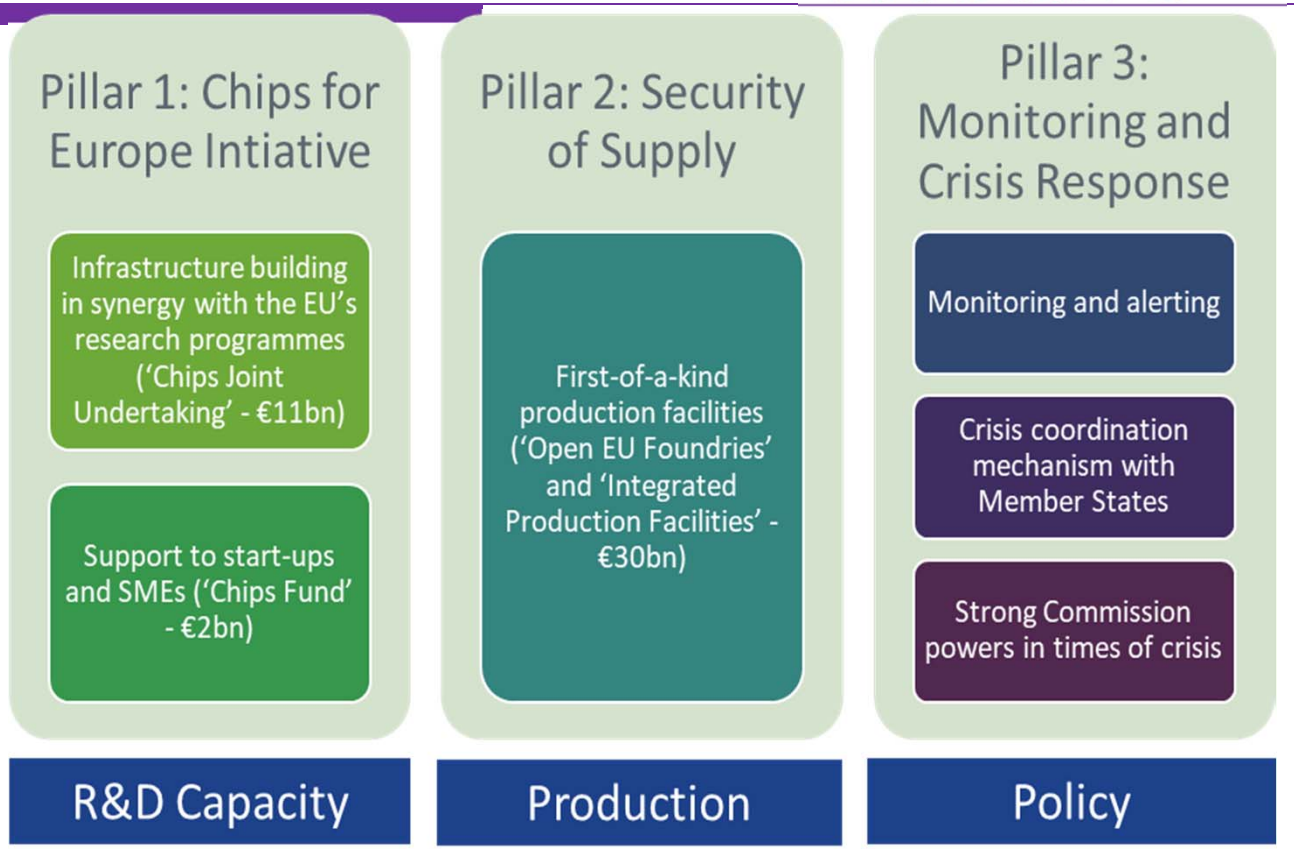


The EU Chips Act Objectives

Pillar 1 focuses on capacity building for cutting edge technologies, in particular:

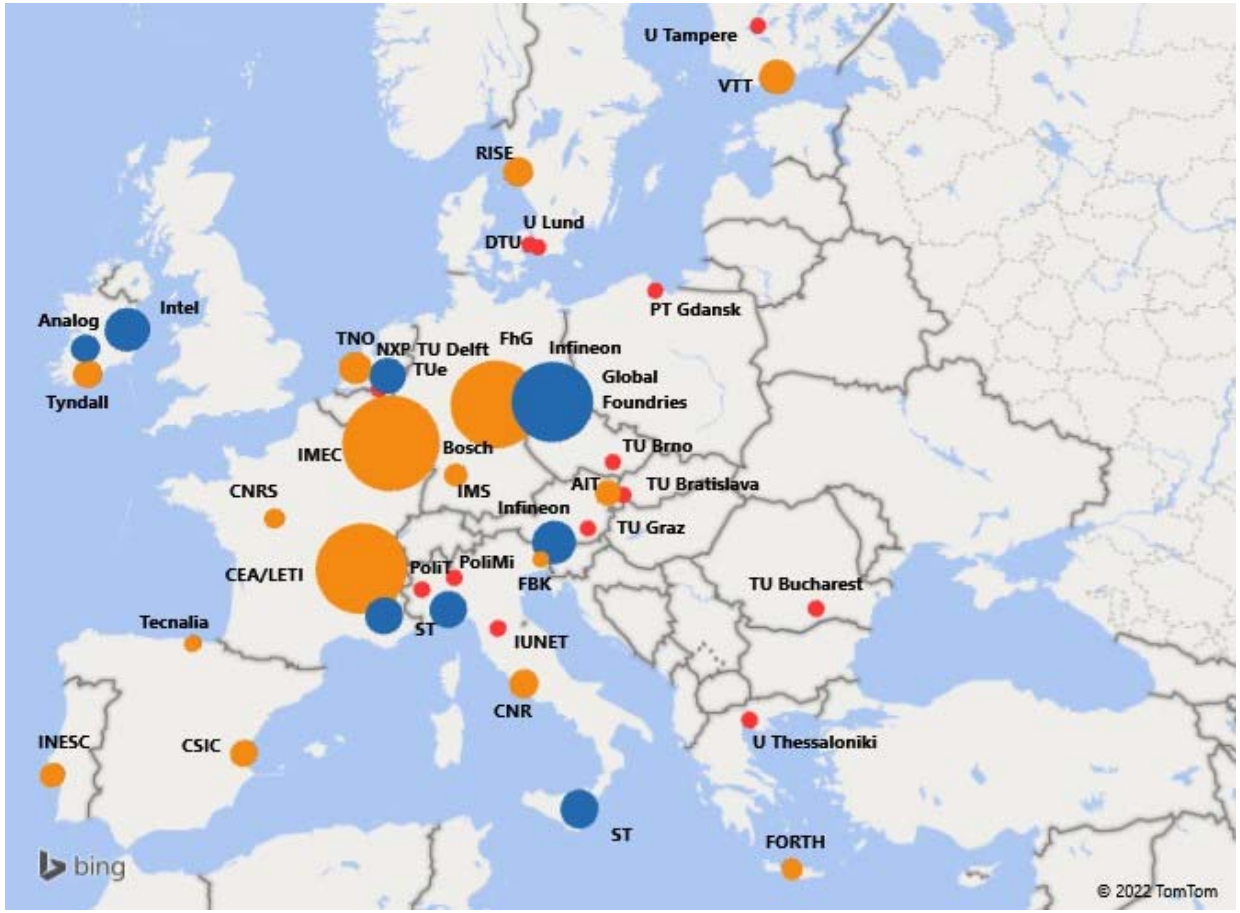
- Infrastructure for design and system integration
- Pilot lines*
- Network of qualification and competence centres
- New capacities for the next generation incl. quantum chips
- Chips Fund for start-ups and SMEs

Pillar 2 focuses industrial facilities for semiconductor manufacturing



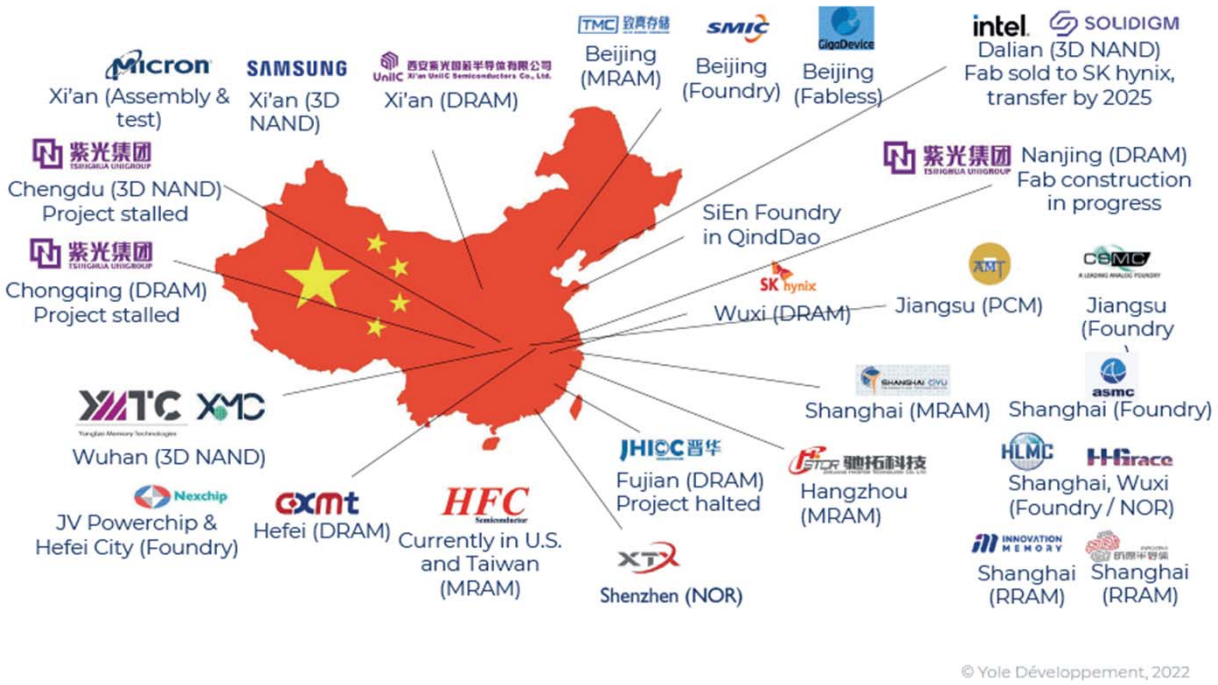
*Pilot Lines: establish European ecosystems for prototype production; achieve reliable fabrication processes for high-volume production; produce small volumes of new technology-based products; employ new production technologies/methodologies

Semiconductor cluster in Europe



Source: Commission Staff Working Document 'A Chips Act for Europe' SWD(2022) 147 final

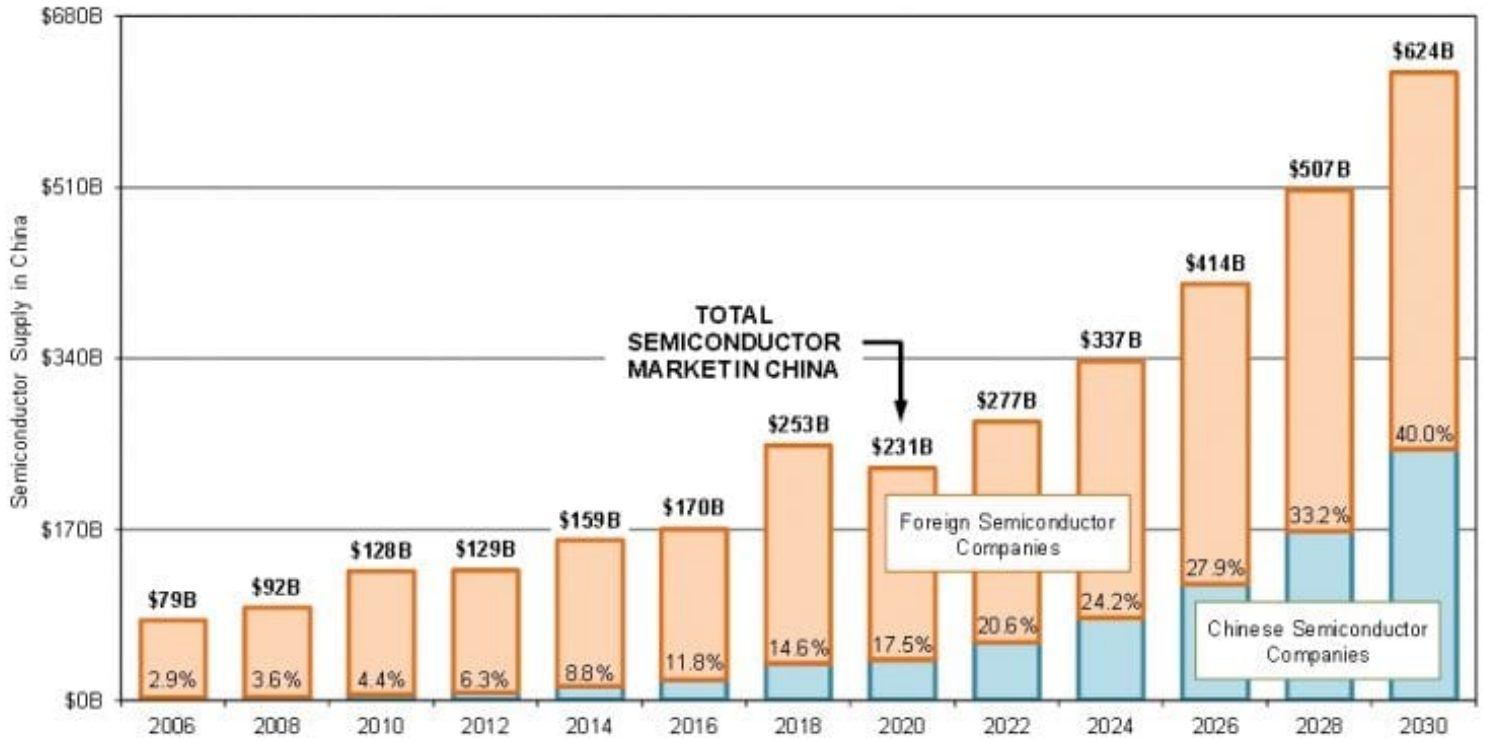
China Industry Key Players



Semiconductor Industry

- No Commercial scale fab operating below 14 nm node
- In July 2022 that Semiconductor Manufacturing International Corporation (SMIC), China's national champion, has probably developed the ability to create a 7-nm chip.
- Although these can be produced by DUV instrumentation they are not cost effective.
- ASML was denied an export permit (due to US pressure on Amsterdam) for extreme UV lithography instrumentation to China

China Internal Semiconductor Market



The semiconductor supply chain in China, indicating the percentage of the supply coming from foreign companies vs Chinese companies. Note that in 2030, China will still import 60% of semiconductors used. Source: IBS.

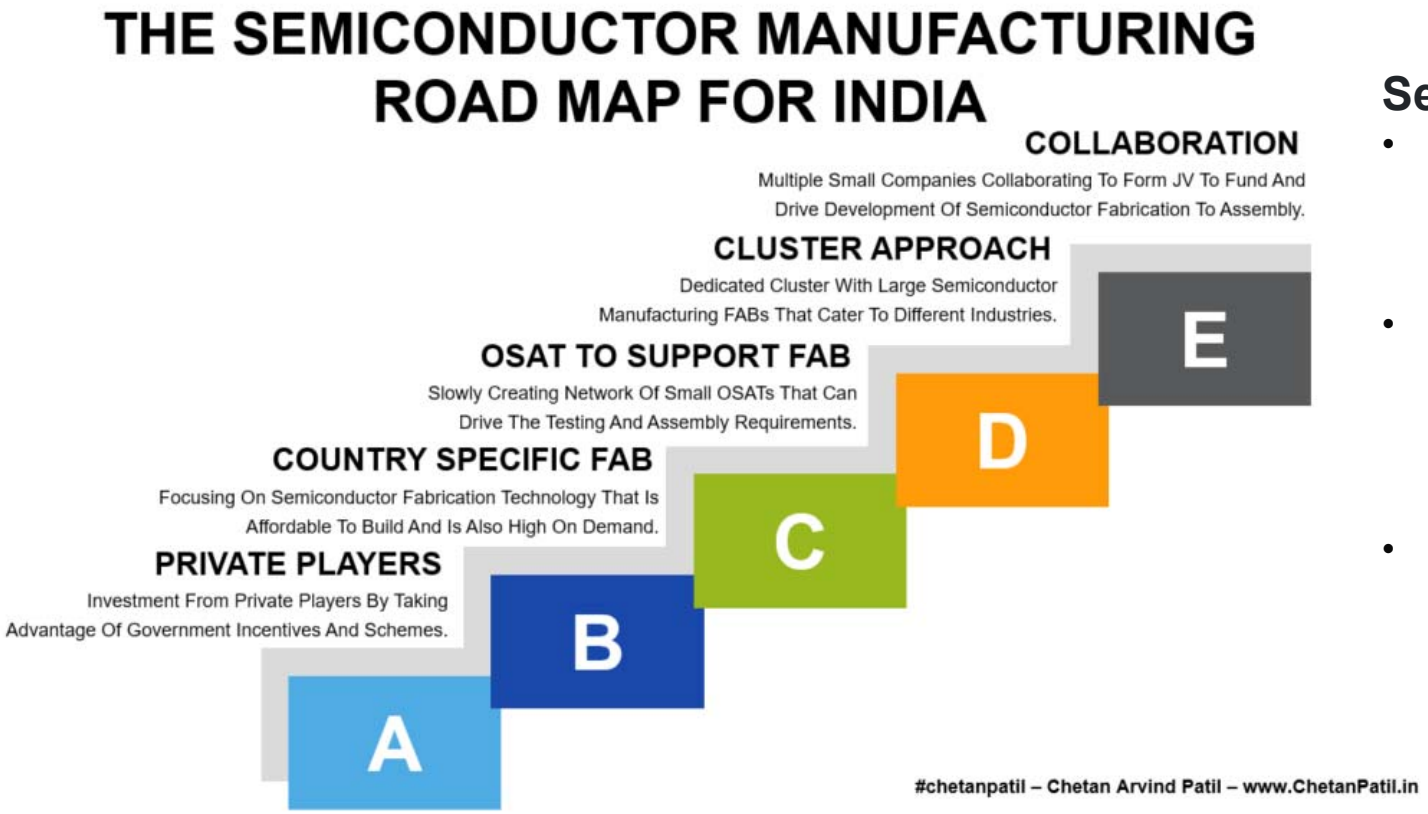
China University Smart Sensors

Peking university		MEMS, Gyroscope, accelerometer, radio frequency device, optical device, flexible device
Northeast Agricultural University		Smart farm technology and system
HIT(Harbin Institute of Technology)		Smart farm technology and system
Huazhong Agricultural University		Excavation and utilization of agricultural microbial resources
Lanzhou University		Grass seed innovation and grassland agro-ecosystem
Institute of Microbiology, Chinese Academy of Sciences		Biosensor development
Hunan University		Chemical biological sensing and metrology, molecular recognition and probes, nanobiology, chemical biosensing, biochemical analysis instruments, chemometrics
Lanzhou University		Peptide drug and clinical transformation
Sun Yat-sen University		Prevention and control of aquatic animal diseases and healthy breeding
Xi'An Jiaotong University		MEMS on Biological detection technology and molecular diagnosis
University of Electronic Science and Technology of China		Magnetoelectric thin films and micro devices, Power semiconductor devices and integrated technologies, Electronic polymers and micro structure sensors
Tsinghua University		Laser and photoelectric testing technology, sensing and measurement information technology, micro and nano manufacturing and testing technology, manufacturing quality control technology

China Internal Semiconductor Market

Advanced Drive assistance systems	Baidu	Nio Inc.	Lixiang	Xiaopeng	
Environmental sensors					
Agri Food sensors	HGTECH	Centre Testing International			
Biomedical sensors	Yuwell	Lepu Medical	Mindray	MGI	OVCTEK
Molecular diagnostics	DA AN GENE	Liferiver	Dian Diagnostics	EDAN	KHB
CMOS based physical sensor devices	WILLSEMI	Galaxycore	Smartsens		

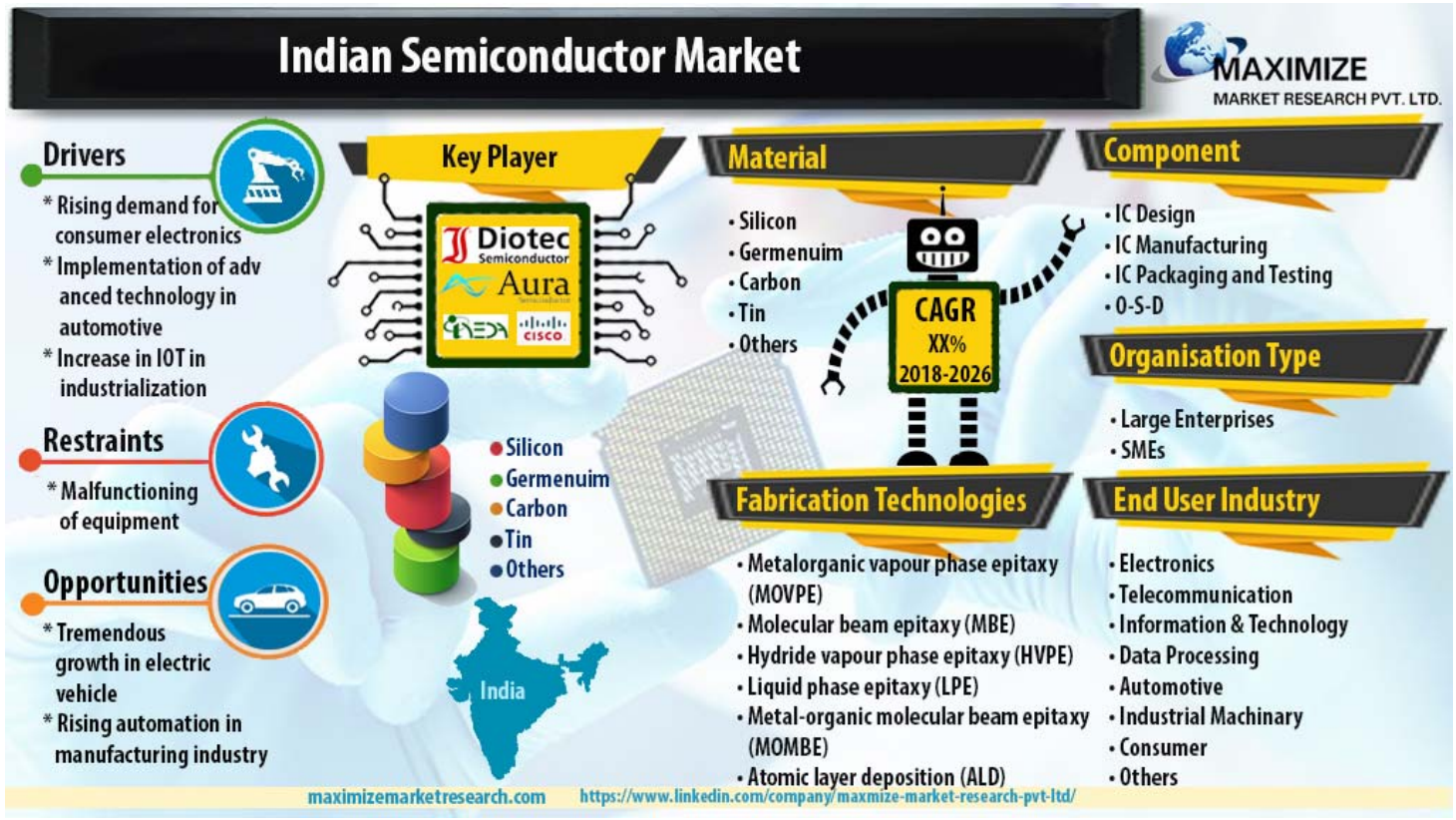
India Semiconductor Road Map



Semicon India Program

- Program for Development of Semiconductors and Display Manufacturing Ecosystem in India (approved in 2021)
- Investment of INR 760 billion (>US$10 billion) for the development of a sustainable semiconductor and display manufacturing ecosystem
- Position the country as a global hub for electronic system design and manufacturing.

India Semiconductor market



- Very little activity in Smart Sensors and Systems.
- Desire by Government to increase IoT in all sectors particularly Agri-foods
- Key Universities
  - IISc Bangalore
  - IIT Hydrabad
  - IIT Roorkee
  - IIT Bombay
  - IIT Madras

Other Existing/Emerging Regions

- Asia Pacific
  - Taiwan
  - South Korea
  - Japan
  - Australia
  - Thailand*
  - Philippines
  - Singapore
  - Malaysia*
  - Indonesia*
- Latin America
  - Mexico
  - Colombia*
  - Brazil
  - Argentina*
  - Peru*
- Middle East and Africa
  - Saudi Arabia
  - UAE
  - Egypt*
  - South Africa*

* Participants from the following low- to middle-income countries are automatically eligible

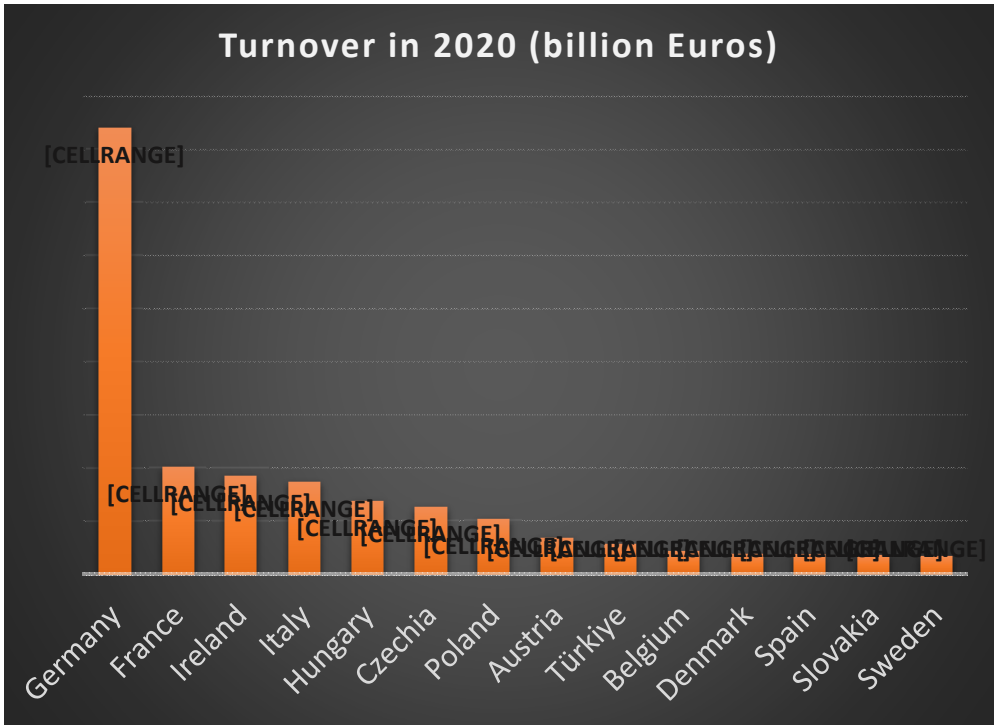
Collaborations

- One key aspects of India's semiconductor vision is International Collaboration
  - Limited joint EU / India call https://dst.gov.in/sites/default/files/Webnotice%20India%20-%20EU%20Joint%20call%20for%20proposal%20with%20Annex%20A%20B%20C_0.pdf
- EU-Australia relations framework agreement 2022
- EU-Thailand agreement on ERC level but could be expanded
- Limited collaboration with Japan Science and Technology Agency (JST) and individual EU countries. ((AI and Information, Biotechnology, Energy, Quantum, Materials, Semiconductors and Telecommunications)
- Latin America has joint calls with individual EU Countries (Bioplastics and Euroaccess)

Conclusions

- Geopolitical divide driving protectionism – but no one will become idenpendent
- Europe is strong in Smart Sensors
- Opportunity for EU to collaborate with new countries – India / Thailand
- Bi-lateral agreements in place with a number of countries which can be expanded
- Win- win for Europe is access to market / talent / problem statements / driving policy (environmental / agri)

Semiconductor cluster in Europe



Leading Semi conductor companies by sales

[Top semiconductor companies by sales 2021 | Statista]

Major Challanges

To achieve application breakthroughs and strategic advantage, the European position must be reinforced through leadership in all relevant equipment, materials, processes and manufacturing technologies by driving the following Major Challenges:

- Enabling new functionalities in components with More-than-Moore technologies
- Novel devices and circuits that enable advanced functionality
- World leading semiconductor manufacturing equipment and technologies
- Advanced Heterogeneous integration technologies, processing, manufacturing and packaging solutions
- Mass modification of sensors, environmentally controlled characterisaiton…
- Sustainability and recyclability
- Edge Computing, AI and ML processes
- Developing a robust SoS architecture – cyber secure, resilient, interoperability…
- Open source business models