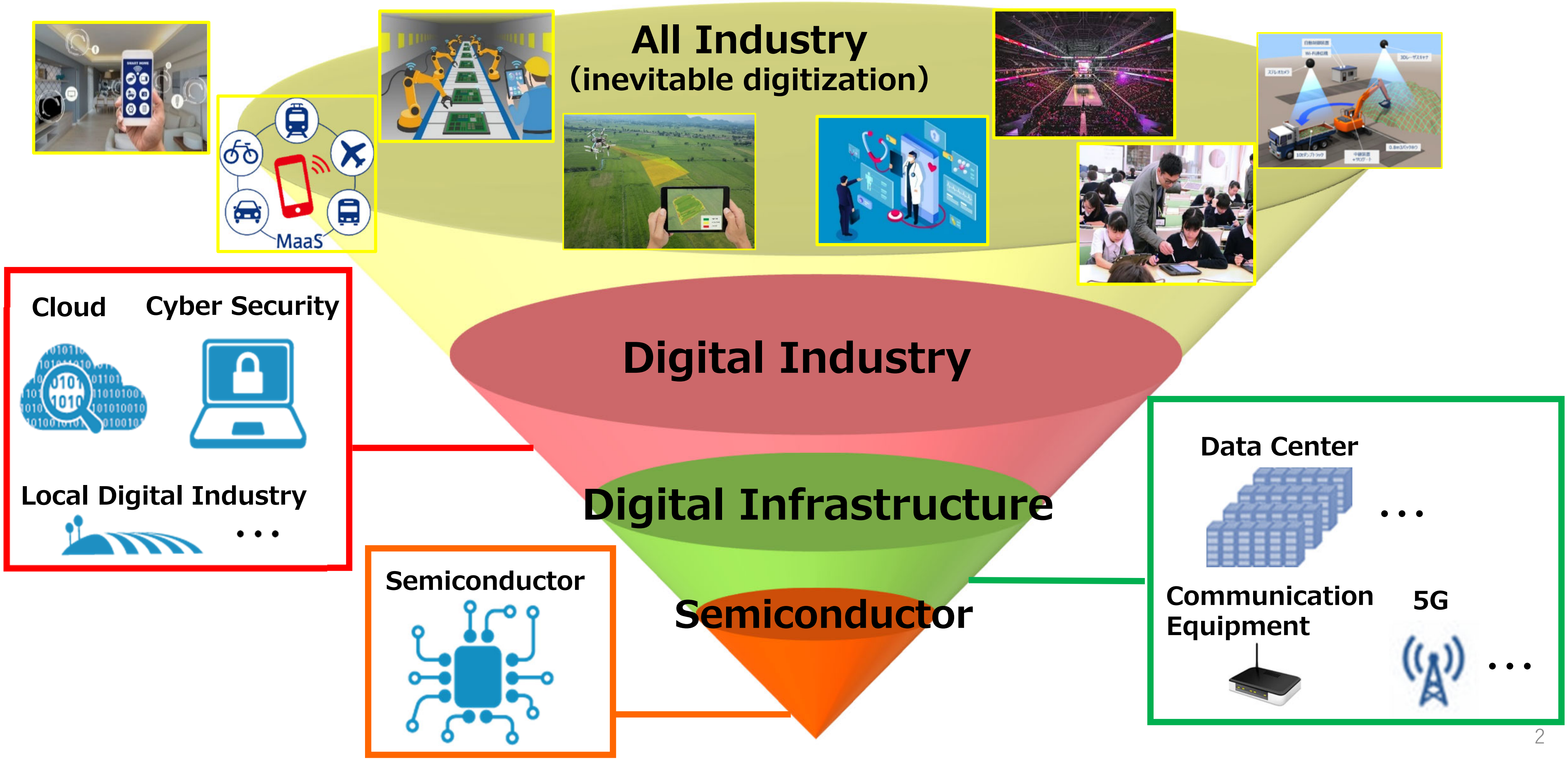
Japan's Semiconductor and Digital Strategy

February 9th, 2022

Ministry of Economy, Trade and Industry
IT Industry Division

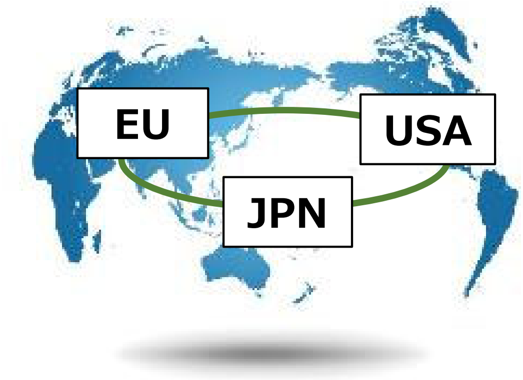
The Necessity of planning the Semiconductor and Digital Industry Strategy

- Integrate promotion of semiconductors, digital infrastructure, software and cloud, which are fundamental technologies in the digital domain.
- It is important to make progress based on the improvement of the convenience of people's lives and industrial needs.

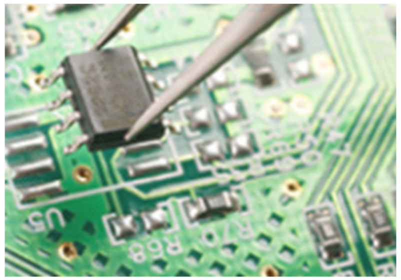


Global structural changes surrounding Digital Technology

【20th century】



Oligopoly in Japan, US and Europe



A part of electrical products

(1) Environmental Changes in the Economic Security

- ➢ Securing semiconductors is directly linked to economic security

(2) Digital Revolution after Coronavirus

- ➢ All societies are digitized and semiconductors are the core products of digital transformation.

(3) Overcoming energy and environmental constraints

- ➢ Energy saving and greening of semiconductors are essential to aim for carbon neutrality in 2050.

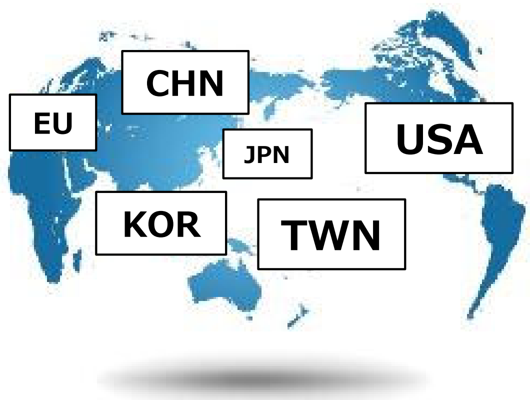
(4) Strengthening resilience

- ➢ The shortage of semiconductors impacts enormously on all industries (supply chain risk).

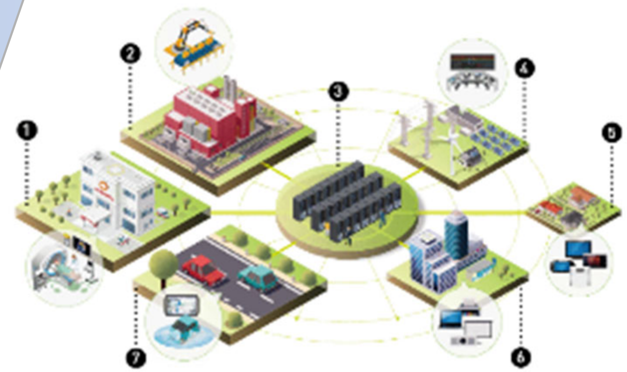
(5) Japan’s Decline

- ➢ Japan's presence has declined in the last 30 years despite the expansion of the global semiconductor market.

【21st century】



Rise of Taiwan and South Korea
⇒ <u>International strategic supplies</u>

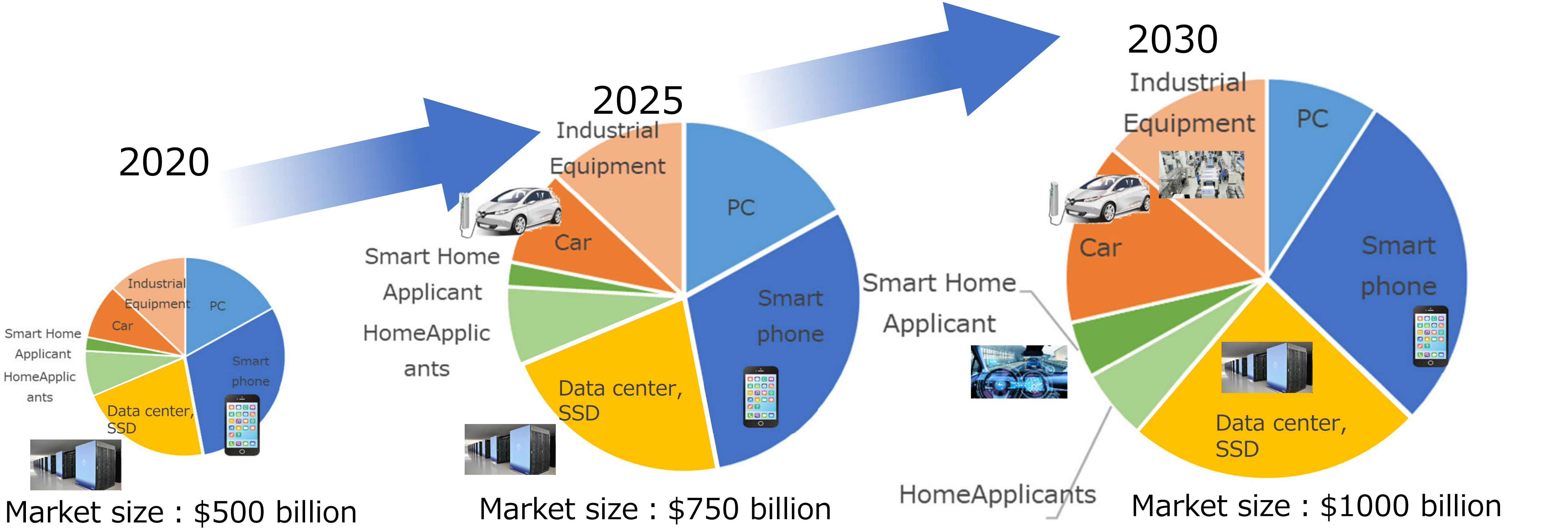


Progress of digital transformation and green
⇒ <u>Key part of security and decarbonization</u>

(Source) TOKYO ELECTRON DEVICE LIMITED HP

Basic Semiconductor Revitalization Strategy in Japan

Step 1 : Enhancement of Basic Production Capacity for IoT



Step 2 : Realization of Next Gene Semiconductor Technology through US – JP Collaboration

Step 3 : RD For Future technology

Photonics-Electronics Convergence, Quantum Computing through Global Collaboration

(Reference) : prepared by METI, based on data from OMDIA

Step1:Advanced Semiconductor Production Capacity

1． JASM（Joint Venture of TSMC（TW）, Sony（JP） and Denso（JP）） 【June 17, 2022】

✓Up to approx **US$3.5 billion** subsidy
✓New-Fab for Logic Semiconductor (12–28 nm)

2． KIOXIA（JP） and Western Digital（US） 【July 26, 2022】

✓Up to approx **US$700 million** subsidy
✓Advanced 3D NAND Flash Memory Investment

3. Micron (US) 【September 30, 2022】

✓Up to approx **US$320 million** subsidy
✓Advanced DRAM(1β) Investment

Step1:General Semiconductor Production Capacity

Challenge

- 20% Demand Growth in 2021 from 2019
- Only 8% Supply Growth (Operation Rate is 95%)

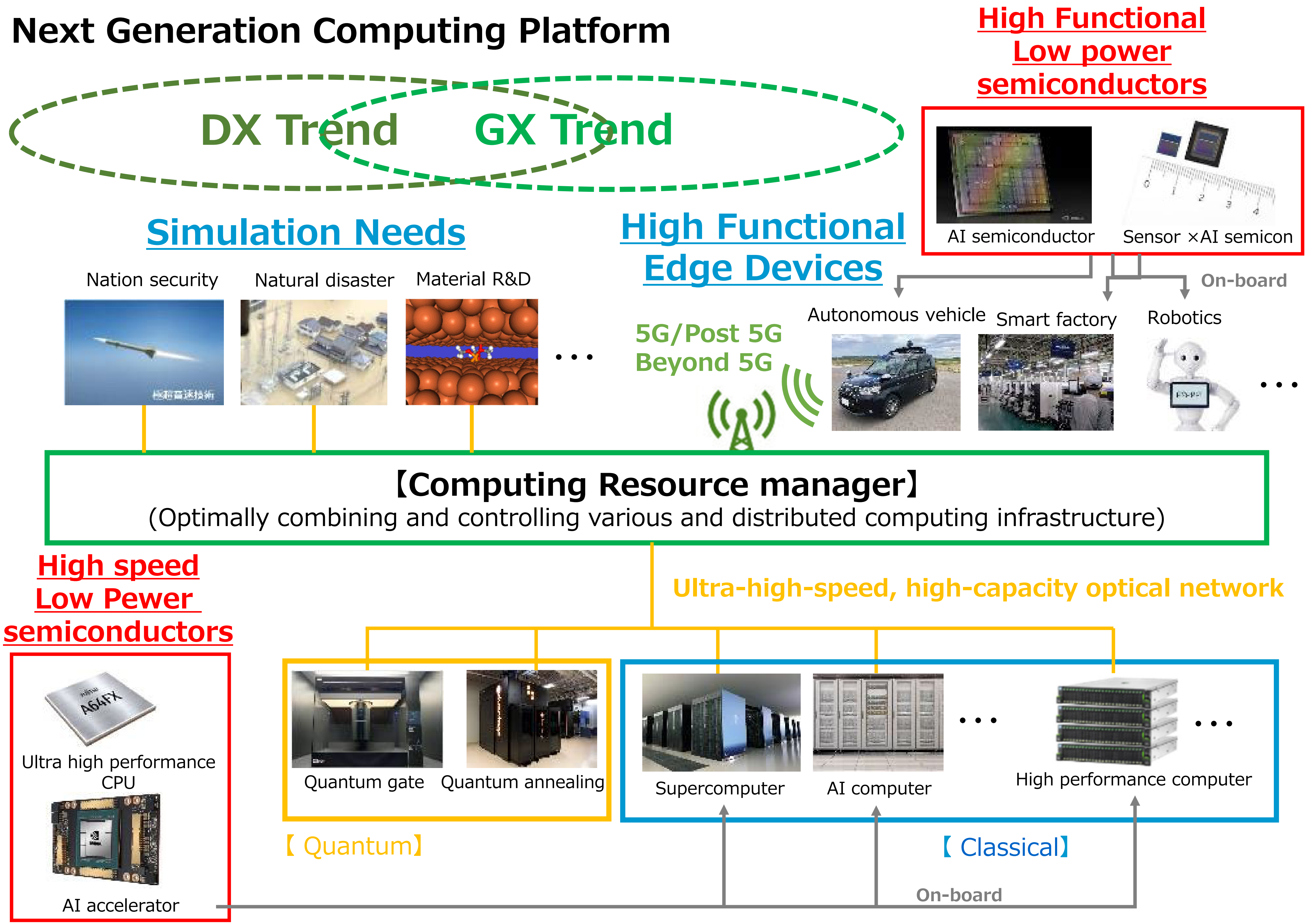
Solution

- Production Capacity Expansion

  For Power Chip, Analog Chip, etc, (Low Investment Incentive in Private)

“Subsidy Program for Indispensable Semiconductors” ($340M)

- Support Capital Investment in 27 Factories out of 81 in Japan (33%)


Next Generation Computing Platform
High Functional
Low power
semiconductors
DX Trend
GX Trend
AI semiconductor
Sensor ×AI semicon
Simulation Needs
High Functional
Edge Devices
On-board
Nation security
Natural disaster
Material R&D
Autonomous vehicle
Smart factory
Robotics
5G/Post 5G
Beyond 5G
【Computing Resource manager】
(Optimally combining and controlling various and distributed computing infrastructure)
High speed
Low Pewer
semiconductors
Ultra-high-speed, high-capacity optical network
A64FX
Ultra high performance
CPU
AI accelerator
Quantum gate
Quantum annealing
Supercomputer
AI computer
High performance computer
【 Quantum】
【 Classical】
On-board

Basic Principles on Semiconductor Cooperation (May 4, 2022)

Mr. HAGIUDA Koichi, Minister of Economy, Trade and Industry of Japan, and Ms. Gina Raimondo, U.S. Secretary of Commerce, met on May 4th, 2022.

The Minister and the Secretary intend that **bilateral semiconductor supply chain cooperation be guided by the following basic principles**:

1. based on **open markets, transparency**, and **free trade**,
2. with **a shared objective to strengthen supply chain resiliency in Japan, the United States, and other like-minded countries and regions**; and
3. in a mutually accepted and **complementary manner**.

The Minister and the Secretary also highlighted the importance of bilateral cooperation, especially on **strengthening and diversifying semiconductor production capacity, promoting workforce development**, **increasing transparency, coordinating emergency response to semiconductor shortages**, and **enhancing R&D cooperation**, together with like-minded countries and regions as appropriate.

We will continue to advance our joint efforts on the basis of these principles.

Step2:Beyond 2nm Next Generation Semicon Tech

Drastic Technology Change **<u>from Fin-Fet to GAA</u>**

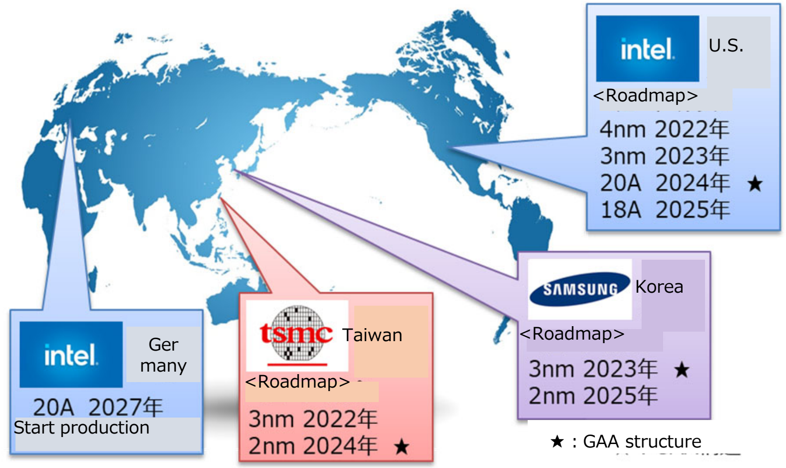
abroad

tsmc SAMSUNG intel IBM

Japan

Japan is 10 years behind from Global Trend

Challenges
- ✓ Development of use cases utilizing next-generation semiconductors
- ✓ Establish knowledge of next-generation semiconductor development and manufacturing
- ✓ Education of human resources



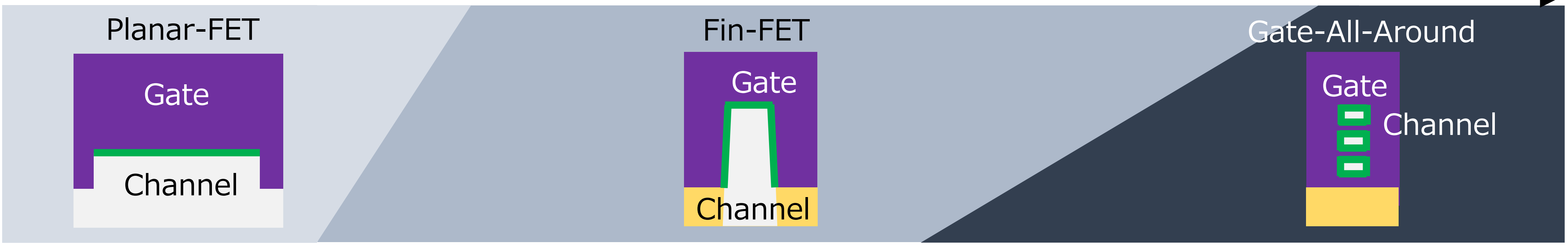
TSMC Japan

Next Generation Semiconductor

Fin-FET introduction

GAA introduction (plan)

45nm — 28nm — 22nm — 16/12nm — 7nm — 5nm — 3nm — 2nm — Beyond

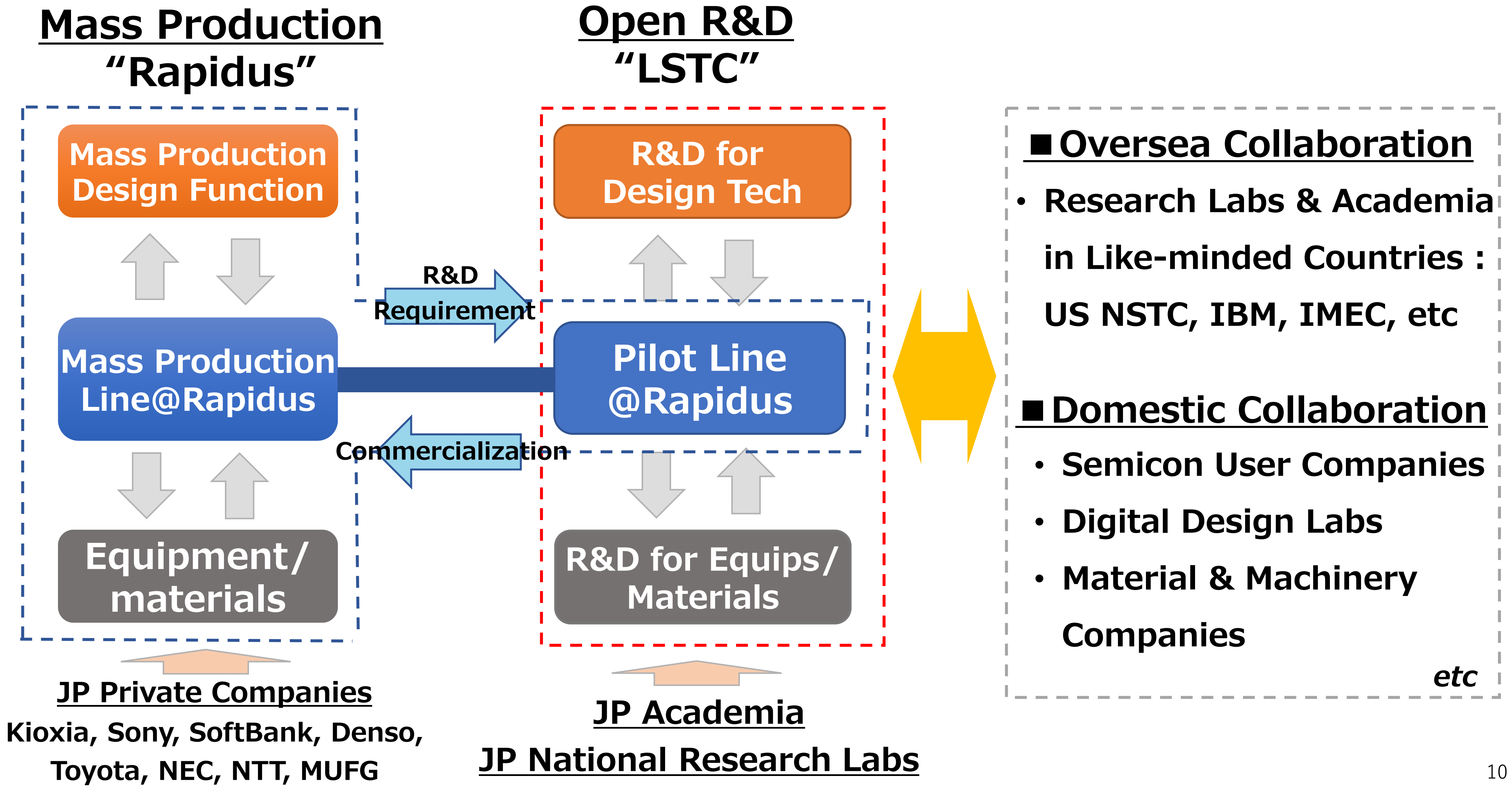


Same gate width in smaller area ＝high integration

Project Framework for Next Generation Beyond 2nm Project (B2P)

<METI announcement on 11th Nov.>: Establishment of Two Entities for B2P

1. "LSTC": Open Collaborative R&D Platform ※Leading-Edge Semiconductor Technology Center
2. "Rapidus": Mass Production Entity (Inc.)



Process for Next-Generation Semiconductor R&D Project

- **70B JPN Yen** will be allocated to Rapidus (announced on Nov. 11)
- R&D Theme by Rapidus; **2nm-node Transistor Integration Technology and Short TAT [*1] Production Technology** through the Cooperation between Japan and the US
  - Will **cooperate with IBM and others** to develop technologies for **2 nm-node logic semiconductors**, build **short TAT pilot lines** in Japan and conduct verifications using test chips.
  - In FY2022, will **acquire the elemental technologies for 2nm-node semiconductors**, **begin installing EUV lithography equipment**, **formulate specifications** for production equipment, transport systems, and production management systems **necessary for short TAT** production system, and deploy the **initial design for pilot line** (**70 B JPN Yen**[*2]).
  - Will aim to **commercialize** next generation logic foundry after the R&D project

※1 TAT: Turn Around Time
※2 $1 = 140 JPN Yen

Mass production base: Rapidus Corporation

- A company established **with the endorsement of major Japanese companies that gathers top-level engineers from all over Japan in order to create a mass production base for next-generation semiconductors.**
- It has been selected to carry out the research and development project toward **the establishment of design and manufacturing bases for next-generation semiconductors in the latter half of the 2020s.**
- **Together with LSTC, Rapidus will aim to build a mass production base for next-generation semiconductors in Japan**.

■ Investing Companies

Company	Investment amount(Billion)
Kioxia	1 billion
Sony	1 billion
Soft Bank	1 billion
Denso	1 billion
Toyota	1 billion
NEC	1 billion
NTT	1 billion
MUFG Bank	0.3 billion

■ Rapidus Corporation main principal officers

Position	Name
Executive Chairman	HIGASHI Tetsuro
President and Representative Director	KOIKE Atsuyoshi

The system may be expanded in the future in accordance with Rapidus Corporation's activities.

Schedule for Next-Generation Semiconductor R&D Project

- **METI and the US Department of Commerce will continue to manage the progress** of the project through a **Japan-US joint task force** based on the Japan-US Summit agreement.
- **LSTC and US NSTC will cooperate**, gathering the best and brightest from both countries.
- **Japan & US and the public & private** will **share roles** appropriately and **cooperate** closely.

2022 and later

Later half of the 2020s

Basic Research (US)
e.g., New York States' Investment of $15B in Albany*

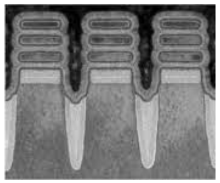
Process Development for Mass Production (JPN)

Mass production & Development (JPN)

Source: From the NY CREATES website

Deployment

Gate All Around Nanosheet technology



Source: IBM website

EUV lithography equipment

Source: ASML website

LSTC Open Collaborative R&D Platform

Chairman
Tetsuro Higashi

Chief in Academia
Makoto Gonokami

Under Discussion in Japan

- ✓ Design Technology Development
- ✓ Device Technology Development (GAA transistors and later)
- ✓ Process and Equipment Technology Development (short TAT)
- ✓ Material Development
- ✓ 3D Packaging Technology Development
- ✓ Human Resource Development
- ✓ Use-Case Creation Hub

US NSTC,

imec, etc.

Overview of Semiconductor human resource development

- Develop the professional human resources to supply of next-generation semiconductor and create the use cases through global collaboration.
- Expand to the regional basis in consideration of the characteristics of each region and private sector is expanding these efforts nationwide.

（1） Development of the Global Professional human resources

Japan NSTC

AIST, RIKEN, NEDO, NIMS, KEK, Tokyo univ, Tokyo Tech, Tohoku univ. Tsukuba univ.
Develop the future human resources to supply of next-generation semiconductor and create the use case.

Next Generation X-nics semiconductor Creation Base

Agile-X～Democratization Base for Innovative Semiconductor Technology (Tokyo univ.)
Develop the innovative human resources through advanced fusion of hardware and software.

Integrated Green-niX (Tokyo Tech, Hiroshima univ. etc.)
Development of recurrent human resources for working through trial production lines for experiencing all processes.

Center for Spintronics Integrated Systems (Tohoku univ)
Development of human resources who can overlook the entire technology value chain

（2） Efforts of Each Regional Basis

Promote to nationwide

Kyushu Human Resource Development Consortium

（Industry） SONY, JASM
（Academia） Kyushu univ., Kumamoto univ.
（Government） Kyushu Bureau of Economy, Trade and Industry, METI

Tohoku Semiconductor and Electronics Design Study Group

（Industry） KIOXIA Iwate,
（Academia） Tohoku univ.
（Government） Tohoku Bureau of Economy, Trade and Industry, METI

Chugoku Region Semiconductor Industry Promotion Council

（Industry） Micron
（Academia） Hiroshima univ.
（Government） Chugoku Bureau of Economy, Trade and Industry, METI

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JEITA

Support of the Industry Organization

Effort of JEITA
・ Human Resources development Project : Visiting Class, Factory Tour, Support to Technical College
・ Human Resources Forum in CEATEC.