

SCREEN Group

IR Day 2023

Investor Relations Division
PR & IR Department
SCREEN Holdings Co., Ltd.

* Cautionary statement with respect to these materials; The earnings forecasts contained in these materials and communicated verbally, are made in accordance with currently available information and rational assumptions. SCREEN Holdings does not promise that the forecasts or estimates will be accurate. Therefore, it should be noted that actual results could differ significantly due to a variety of factors.

* Figures have been rounded down to eliminate amounts less than 100 million JPY, except per share figures. A ratio has been rounded off.

* SCREEN's fiscal year (FY) encompasses the period from April 1 to March 31 of the following calendar year. (Ex. FY2024/03: April 1, 2023 - March 31, 2024)

■ Progress of the “Value Up 2023” Medium-term Management Plan; Revised Management Grand Design

Toshio Hiroe President, Member of the Board, Chief Executive Officer of SCREEN Holdings Co., Ltd.

■ SPE Business Trends

• Outlook of semiconductor market and WFE, and SPE's growth strategies

Masato Goto President of SCREEN Semiconductor Solutions Co., Ltd.

• Initiatives to increase market share

Hiroaki Takahashi

Division Head, Clean Technology Development Operations, SCREEN Semiconductor Solutions Co., Ltd.

• Initiatives to expand the business of semiconductor annealing equipment

Takumi Mikawa

General Manager, Senior Technology Executive, SCREEN Semiconductor Solutions Co., Ltd.

■ Growth Strategy of Each Business Segment

• Growth strategy for GA business

Yukiyoshi Tanaka President of SCREEN Graphic Solutions Co., Ltd.

• Growth strategy for FT business

Atsushi Sonoda President of SCREEN Finetech Solutions Co., Ltd.

• Growth strategy for PE business

Masato Suemori President of SCREEN PE Solutions Co., Ltd.

• Activities to create new businesses

Toshio Hiroe President, Member of the Board, Chief Executive Officer of SCREEN Holdings Co., Ltd.

■ Q&A

Progress of the “Value Up 2023” Medium-term Management Plan; Revised Management Grand Design

Toshio Hiroe

CEO, President

SCREEN Holdings Co., Ltd.

- **Progress of the current Medium-term Management Plan, “Value Up 2023”**
- **Revision of the corporate philosophy and purpose**
- **Outline of the Management Grand Design**
- **Concept of the next Medium-term Management Plan**

	Economic Value Targets for the final fiscal year (Initial planned)	FY2021/03 (1st-year Result)	FY2022/03 (2nd-year Result)	FY2023/03 (3rd-year Result)	FY2024/03 (4th-year Forecast)	Economic Value Targets for the final fiscal year ending March 31, 2024 (Revised in July 2022)
Net sales	¥400.0 bn or above	¥320.3 bn	¥411.8 bn	¥460.8 bn	¥495.0 bn	¥500.0 bn or above
OP Margin	15% or above	7.6%	14.9%	16.6%	17.2%	17% or above
ROE	15% or above	7.9%	19.9%	21.0%	–	20% or above
Operating CF	¥120.0 bn or above (Four-year cumulative)	¥57.2 bn	¥138.9 bn (Two-year cumulative)	¥212.8 bn (Three-year cumulative)	–	¥240.0 bn or above (Four-year cumulative)
Shareholder Returns	Total consolidated shareholder return ratio of 30% or above	27.7%	30.1%	30.2%	30% or above	Total consolidated shareholder return ratio of 30% or above

Notes: 1. The above figures are predicated on organic growth

2. The figures in green indicate that our initial medium-term goals have been achieved

Material issues	Targets for the fiscal year ending March 31, 2024	The fiscal year ended March 31, 2023		Progress Evaluation
		Results	Self-evaluation, issues, measures, etc.	
Reduce CO2 emissions from business activities	45.5 (thousand metric tons CO₂e) 10% reduction compared with FY2019 - Continual activity toward our SBT (Scope1 + Scope2): 30% reduction by the end of FY2030	23.9 (thousand metric tons CO ₂ e) 52.7% reduction compared with FY2019	Substantial reductions were achieved mainly as a result of the introduction of renewable energy at Hikone Plant and other facilities. Other measures are under consideration, such as introducing renewable energy at other sites, promoting energy-saving of equipment, and installing energy generation/storage solutions.	○
Reduce CO2 emissions from the use of sold products	2,395 (thousand metric tons CO₂e) 8% reduction compared with FY2019 - Continual activity toward our SBT (Scope 3): 20% reduction by the end of FY2030	2,577 (thousand metric tons CO ₂ e) 0.9% reduction compared with FY2019	Emissions remained unchanged despite the increase in product sales, but to achieve the target, we should accelerate the development of products conducive to improving energy efficiency.	×
Reduce the volume of waste generated, promote recycling	188 (kg/metric tons) 5% reduction compared with FY2019 - Waste generated in business activities (in intensity per unit weight of product shipments)	172 (kg/metric tons) 13.0% reduction compared with FY2019	Our promotions (e.g., recycling waste plastic) led to reduced waste generated volumes and higher recycling rates.	○
Promote effective water use	246 (m³/metric tons) 5% reduction compared with FY2019 - Business operating site water withdrawal for service water, industrial water, etc. (in intensity per unit weight of product shipments)	230 (m ³ /metric tons) 11.1% reduction compared with FY2019	Although total water withdrawal slightly increased due mainly to the impact of the establishment of a new factory, our efficient production systems enabled us to achieve reductions in water withdrawal per unit weight of product shipments above the target.	○
Human Resources	- Promotion of measures to develop solution creators - Enhance systems and measures that provide a tangible sense of growth - Create an environment that supports the hiring and development of diverse human resources and enables them to succeed - Apply sustainable new work styles	Conducted Group-wide engagement and individual surveys Expanded training for cultivating next-generation business leaders Conducted programs for women's empowerment Enhanced the work-at-home system to promote work-life balance	We are continuing our work to create a sustainable environment in which any skilled employee can feel engaged and make an ongoing contribution regardless of their diverse attributes. Measures to develop solution creators are underway, based on analyses of Group-wide surveys.	△
Enhance industry-academia-government collaboration and community collaboration	Advance various collaborative projects through cooperation with government agencies, educational institutions, etc.	Worked with the Lake Biwa Museum and Seian University of Art and Design to develop biodiversity-themed educational game materials for children Implemented a capstone project with Kyoto University of Advanced Science	By working more closely with government agencies and educational institutions, we are promoting collaborations that will benefit all parties (industry, academia, and government) over the medium to long term.	○
Identify key risks and reduce risks	Identify risks to corporate value and minimize their impact	Lowered the rating of five out of the seven key Group risks through the activities of the Group Risk Management Committee, consisting mainly of HD Management Committee members	We have strengthened support through our second line of defense in dealing with the key Group risks identified at the beginning of the fiscal year, especially those in the four business operating companies.	○
Expand CSR initiatives in the supply chain	Pursue ongoing strengthening of our supply chain management system, including widespread adoption of our Code of Conduct, procurement practices and BCP	Built a sustainability website for major suppliers such as top by transaction value (launched in June 2023)	We strive to assess the situation through various surveys and promote supply chain sustainability in cooperation with local governments and other companies.	○
Enhance resilience to increasingly severe natural disasters	Improve the resilience of the Group's business continuity planning in the face of increasingly diverse disaster risks	Revised and expanded rules and manuals, and accelerated the establishment of an effective BCP system that covers domestic and overseas sites Conducted a large-scale comprehensive drill for the Group Emergency Headquarters	We are considering improvements to our IT systems, including those in the supply chain, to increase the speed and reliability of our IMP and BCP structures.	○

Corporate Philosophy

As SCREEN Group celebrates its 80th anniversary, its corporate philosophy has been redefined centered on the corporate purpose, *Innovation for a Sustainable World*.

Corporate Philosophy

Purpose

Innovation for a Sustainable World

Sharing the Future

Building a better future for society with commitment and integrity

Personal Development

Realizing everyone's full potential through trust and teamwork

Pursuit of Technological Excellence

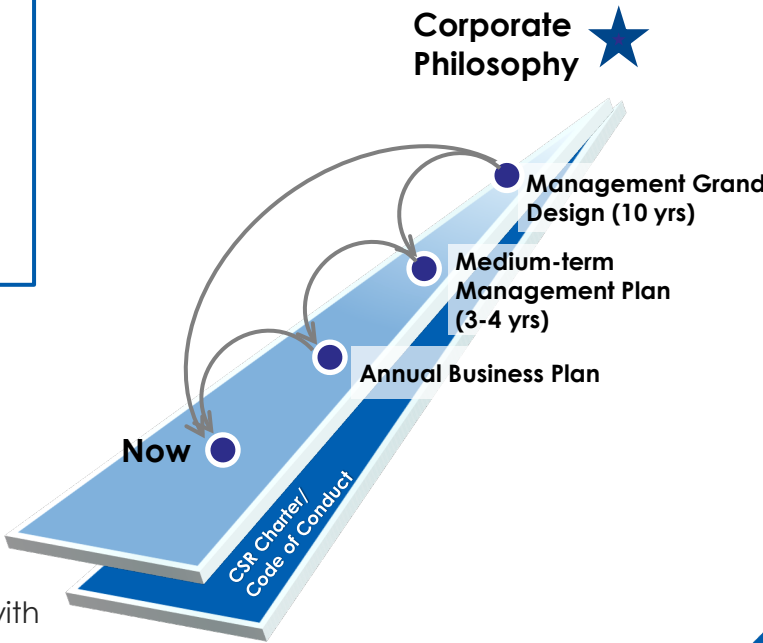
Exploring technologies while integrating with innovative collaboration

Founder's Motto

"Shi Ko Ten Kai"

Broadening everyone's thoughts and horizons for innovation

- Management System
- Management Grand Design Future ten-year vision for enhancing SCREEN Value
 - Medium-term Management Plan Three-year business plan based on the Management Grand Design
 - Annual Management Plan Fiscal-year business plan for achieving the Medium-term Management Plan
- CSR Charter / Code of Conduct
- CSR Charter / Code of Conduct Principles of action and standards that all Group employees should comply with



Achievement of Our 10-year Vision through Business Activities

Purpose

Innovation for a Sustainable World



10-year Vision

Be a Solution Creator
– Becoming what the world needs, together with our partners –



CSV created through business

SPE

Improving the flow of information by adding ingenuity to nanotechnology

GA

Enriching lives and continuing to make the world more colorful through print

FT

Creating a better future with advanced devices, by improving coating techniques, layer by layer

PE

Exploring different approaches and technologies for controlling light to provide solutions that will support a better future

Outline of the Management Grand Design



Megatrends for SCREEN

- DX (Digital transformation)
- GX (Green transformation)
- Well-being (Physical & mental health, happiness)
- Multipolarization of the world economy

SCREEN Value

Outcomes

Outcome indicators

- Financial targets
- Non-financial targets

Our 10-year vision

Be a Solution Creator

Becoming what the world needs, together with our partners

Priorities for SCREEN

Materiality

- Providing new values to society and people
- Reducing environmental impact
- Supporting personal growth of each employee
- Enhancing business foundations

Policy

Policy for tackling materiality

Strategies

Strategies for boosting SCREEN Value

- Business foundation enhancement
- Business growth

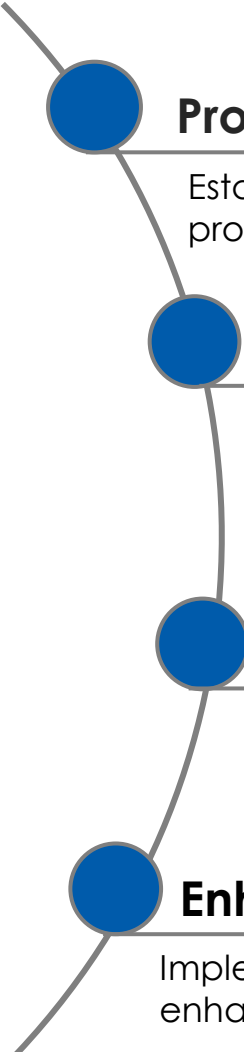
10-year Megatrends

We have identified four megatrends, considering the six expected movement in the next 10 years of “Demographic/economic trends,” “Social value,” “Post-SDGs,” “Energy transformation,” “Intensified economic security concerns and resource wars,” and “Technologies.”

Megatrends for SCREEN		Opportunities, risks, and the Company's response
DX (Digital transformation)	The electronics industry will play an even greater role in responding to changes in the industrial structure from 5G to 6G, IoT to IoE, and AI, as well as driving automation and productivity. Technological innovation will be essential to keep up with these changes.	Transformation of various industrial structures through digitalization will provide business opportunities. The impact will be particularly large in the area of electronics, which supports DX, and SCREEN views this as a driver of growth. → The introduction of digitalization into management and manufacturing will transform the way we work.
GX (Green transformation)	The focus on climate change, as well as biodiversity, human rights, water resources, and a circular economy, will increase demand for solutions that reduce environmental impact and are in line with global environmental standards.	The need to reduce environmental burden and realize a sustainable society is becoming increasingly important as a corporate social responsibility, creating business opportunities in the energy business and environmentally friendly products. → SCREEN will continue to promote environmentally friendly manufacturing.
Well-being (Physical & mental health, happiness)	Commitment to balance human well-being and economic prosperity will become increasingly important as the source of a company's purpose, and there will be even greater demand to enhance quality of life (QOL) for all stakeholders, including employees.	People's mental and physical well-being will increase in importance. Business opportunities exist in social issues that enhance people's quality of life. → SCREEN will continuously promote the health and wellness of its employees.
Multipolarization of the world economy	The impact of trade restrictions and economic sanctions on key technologies, such as high-end semiconductors, is increasing due to intensifying geopolitical risks. In addition to impacting the supply chain, this is also increasing the pressure for compliance with international order and competition rules.	With forecasts for more trade barriers in the world economy, it is necessary for SCREEN to view this as both a risk and an opportunity given that SCREEN will further expand its business globally.

Materiality: Priorities for SCREEN

Materiality refers to issues that are identified by management to be of high significance to both society and the company. They will be addressed under a sound corporate governance structure with the aim of realizing our 10-year Vision.



Providing new values to society and people

Establishing businesses focused on social needs, thereby adding value to our technologies, products, and services to contribute to the development of a sustainable society.

Reducing environmental impact

Reducing greenhouse gas emissions, waste disposal, and use of exhaustible resources through business activities, thereby addressing socioenvironmental needs such as climate change and biodiversity.

Supporting personal growth of each employee

Motivating each employee to take on new challenges and supporting their personal growth, by ingraining our corporate philosophy developing solution creators.

Enhancing business foundations

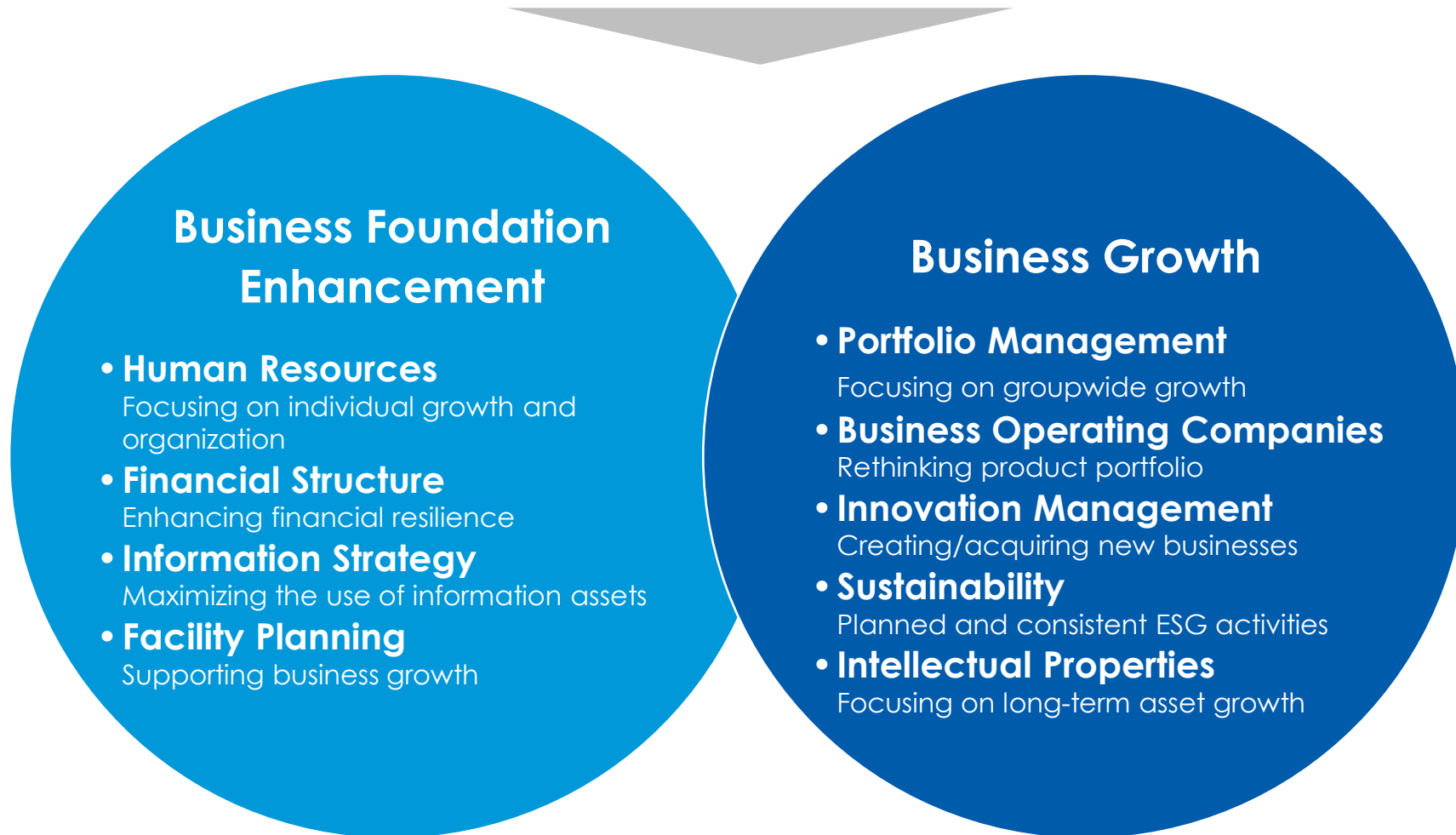
Implementing growth strategies and continuously enhancing its business foundations to enhance our corporate value, in line with the overarching vision.

Policy and Strategies for Tackling Materiality

Policy

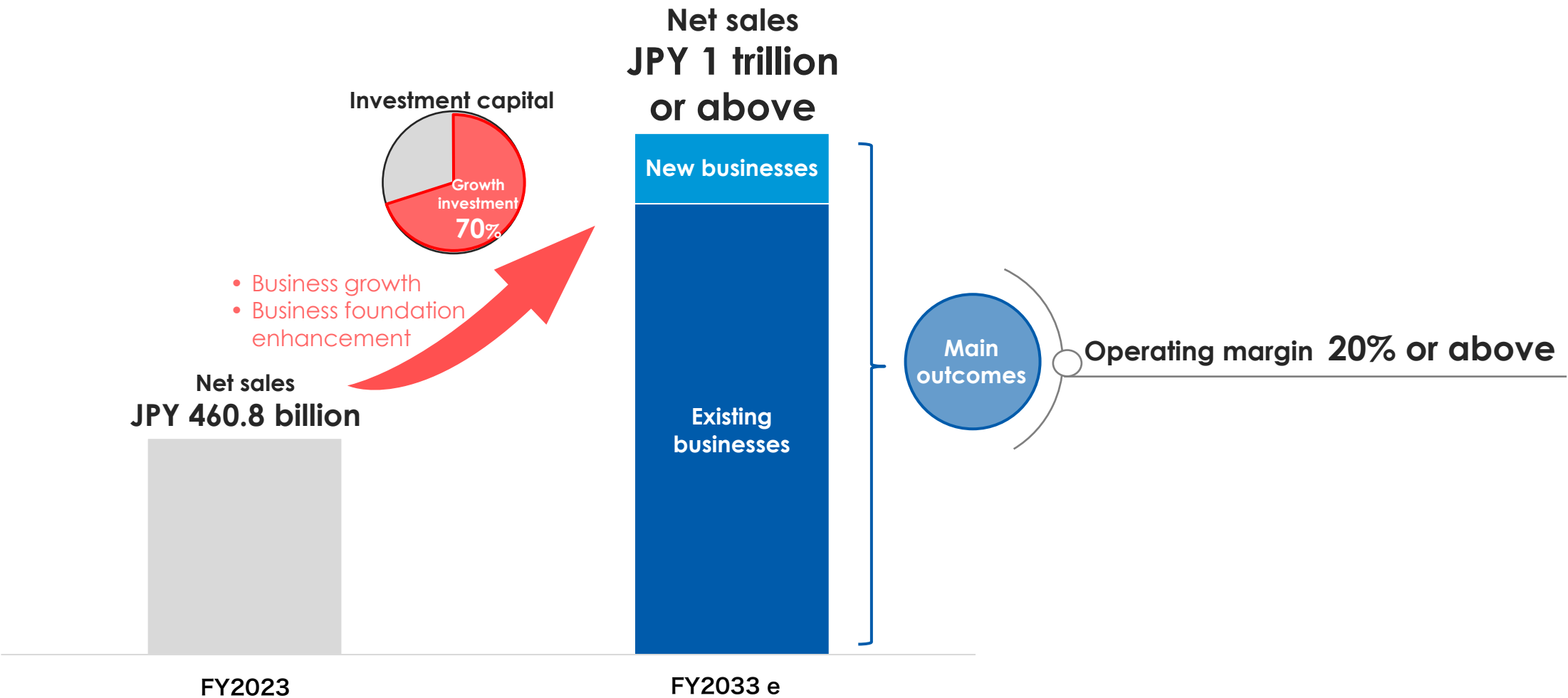
The SCREEN Group will join efforts in enhancing its business foundation and achieving business growth. By providing solutions that address social needs through business, we create outcomes that enhance SCREEN Value.

Strategies



Outcomes: Financial Targets

Aimed at growing existing businesses and creating new business segments, 70% of investment capital* will be allocated to growth investment. The target net sales in FY2033 is JPY 1 trillion or above.



* Operating cash flow before R&D expenses

Non-financial Targets

Regarding non-financial targets, we will quantify our non-financial targets under the next medium-term plan so that we can confirm the progress in each area.



New Value Creation

Proportion of net sales from new products or products equipped with new technology

New business operating companies originated from social needs

Intellectual property

ETR

Number of patents held



Environment

Proportion of net sales from Super Green Products

GHG emissions (Scope 1+2)

Waste disposal (in net sales)

Energy usage (in net sales)



Human Resources

Engagement rate

Healthy Workplace Presenteeism*

Number of occupational accidents resulting in work-related safety leave of 4 or more lost work days



Business Foundations

Human Resources Portfolio Fulfillment Rate

Equity ratio indicating the optimal capital structure

Increase in transparency of management

Robust cybersecurity

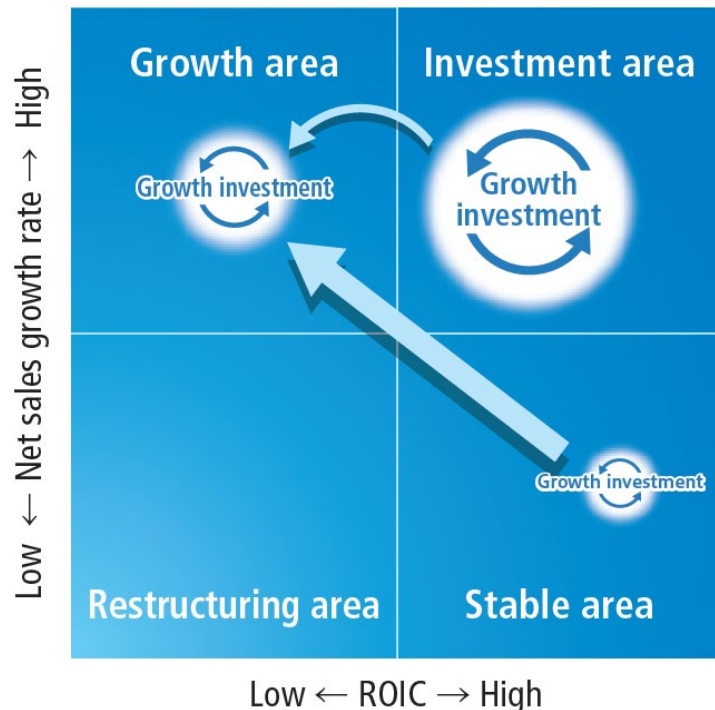
* Presenteeism: Self-assessed ratio of work performance over past four weeks, based on assumption that 100% represents performance when unaffected by illness or injury

Business Growth: Portfolio Management

- Investment capital: Generate through the growth of business operating companies and by refreshing the product portfolio
- Growth investment: 70% of investment capital will be allocated to support further growth of existing businesses and creation of new business operating companies through innovation management

Our business portfolio

Four-field matrix based on net sales growth and ROIC



Growth area

This area is for new businesses that will eventually aim for moving to the investment area.

Investment area

This area is for existing businesses that prioritize self-investment and reinvest in the growth area.

Stable area

This area is for existing businesses that prioritize reinvestment in growth area over self-investment.

Restructuring area

Restructuring is performed under the guidance of HD.

Business Growth: Innovation Management

Based on exploration activities centered around our focus areas, we will aim to create new business operating companies and solutions by investing in the development of new business seeds in phases, and through new business acquisition through collaboration with other companies.

Creating New Businesses and Solutions

Focus Areas

DX

Contribute to DX in society
DX in equipment

GX

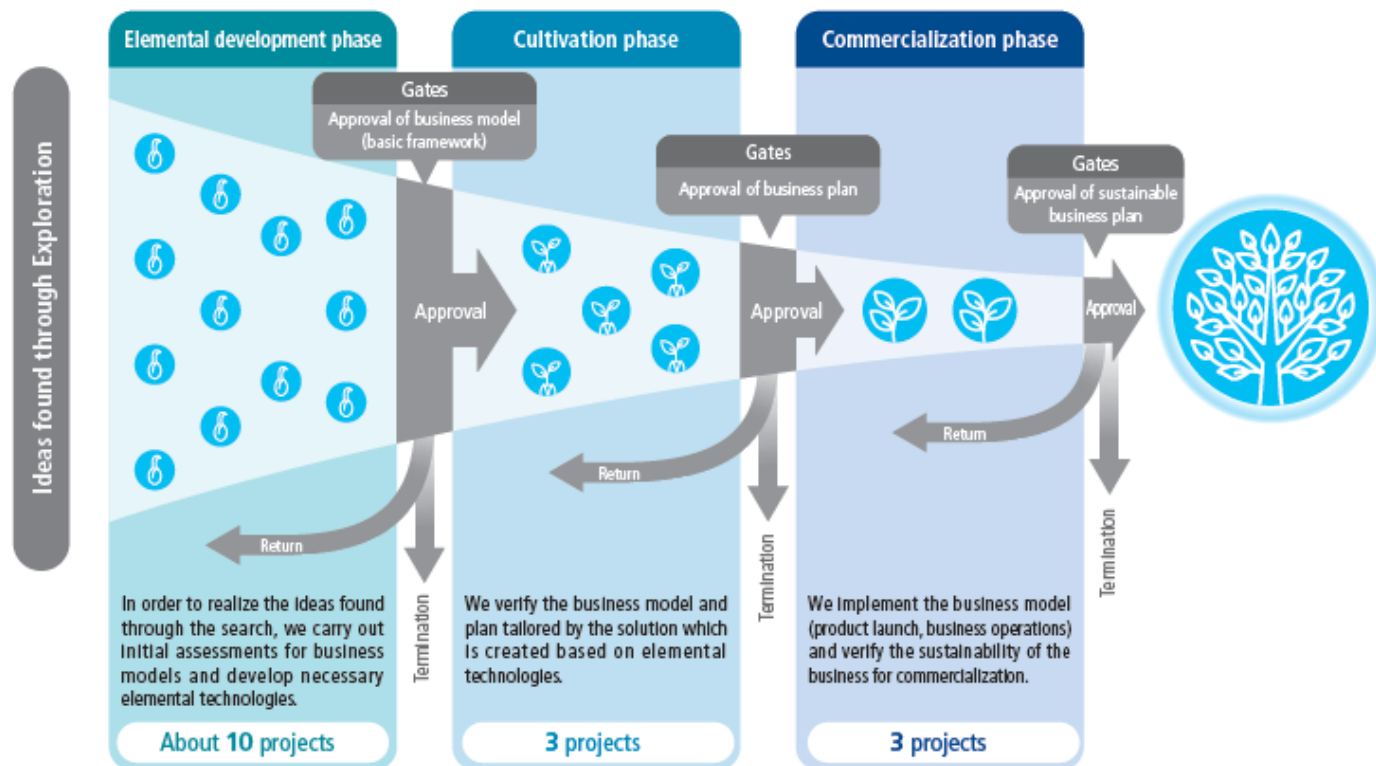
Contribute to decarbonization
Make low-energy equipment

Humanics

Automation/
self-driving
Integrate people and technologies

Mobility

Technologies that support convenient transportation of people and goods



Outcomes

Net sales from new businesses

New business operating companies

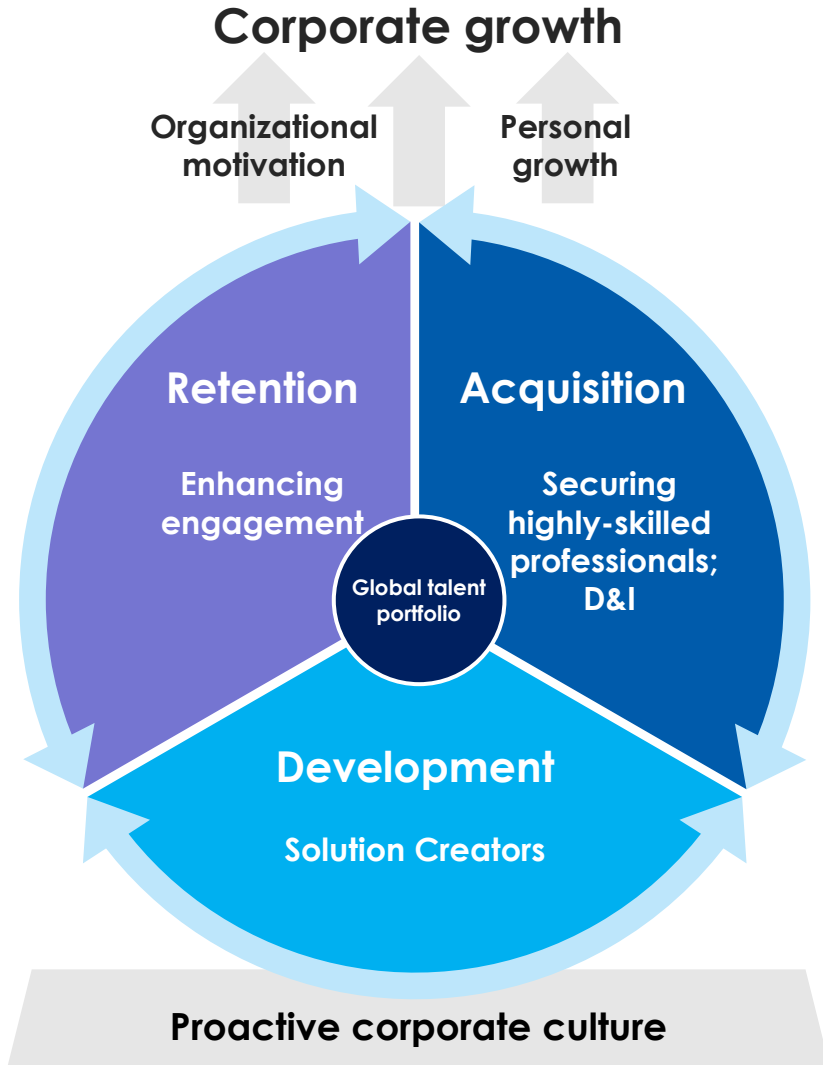
Acquisition of New Businesses

To strengthen our portfolio and create new businesses, we will actively seek opportunities to collaborate with other companies while considering their potential for capitalization (investment, M&A, etc.)

- High-priority business segments: SPE, ADPKG/PE, hydrogen energy, and other growing segments

Business Foundation Enhancement: Human Resources

Enhancing our talent pool through organizational motivation and by supporting personal growth



Global human resource portfolio

- Establish a talent portfolio aligned with targeted business models and strategies
- Introduce a systematic scheme for talent portfolio management and for strategies related to talent acquisition, development and retention

Securing highly-skilled professionals and D&I promotion

- Acquire talents who can support SCREEN's sustainable growth
- Promote D&I (highly-skilled talents regardless of gender and nationality) to support value creation
- Review the HR scheme for specialists for diverse professionals to demonstrate their best abilities in a global environment

Developing Solution Creators

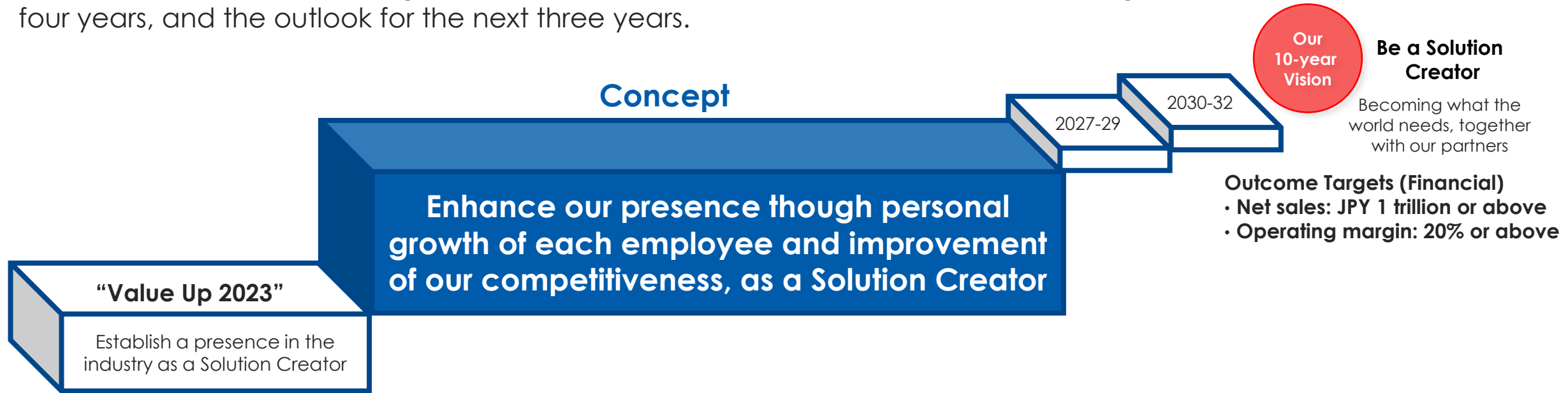
- Cultivate and encourage employees to think and act independently
- Develop a corporate culture supportive of taking new initiatives and open innovation
- Build mechanisms that encourage and drive self-motivated actions, collaboration, and new workstyles

Enhancing engagement

- Strengthen global engagement to engrain the corporate philosophy
- Promote work-life balance by accommodating diverse workstyles
- Provide a work environment that enables employees of all age groups to demonstrate their abilities

Concept and Key Points to be Addressed of the Next Medium-term Management Plan

To achieve our targets in the revised Management Grand Design, we have identified key points to be addressed in the next medium-term management plan, based on the achievements and pending issues from the past three-four years, and the outlook for the next three years.



Key Points to Be Addressed

- Increase our market share by launching new technologies/products, and strengthening marketing
- Create new businesses
- Improve operation by further promoting ROIC management
- Enhance our business foundations for future growth

Outlook of the semiconductor market and WFE, and SPE's growth strategies

Masato Goto

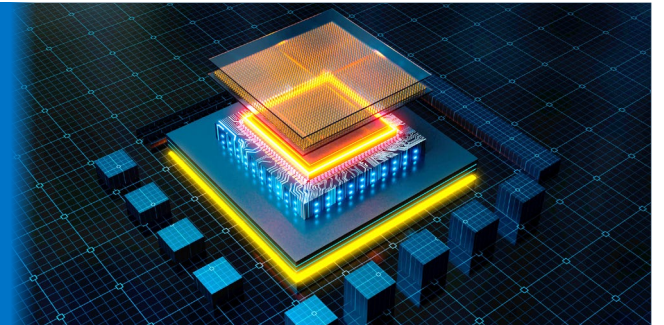
President

SCREEN Semiconductor Solutions Co., Ltd.

Market trends



R&D progress



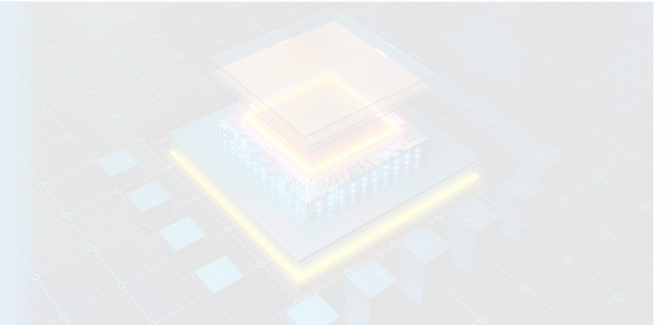
Productivity improvement



Market trends



R&D progress

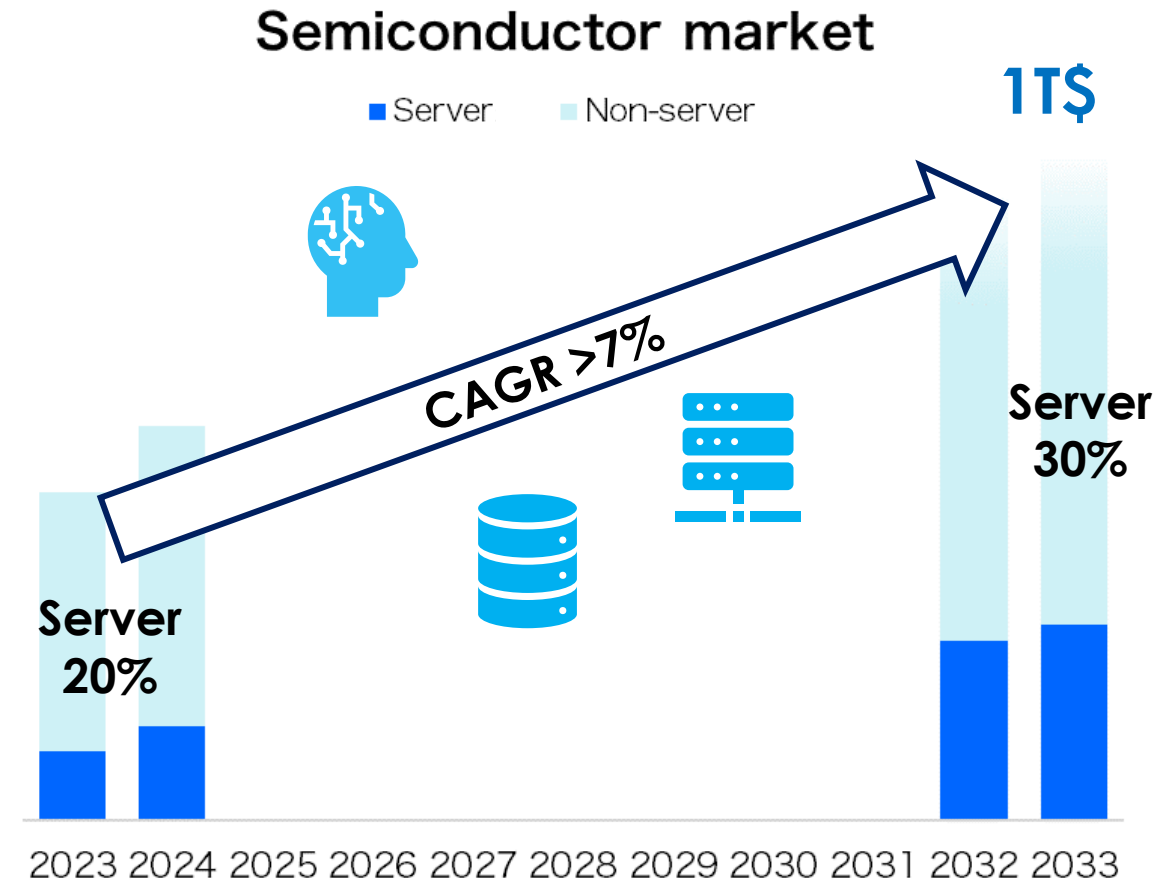
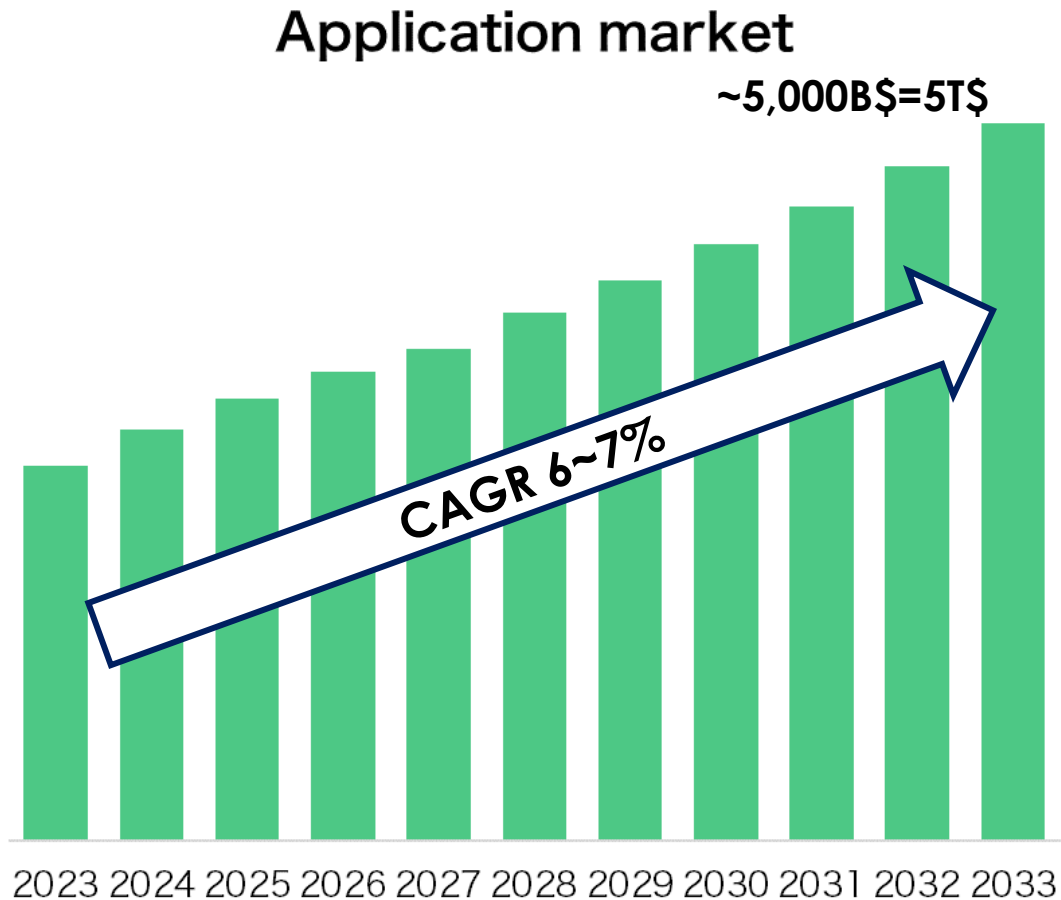


Productivity improvement

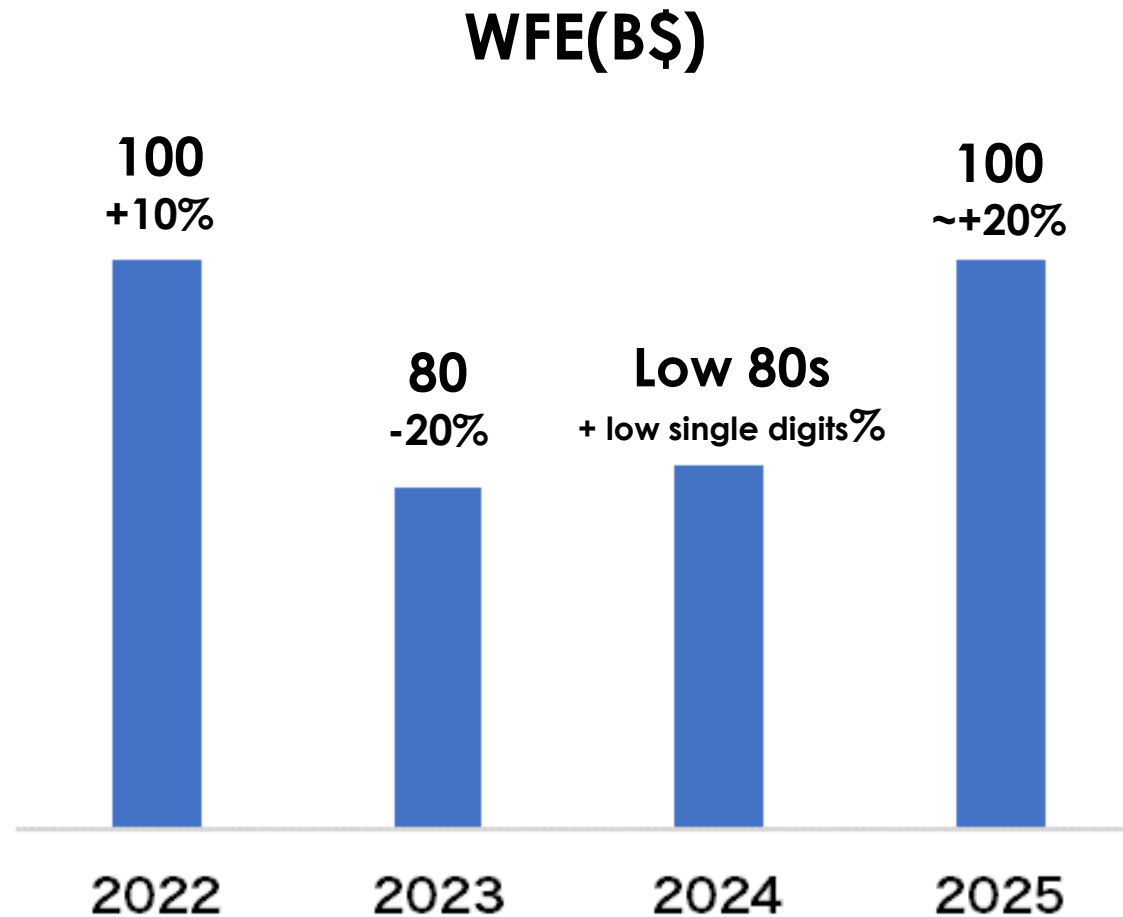


Application & Semiconductor market forecast

- Application: Growth in the medium to long term [CAGR 6-7%]
- Semiconductor: 1T\$ level in 10 years driven by AI, Server and so on



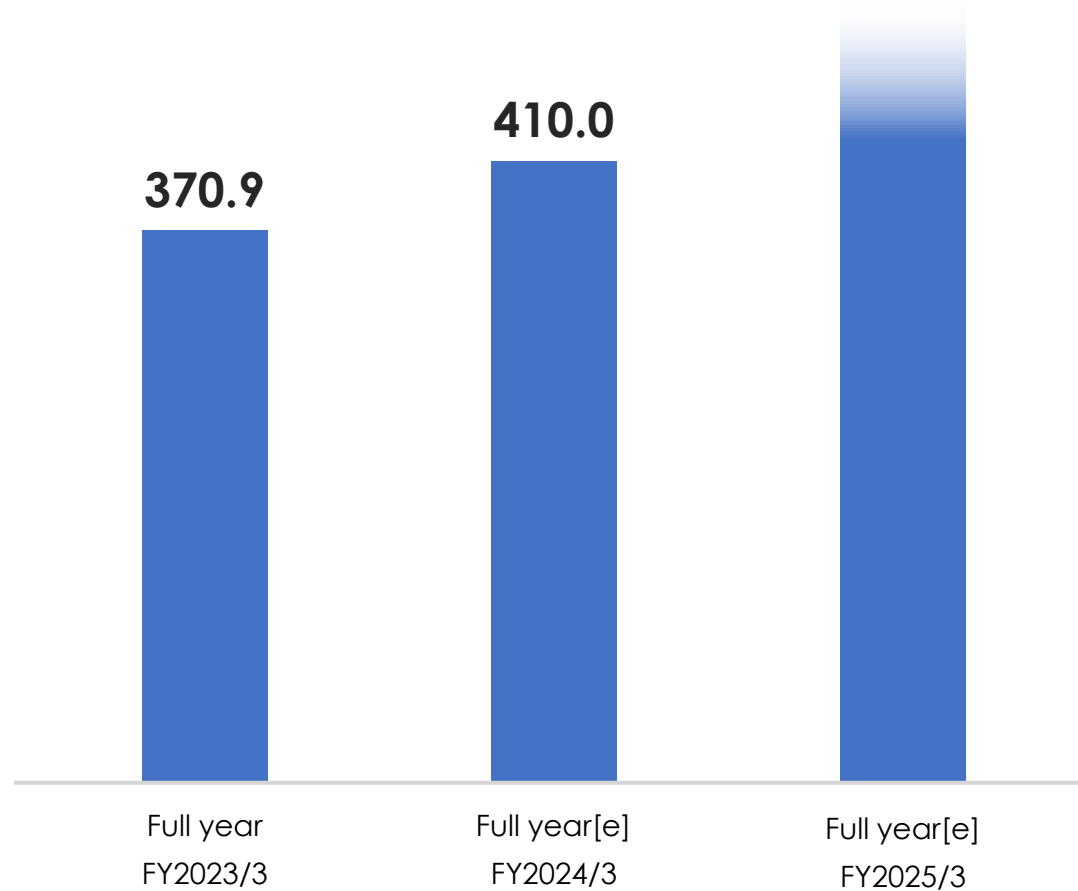
■ WFE market will start recovery from CY2025



- CY23 WFE forecast is around \$80B
- WFE may hit bottom in CY23, 24 and it will start recovery from CY25 due to start recovery Memory market from CY25
- Although Foundry/Logic will show a slight downward trend sometimes, from a medium- to long-term perspective, it continues to steadily upward trend

■ The market is adjustment phase in a short-term

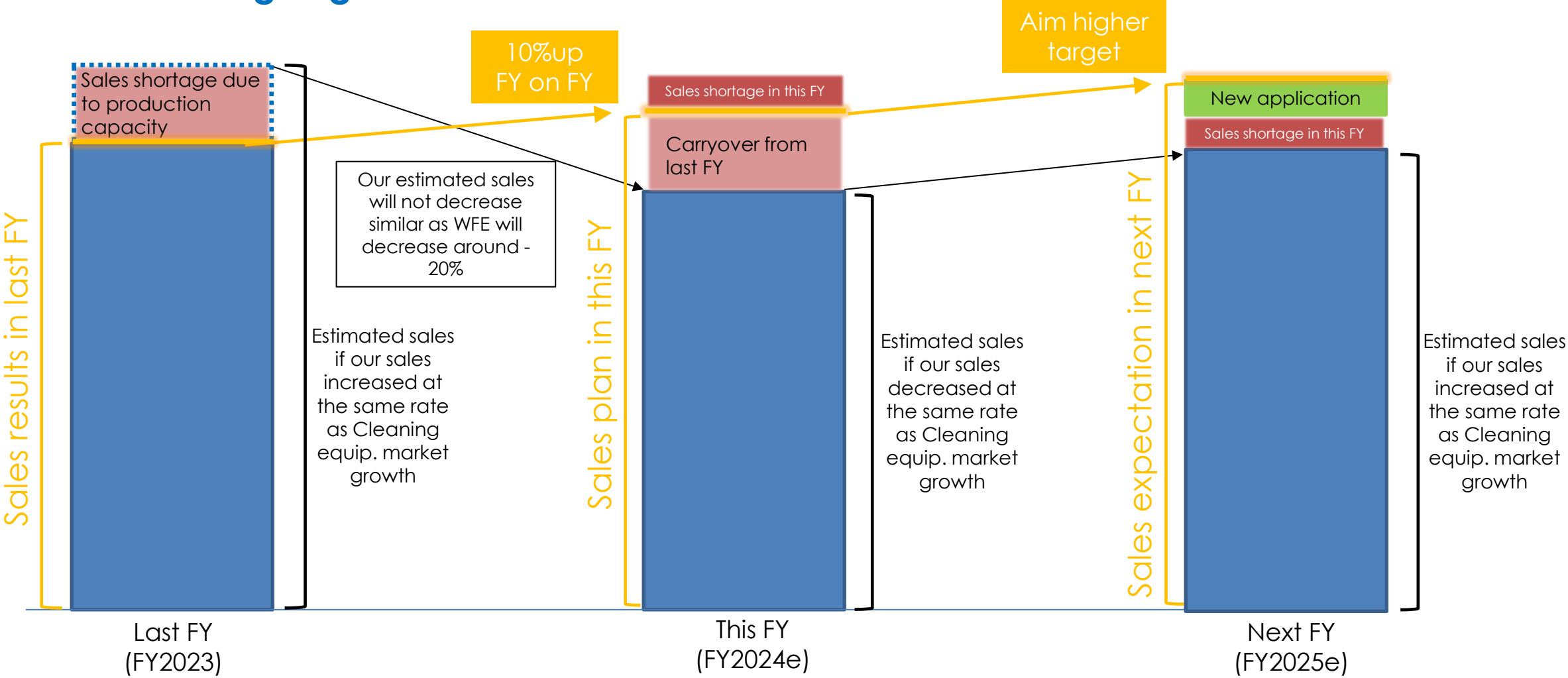
Sales revenue (Billions of JPY)



- Our market share has been on the decline in recent years, but we have not lost any POR
- Both sales and market share are expected to increase this year and next year
- Complete current development items with the aim of obtaining additional POR

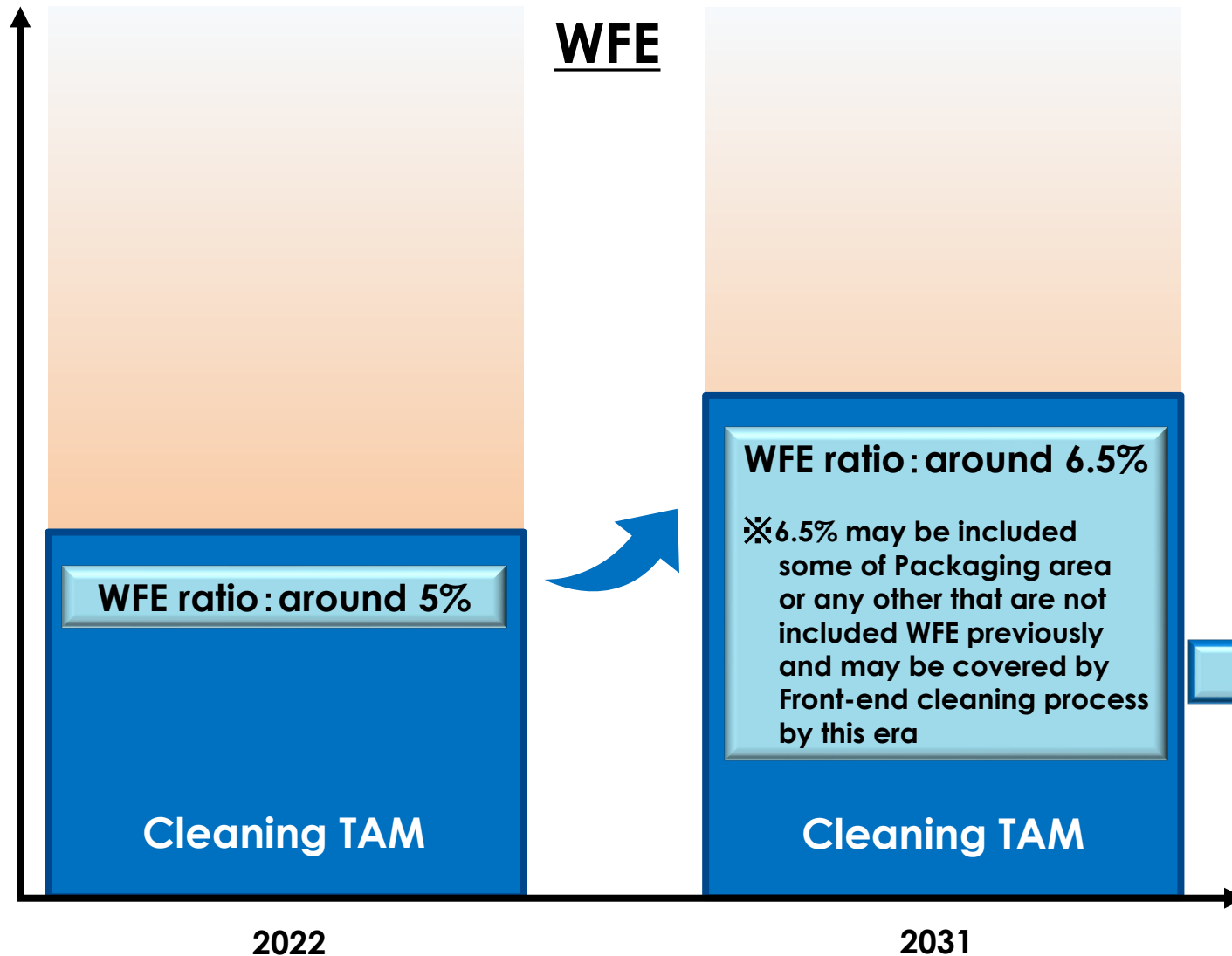
Our SPE business situation

■ Our business is going well

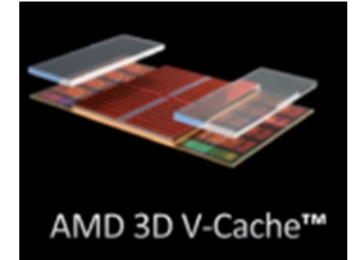


Our SPE business area

SPE



Source : IMEC, FUTURE SUMMITS 2022



Source : AMD, Web-site
[chiplet-architecture-white-paper.pdf](#)

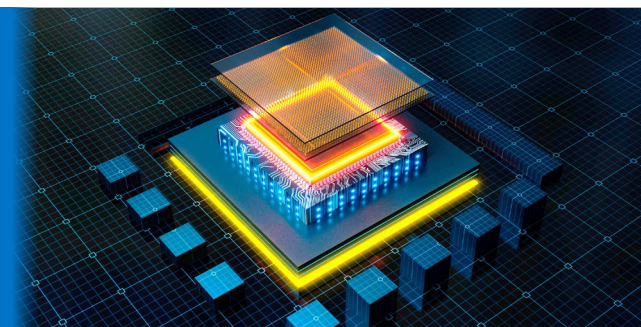
Increase Cleaning TAM

- **Continued miniaturization**
Increase process steps
e.g. BS cleaning etc. for EUV process
→ Refer Cleaning tech. part material
- **Ad-Logic [Chiplet etc.]**
Increase process steps
e.g. Bonding, Contact hall, Wafer thinning etc.
→ Refer Cleaning tech. part material

Market trends



R&D progress

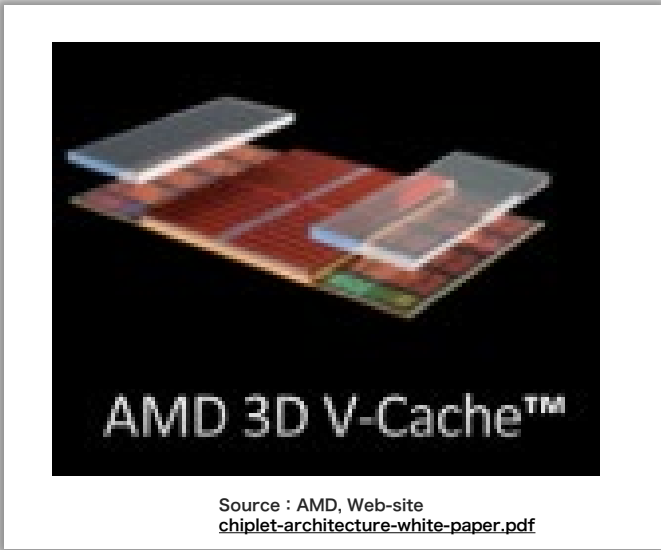


Productivity improvement



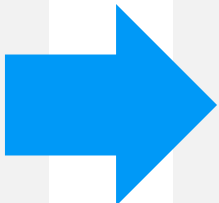


Source: SCREEN estimation



Source : AMD, Web-site
chiplet-architecture-white-paper.pdf

Miniaturization and 3D integration



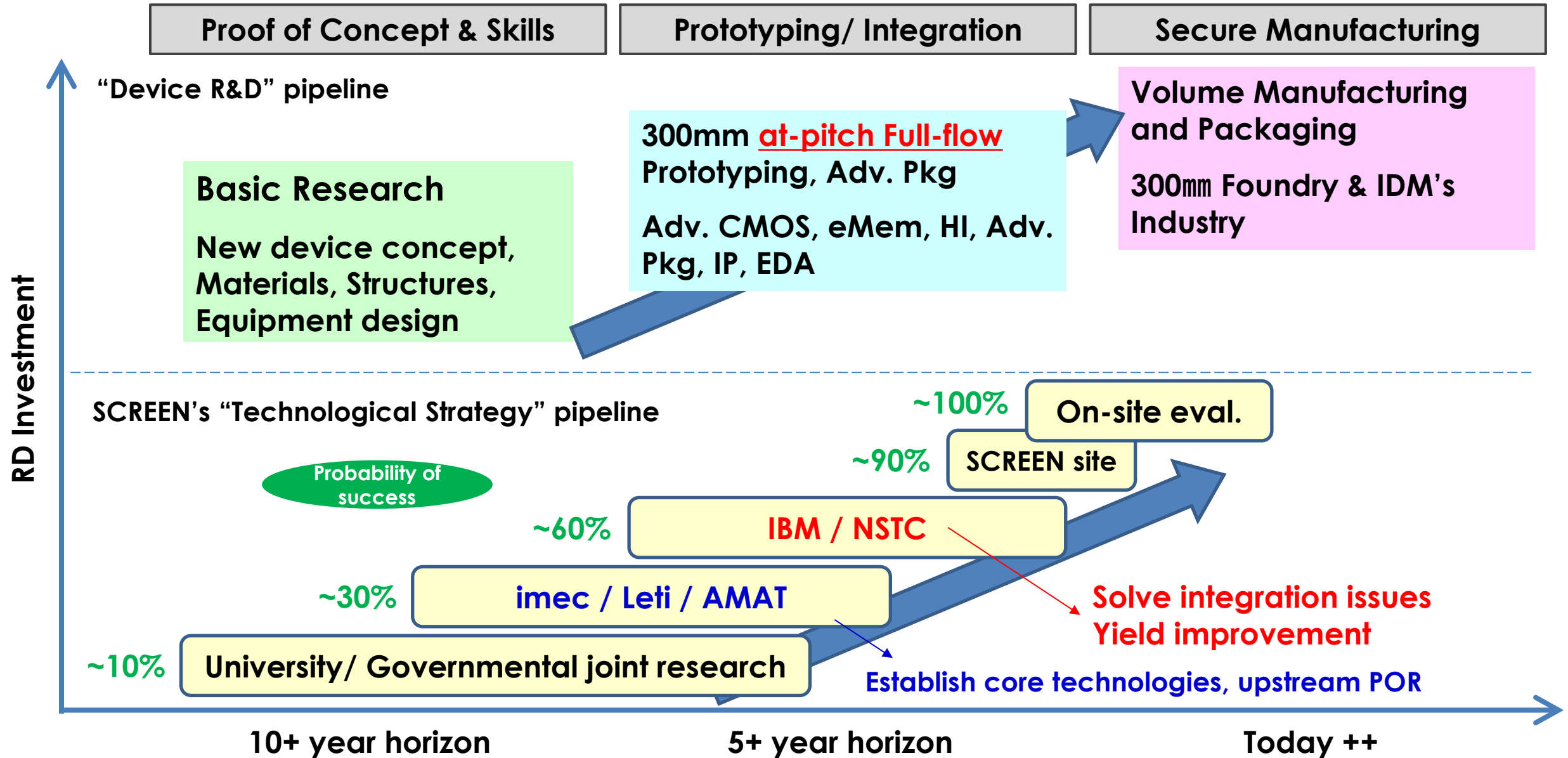
Completion of development
Utilizing know-how, collaboration results



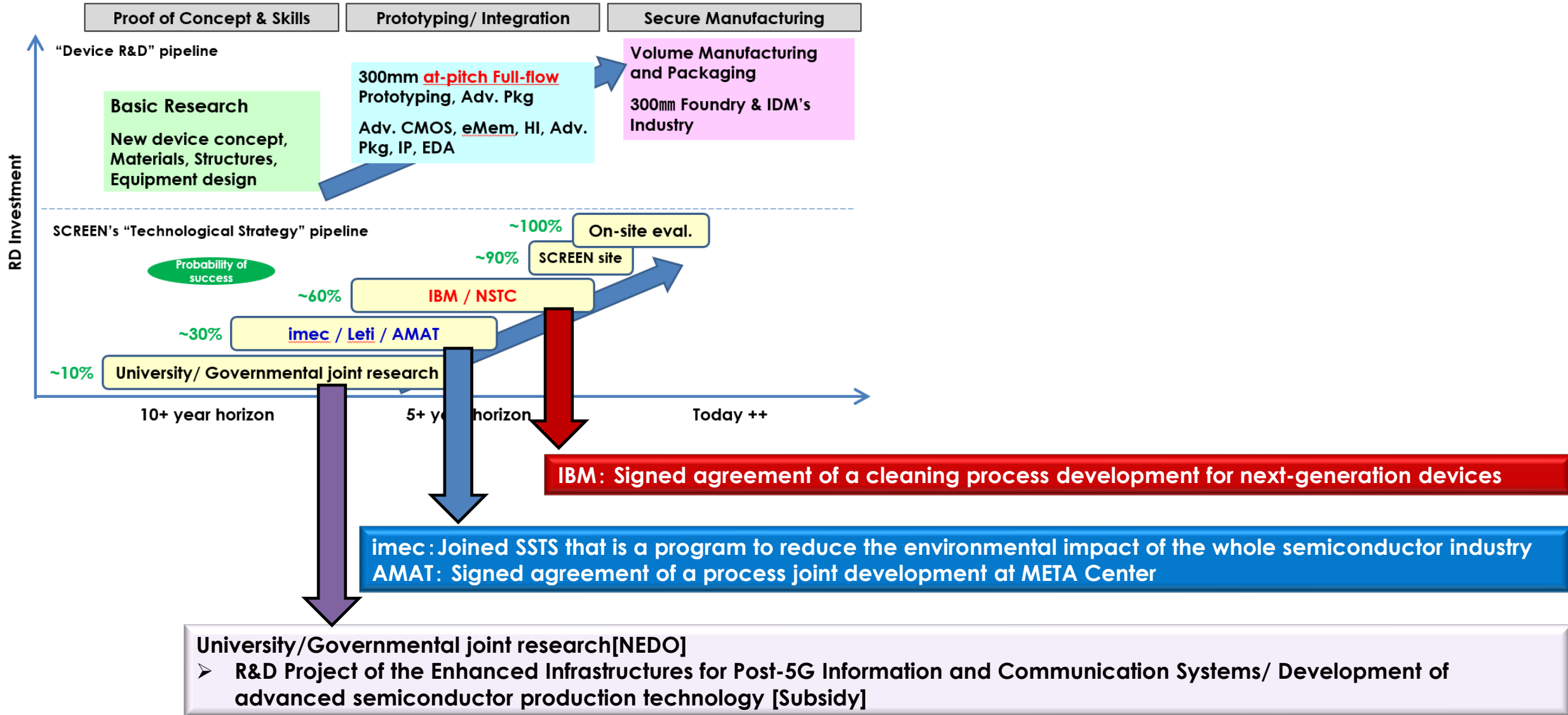
Provide Solution

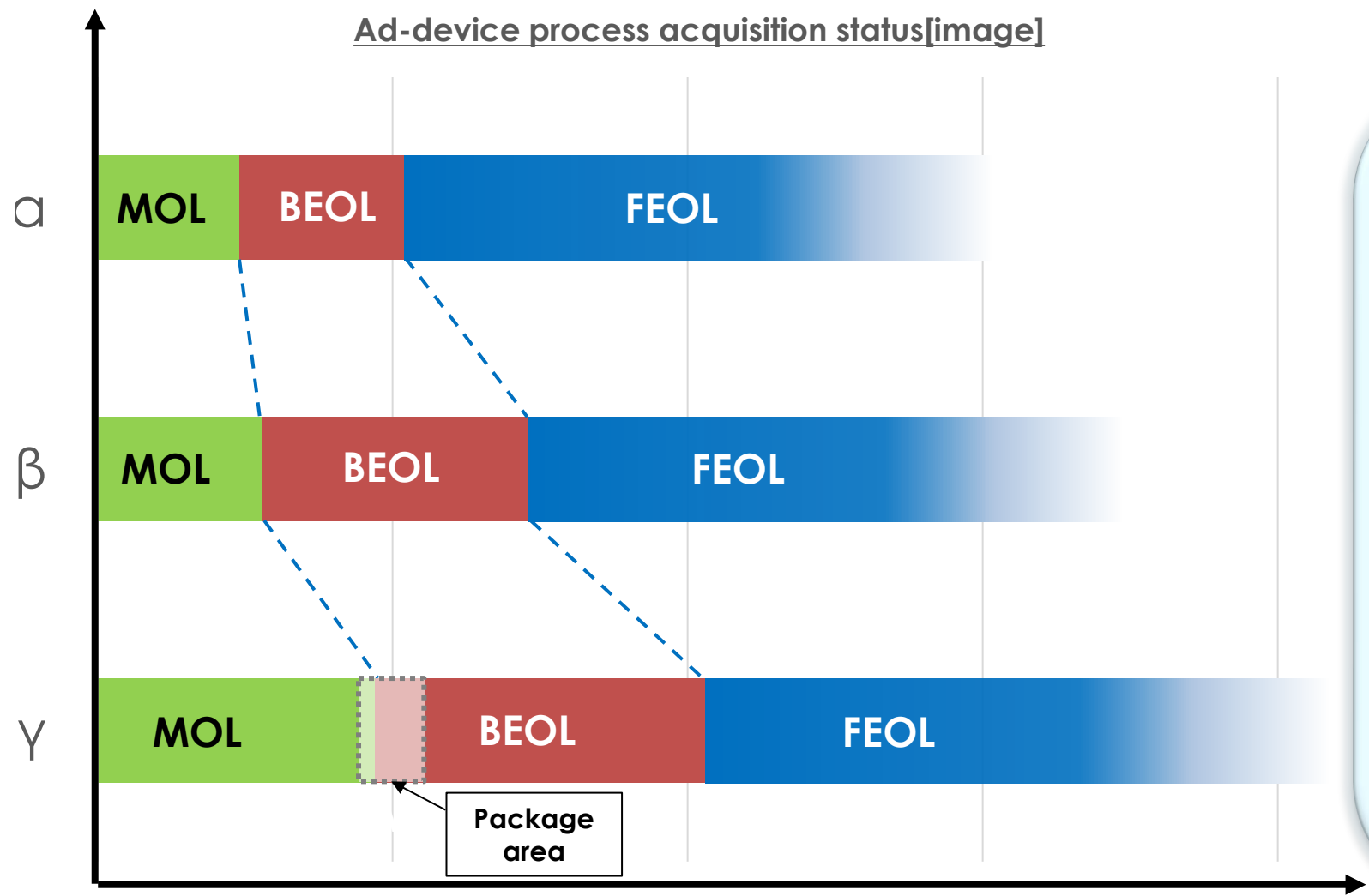


R&D pipelines to enhance added value for customers



R&D pipelines to enhance added value for customers -Progress-





Acquire business in advanced cleaning area

- Continued miniaturization
- Diversification of structure



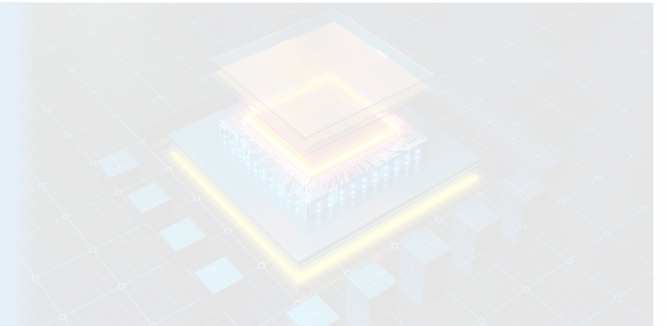
Expand business in advanced cleaning area

MOL/BEOL business is also getting higher

Market trends



R&D progress



Productivity improvement



Productivity improvement of whole SPE group companies

SPE



Takaoka Plant



Conceptual drawing of completion of S³-5 at Hikone

■ Aim to have Capacity of 500 billion yen* for whole SPE group companies

- SPE Works: New building construction in Takaoka Plant
- SPE Quartz: Expanded and renovated Koriyama and Iwaki plant
- Hikone area : New S³-5 plant construction

* This may change once the next medium-term plan is finalized



Improve the flow of information by adding ingenuity to nanotechnology

Investment is expected to recover from the end of 2024 to 2025



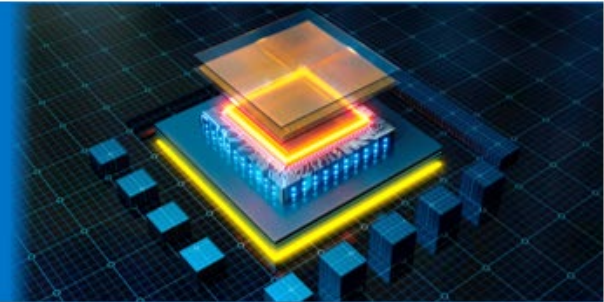
Improved our business opportunities



Development for Miniaturization and 3D integration



Our market share improvement



Productivity improvement for next big demand

- S³-5 Scheduled for completion in Jan. 2024
- Productivity improvement of whole SPE group companies



Initiatives to increase market share

Hiroaki Takahashi

Division Head

Clean Technology Development Operations

SCREEN Semiconductor Solutions Co., Ltd.

■ The growing importance of cleaning processes

■ Technology in high value-added area

UCPSS2023 (September 12th to 14th 2023 in Belgium)

- Fundamental technology
- Selective wet etching
- Technology for scaling and 3D devices

■ Summary

■ The growing importance of cleaning processes

■ Technology in high value-added area

UCPSS2023 (September 12th to 14th 2023 in Belgium)

- Fundamental technology
- Selective wet etching
- Technology for scaling and 3D devices

■ Summary

Wafer bonding process introduced for each device

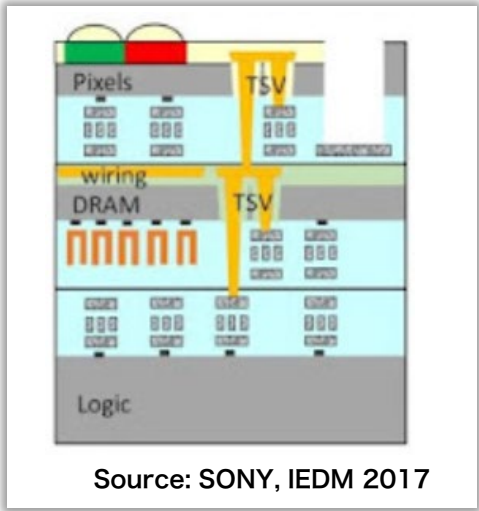
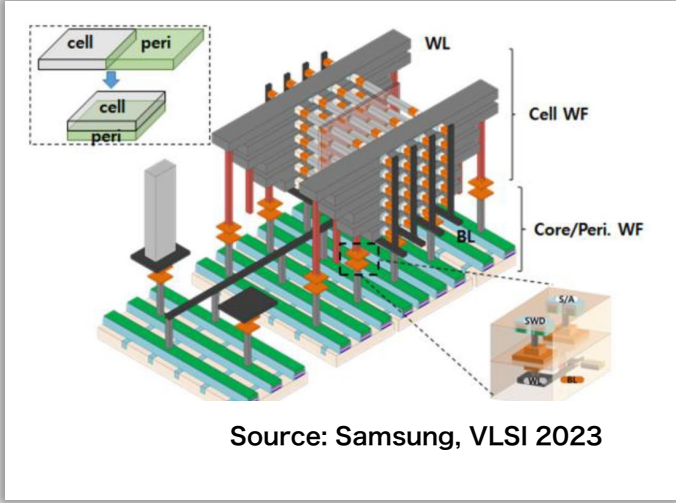
Introduced

CIS



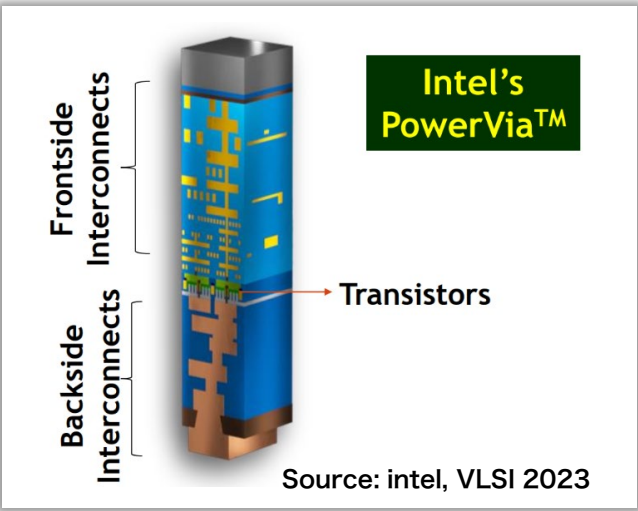
Expected to be introduced in 2025-26

Ad-Logic



3D-NAND

Partially introduced after 2025

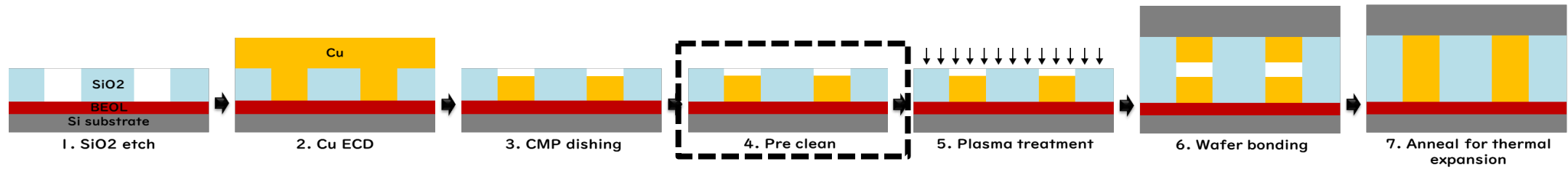


3D-DRAM

Expected to be introduced in 2028

■ Increased added value of cleaning due to scaling and 3D devices

Cleaning challenges related to wafer bonding: Before bonding



Source: SCREEN estimation

Negative factors: Oxidation, Contamination and Roughness

1. High temperature and pressure are required for bonding due to surface oxide

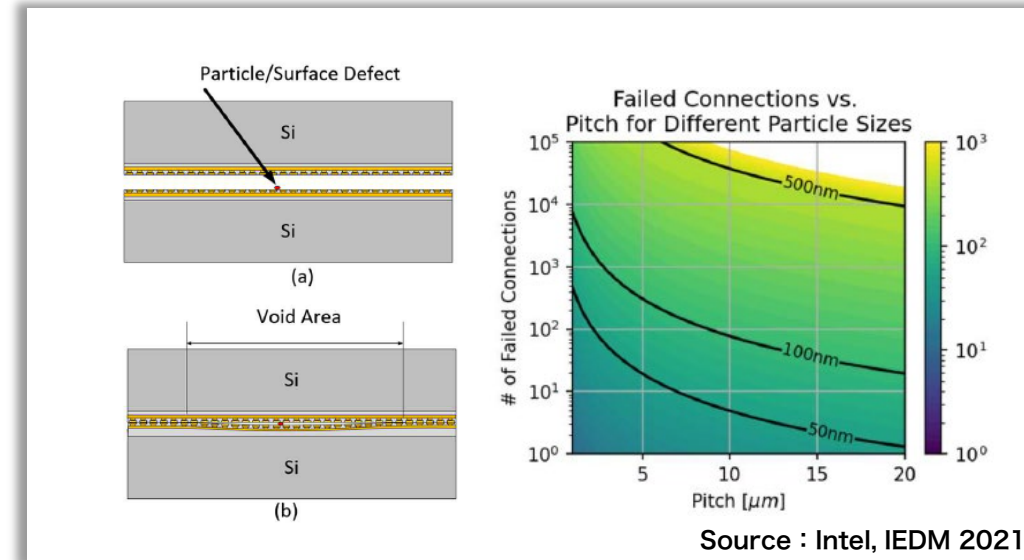
→ **Cleaning is required to prevent surface oxidation**

2. Voids occur due to contamination which generates poor bonding

→ **Cleanliness is important**

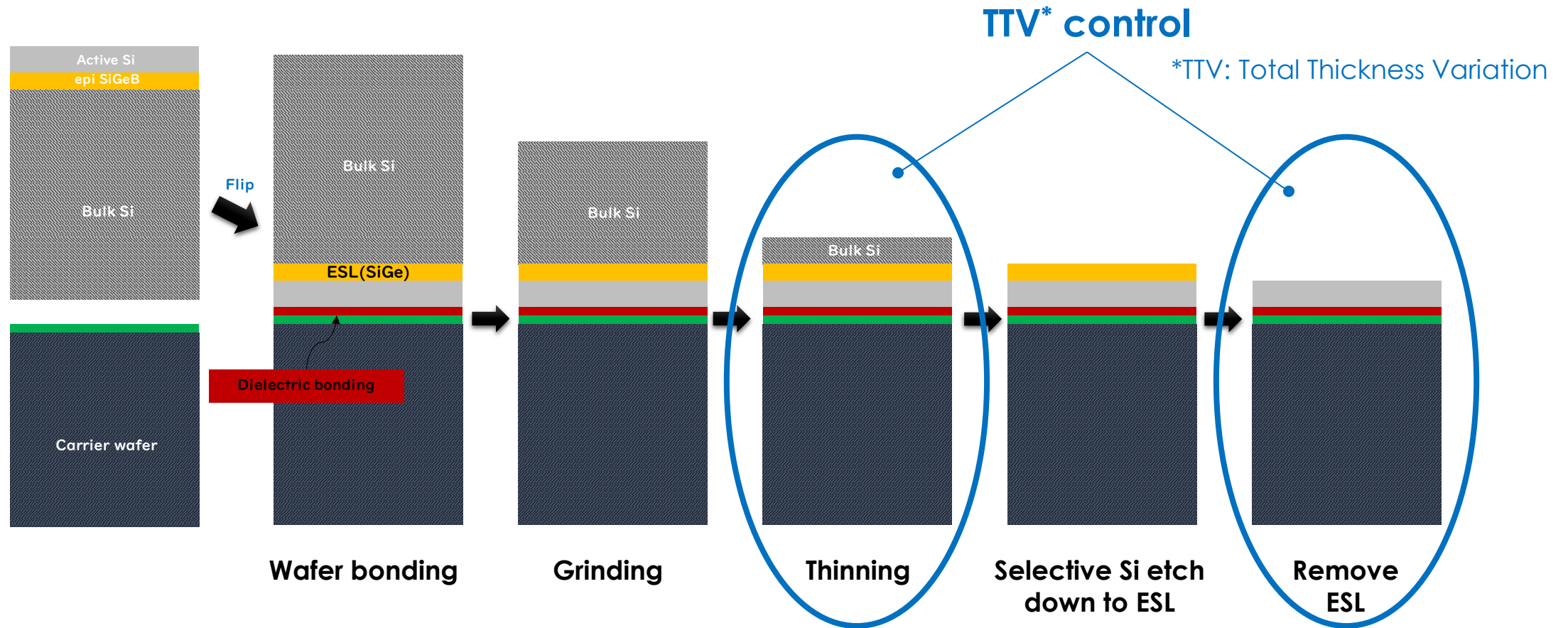
3. Due to the scaling of Cu wiring, it is difficult to thermally expand, which leads poor bonding

→ **Loss-free cleaning is required in front-end cleaning process**



■ Surface treatment is important before wafer bonding, as nm-level roughness greatly affects yield.

Cleaning challenges related to wafer bonding: After bonding (1/2)



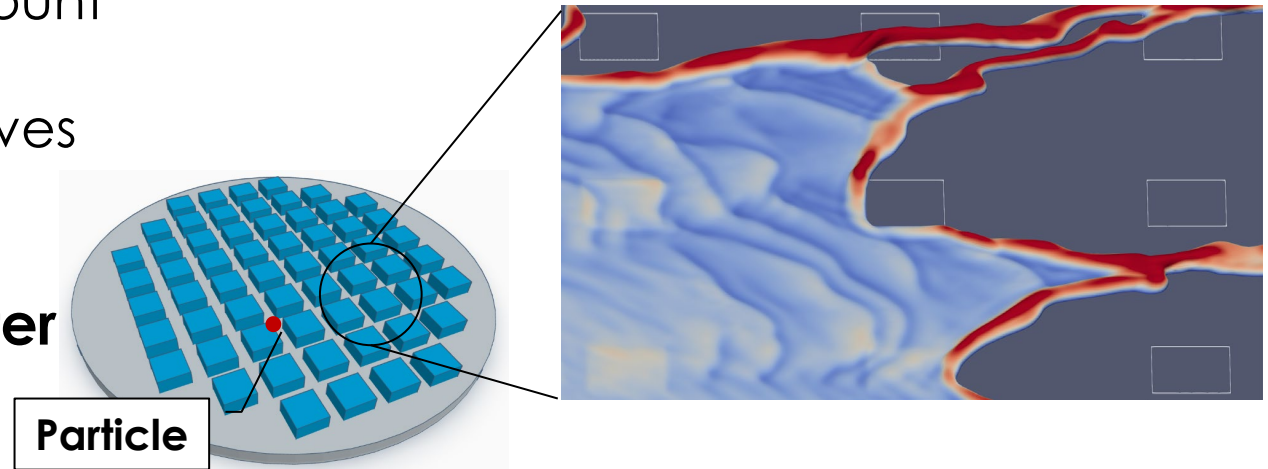
Source: SCREEN estimation

■ Wet treatment is required as final step, since it is difficult to adjust the thickness within wafer surface with grinding and CMP

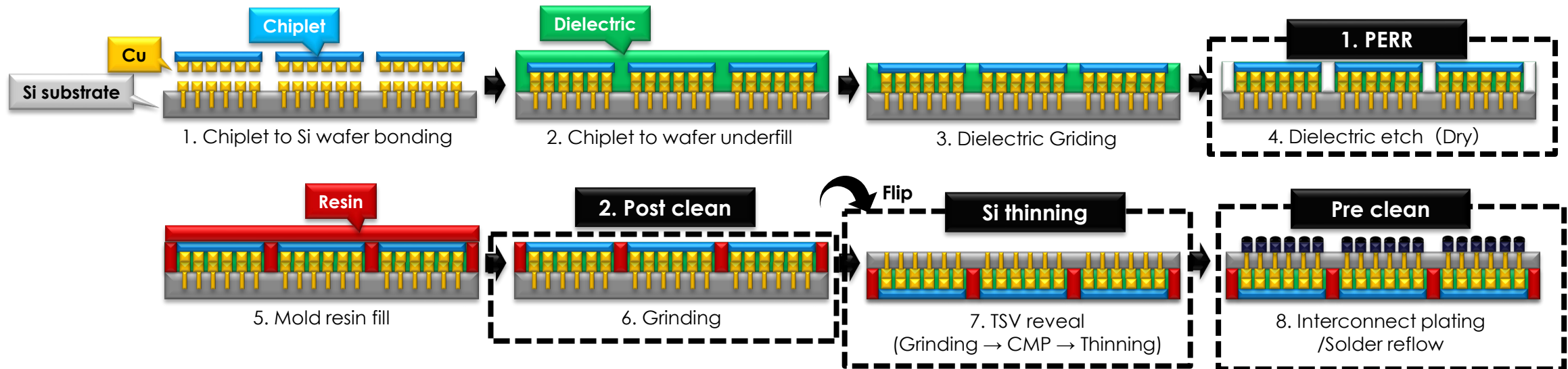
1. PERR (Post Etch Residue Removal)

- Cleaning is required taking into account the thickness of the chip
- Remove particle existing in the grooves between chips

Fluid simulation example on CoW



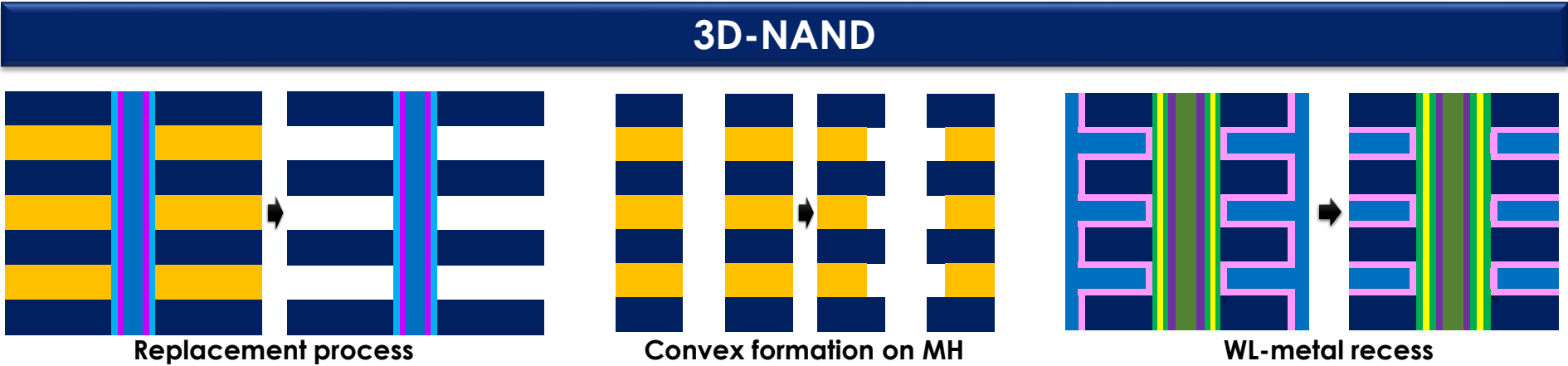
2. Measures against wafer warping after resin embedding



Source: SCREEN estimation

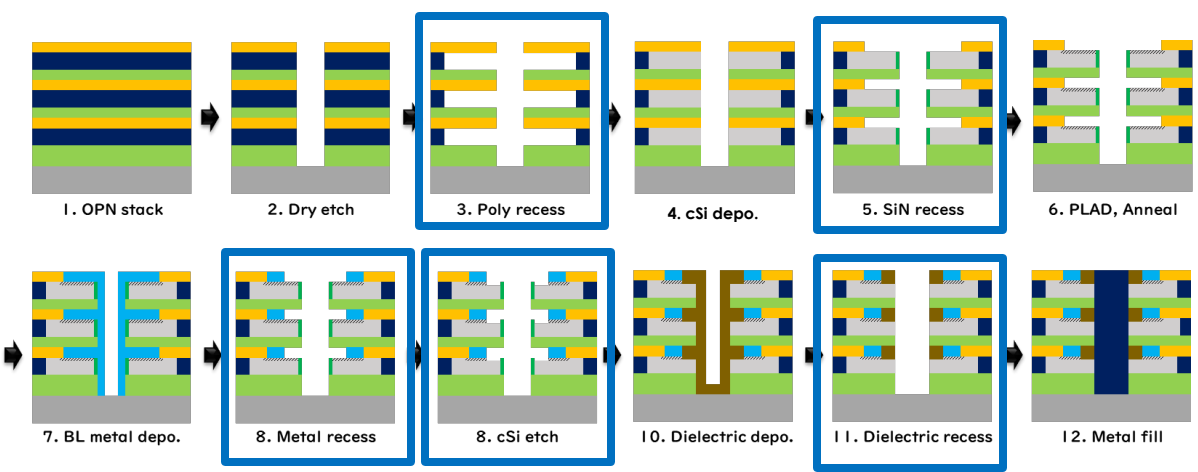
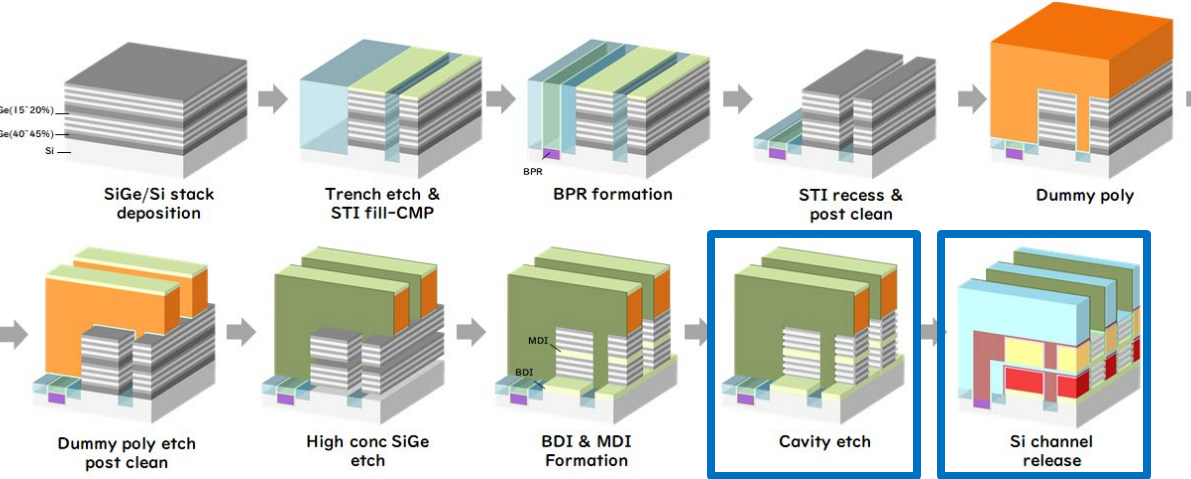
Cleaning challenges related to 3D devices

Source: SCREEN estimation



Logic(Monolithic CFET)

3D-DRAM



The process flow of each device is based on our own research

■ Horizontal wet etching started with 3D-NAND will be expanded to Logic and DRAM

Factors of cleaning step increment in advanced logic

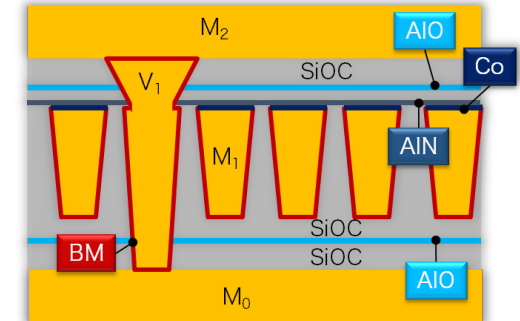
1. Increased number of BEOL wiring layers

2. Demand for wafer backside and bevel cleaning

- ESL* (Aluminum-family materials) removal in MOL/BEOL (Critical wiring layer)
- Metal contamination removal related to MOR* for EUV
- EUV defocus measures
- Removal of new materials (Ru, Mo)

*ESL: Etching Stop Layer

*MOR: Metal Oxide Resist

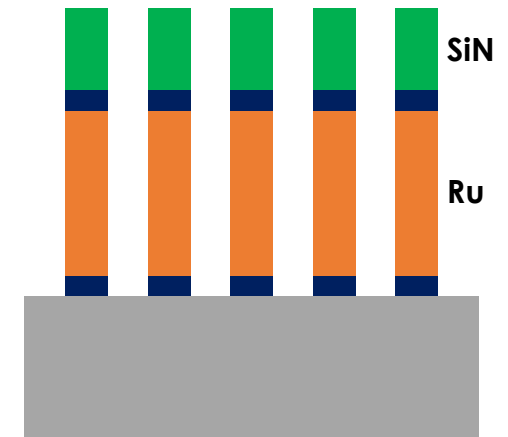


Source: SCREEN estimation

3. Bottom-up process for via

4. Post clean for subtractive etching of new material (Ru)

5. Increased number of EUV multi-lithography process due to scaling of wiring pitch

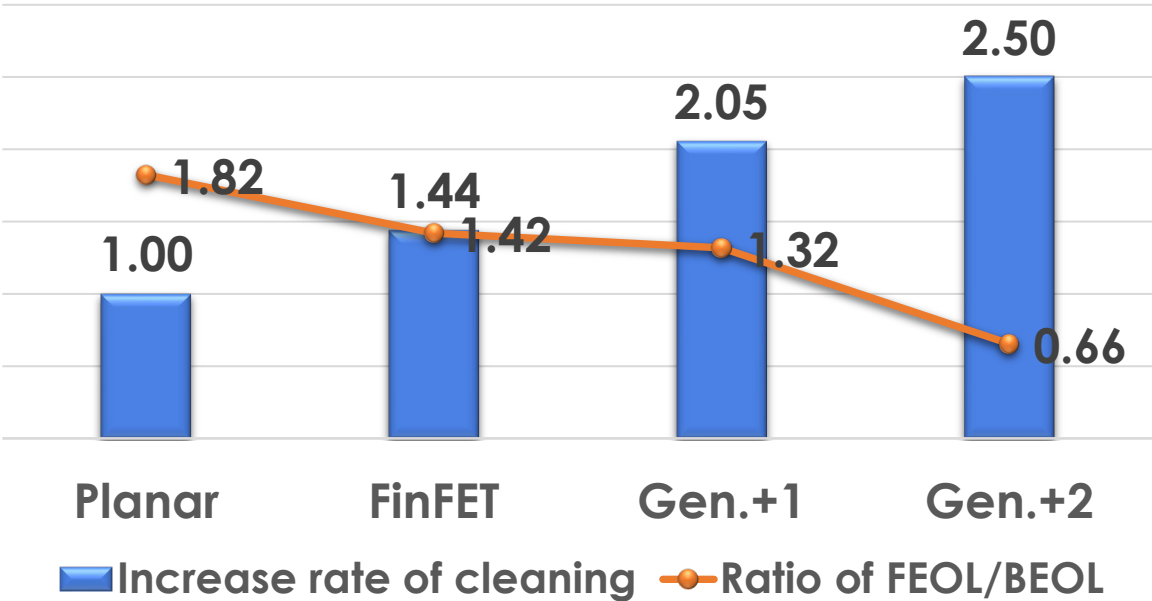


Source: SCREEN estimation

Number of cleaning steps in advanced logic (According to our research)

Non-EUV generation

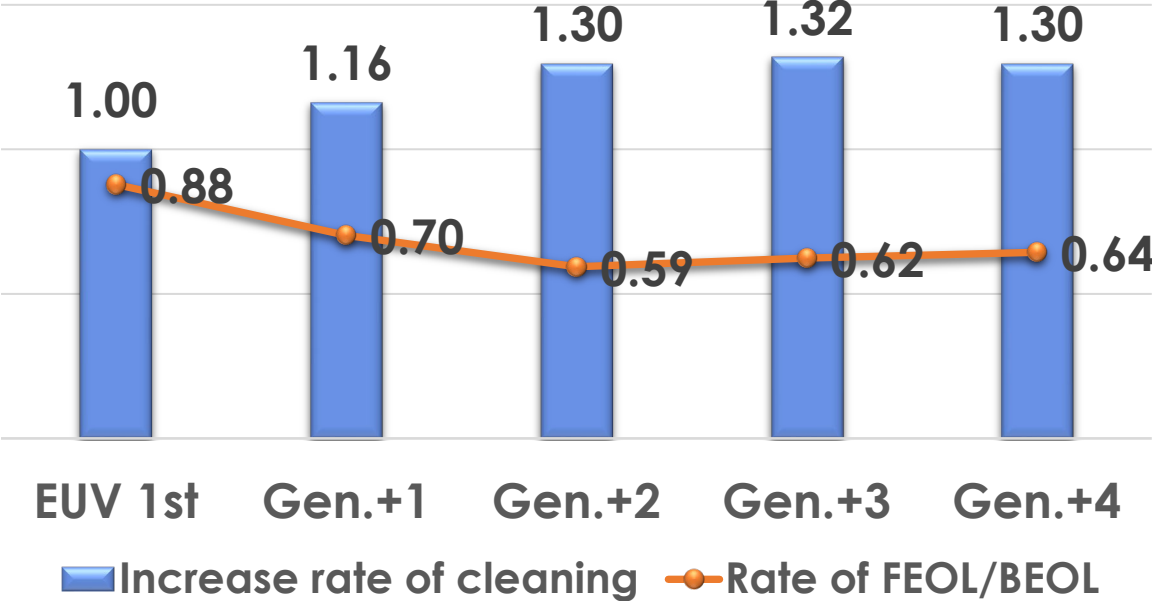
Legacy generation
Increase/decrease rate of cleaning process when Planar = 1



- ❑ Changes in transistor structure (Planer→FinFET)
- ❑ Increased number of multi-lithography steps
- ❑ Increased number of wiring layers

EUV generation

Advanced generation
Increase/decrease rate of cleaning process when EUV 1st = 1



- ❑ Changes in transistor structure (Gen.+1→Gen.+2)
- ❑ Introduction of BSPDN* structure (Gen.+3)
- ❑ Increased number of wiring layers

*BSPDN: Backside Power Delivery Network

■ With scaling, cleaning steps become more important, and the number of steps will increase

■ The growing importance of cleaning processes

■ Technology in high value-added area

UCPSS2023 (September 12th to 14th 2023 in Belgium)

- Fundamental technology
- Selective wet etching
- Technology for scaling and 3D devices

■ Summary

Fundamental technology: CFD

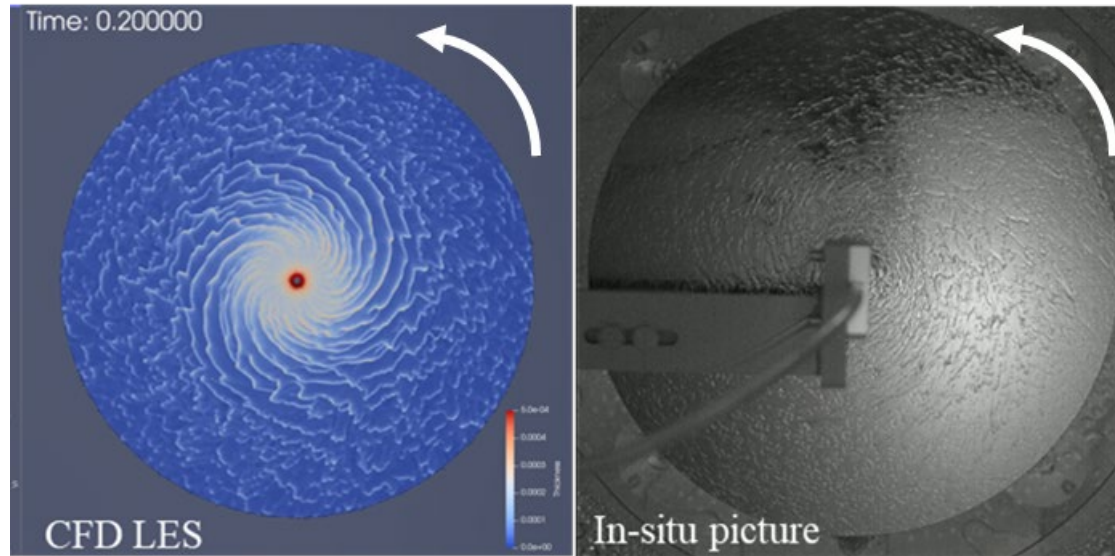
SPE

Lead author: Dr. Naser Belmiloud

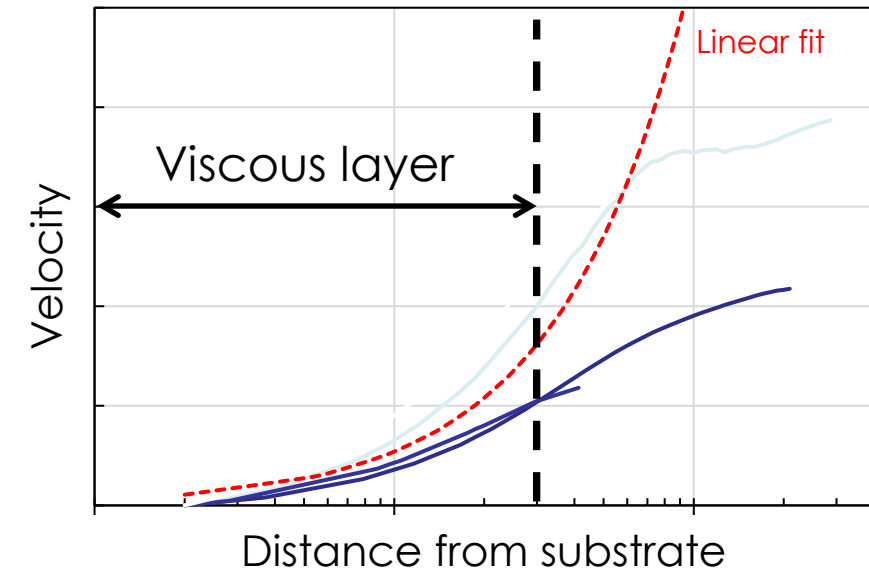
Title: Fluid simulation over a rotating disk: momentum and mass transfer across the wafer boundary

Comparison between CFD LES* and High speed camera

*LES: Large Eddy Simulation



Viscous layer near substrate and turbulent on it



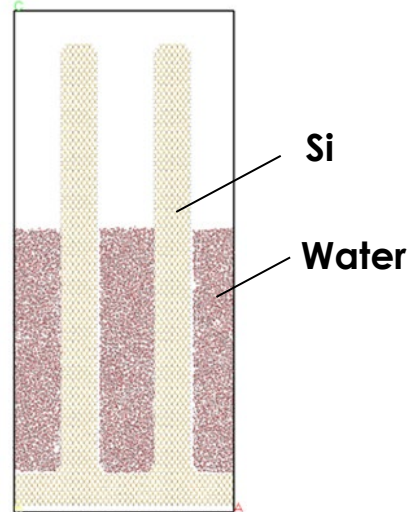
This report is based on results obtained from "Research and Development Project of the Enhanced Infrastructures for Post-5G Information and Communication Systems" (JPNP20017), commissioned by the New Energy and Industrial Technology Development Organization (NEDO).

- Understanding the behavior of the viscous layer near the substrate is essential to increase the added value of cleaning
- Controlling the thickness of viscous layer through parameter setting to seek the best cleaning conditions

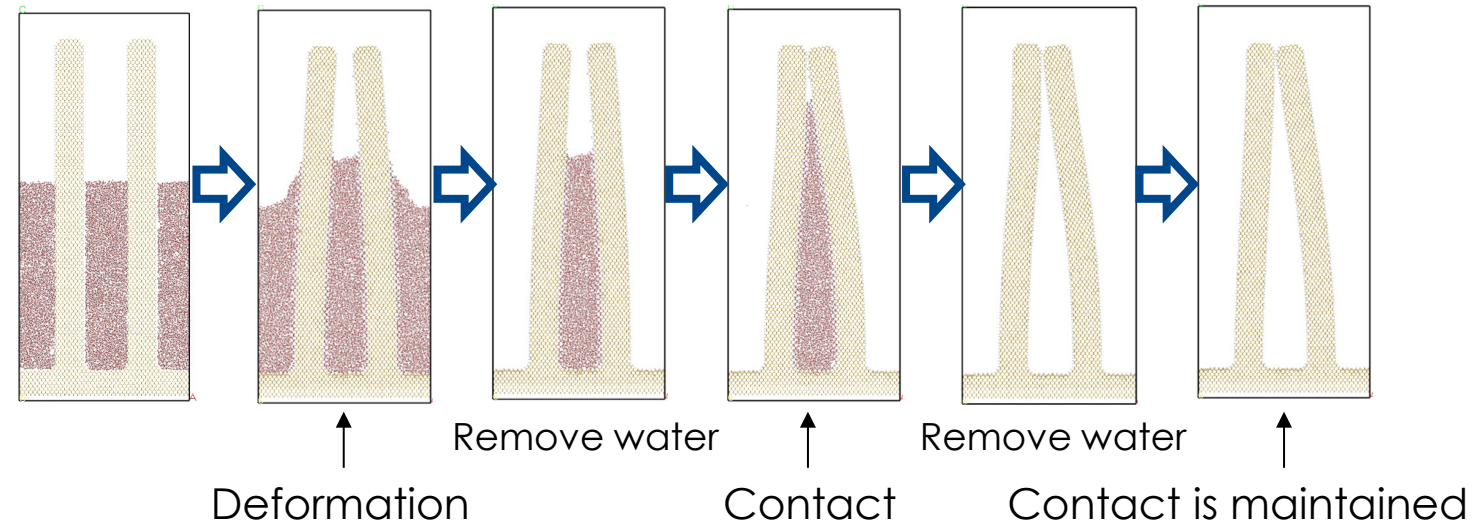
Lead Author: Ryuichi Seki

Title: FinFET pattern collapse in reactive molecular dynamics simulation

Model: Water filled in FinFET



Result: FinFET pattern deformation and contact



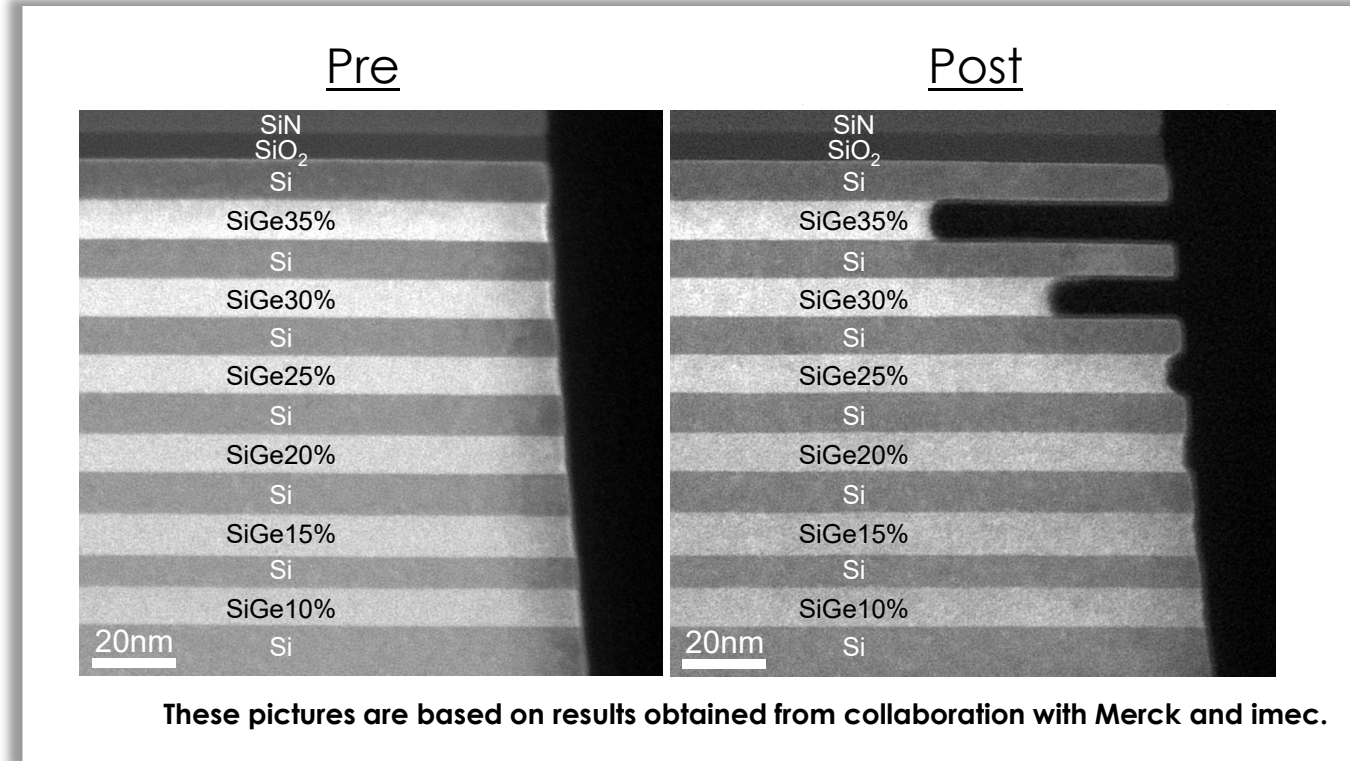
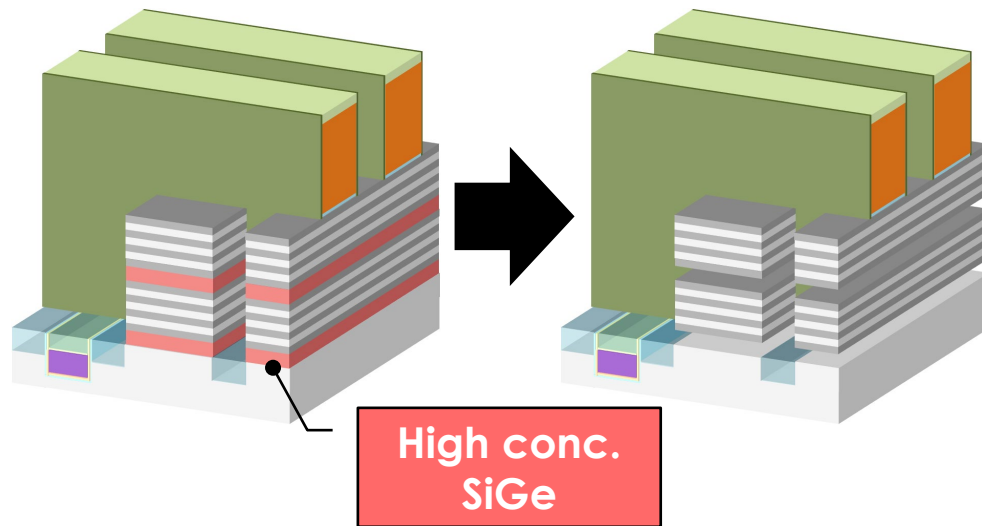
- Understanding of drying behavior at the molecular level is necessary to pursue dry technology
- Aim to sophisticate our drying technology through further understanding of it

Selective wet etching

Lead author: Hikaru Kawarazaki

Title: SiGe selective etching to enable bottom and middle dielectric isolations for advanced gate-all-around CFET architecture

Example



- SiGe selective etching technology is required to fabricate Nanosheet, Forksheet and CFET
- Propose technologies and process, maximizing merits of chemical characteristic

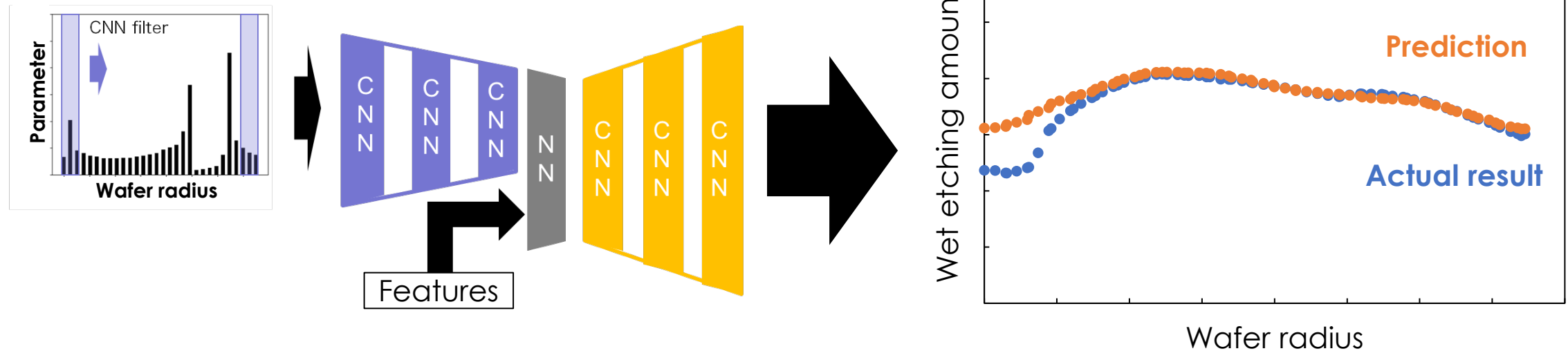
Technology for scaling and 3D devices

Lead author: Masahiro Tokuyama

Title: Proposal Etch Prediction Model using Convolutional Neural Network

Wet etching profile prediction model using CNN*

*Convolutional Neural Network



Related patent pending

- Flexible wet etching is required for thickness variation caused by previous process
- Aiming for high-value-added wet etching equipment using technology that predicts the amount of wet etching

■ The growing importance of cleaning processes

■ Technology in high value-added area

~UCPSS2023 (September 12th to 14th 2023 in Belgium)~

- Fundamental technology
- Selective wet etching
- Technology for scaling and 3D devices

■ Summary

- As devices become more integrated through scaling, 3D technology and wafer bonding, the added value of cleaning is increasing.
- At advanced nodes, we believe that the added value of SCREEN's unique technology will increase as the importance of cleaning and the number of steps increase, making it possible to further drive market growth.
- We will continue to provide solutions to maximize added value for our customers.

Initiatives to expand the business of semiconductor annealing equipment

Takumi Mikawa

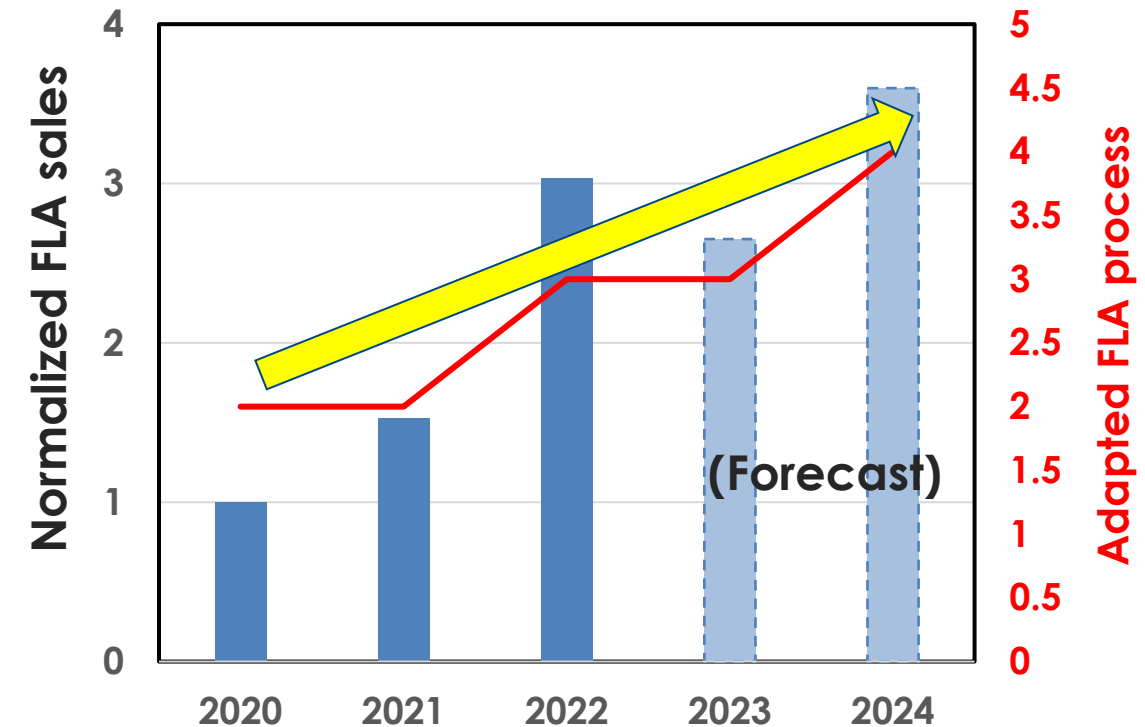
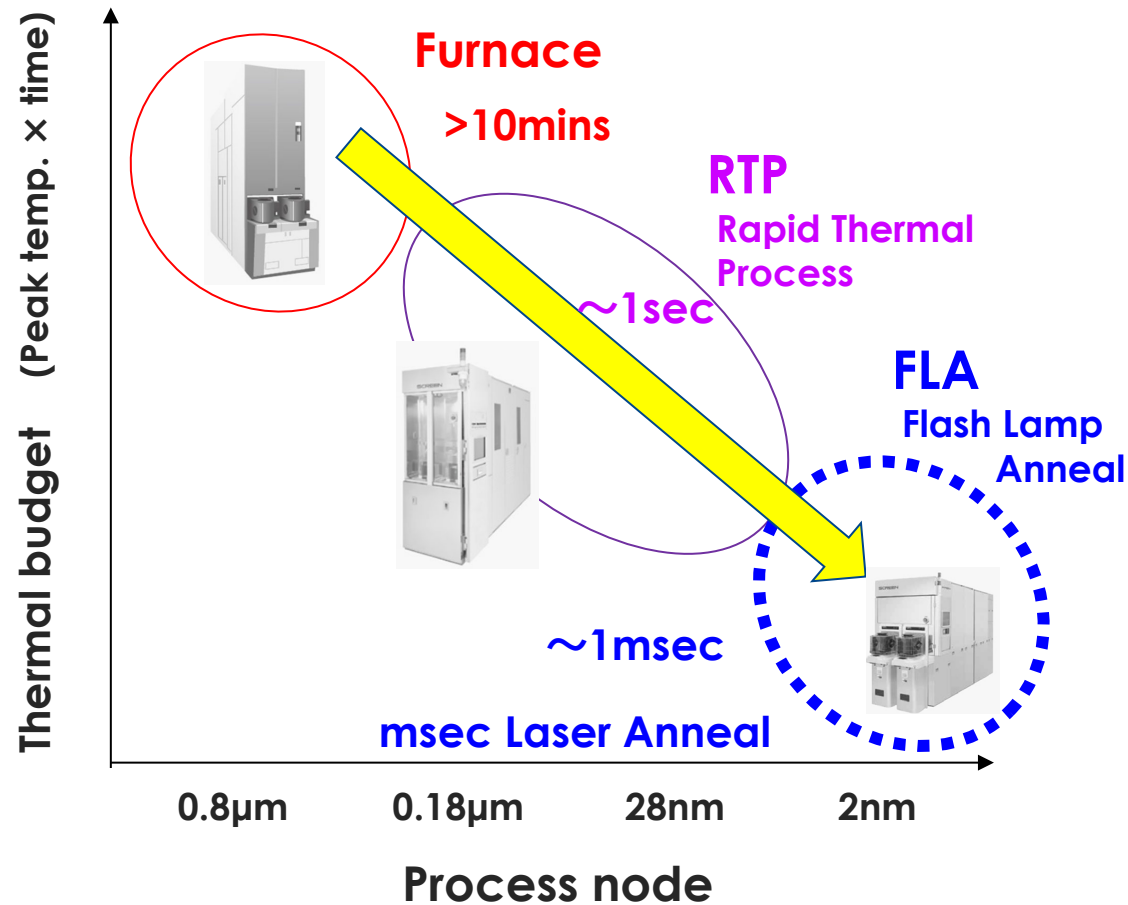
Senior Technology Executive

SCREEN Semiconductor Solutions Co., Ltd.

- Strategy on the thermal business
- Overview of Flash Lamp Anneal (FLA) equipment
- Target device
- Benchmark with competitors
- Summary

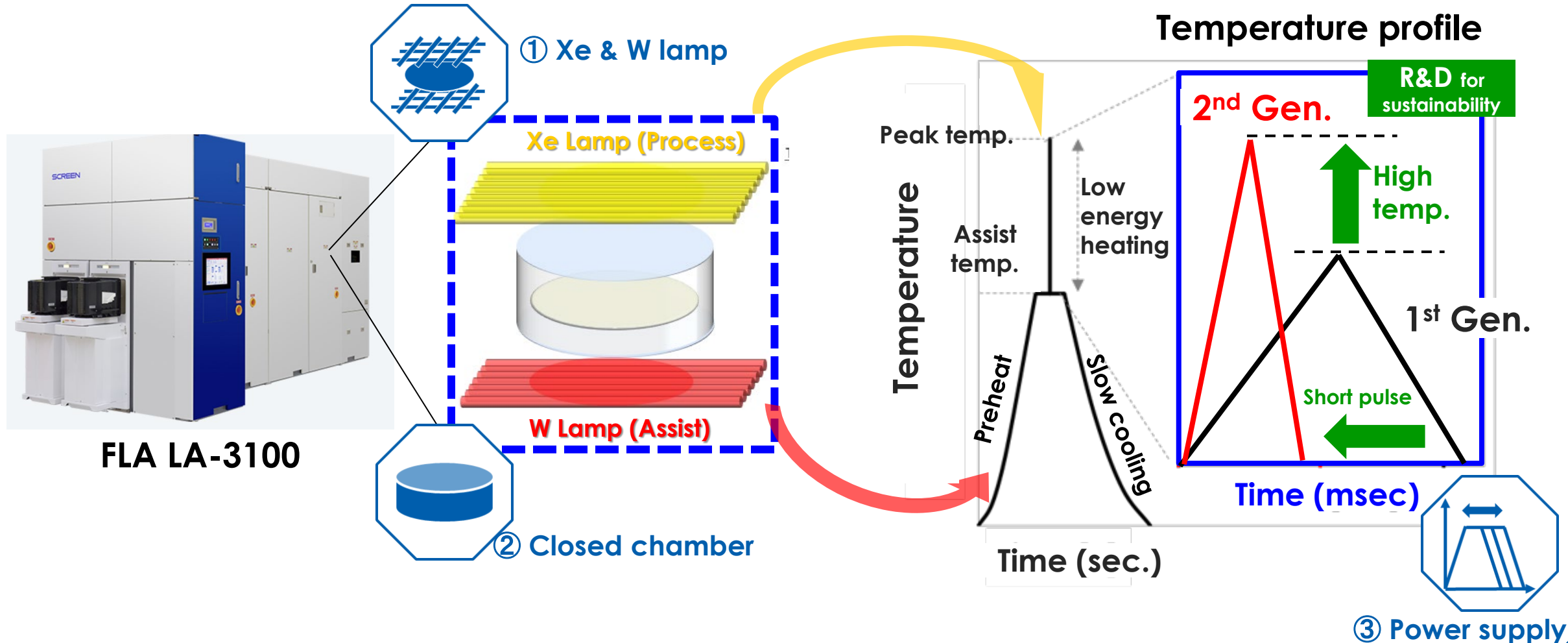
Strategy on the thermal business

- ◆ Need more precise control on the annealing process by the scaling
- ◆ Get market share by a low thermal budget process to meet the customer needs
- ◆ Grow FLA business sales steadily and Evaluation of R&D tool are going well



Overview of Flash Lamp Anneal (FLA) equipment

- ◆ Precise control of temperature profile in msec by 2 different lamp configurations to provide the best thermal energy
- ◆ Anneal at an extremely low-oxygen environment to prevent oxidation, by a closed chamber

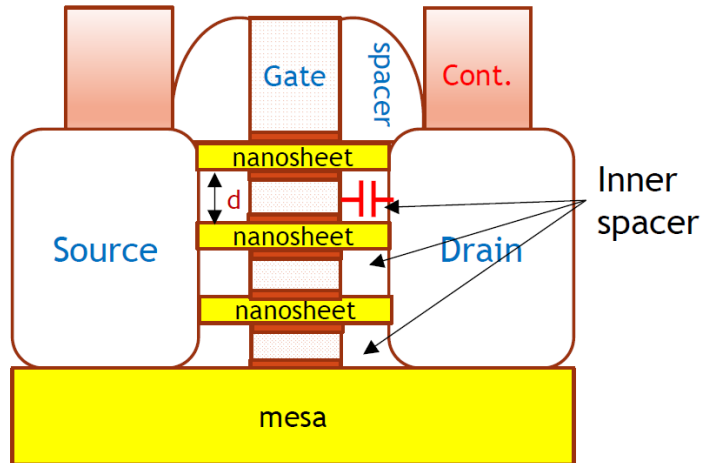


Target device: 1. Expand market share in main applications

◆ More opportunities to require the delicate thermal energy design by scaling

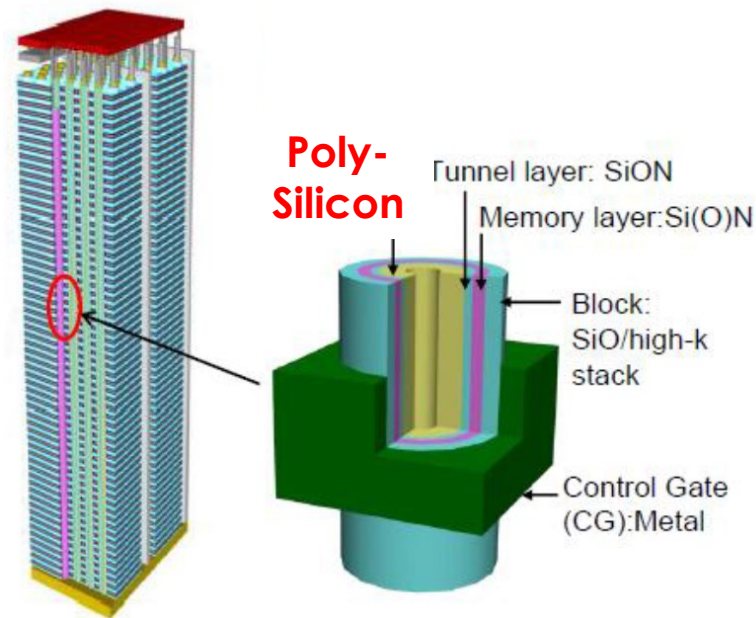
Ex.1) Lower resistivity of logic transistor source/drain regions and contact

Ex.2) Lower resistivity and variation in polysilicon in memory cell (3D-NAND, DRAM)



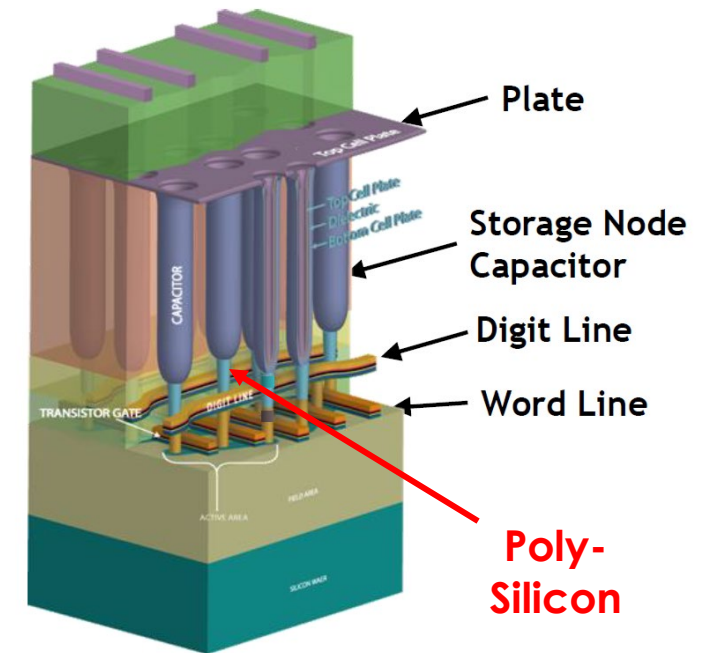
Source: Jin Cai, "CMOS Device Technology For the Next Decade," VLSI2021 Short Course

Advanced Logic (Nanosheet)



Source: N. Shibata, "History and Future of Multi-Level-Cell Technology in 2D and 3D Flash Memory," IMW2020 Tutorial

3D-NAND



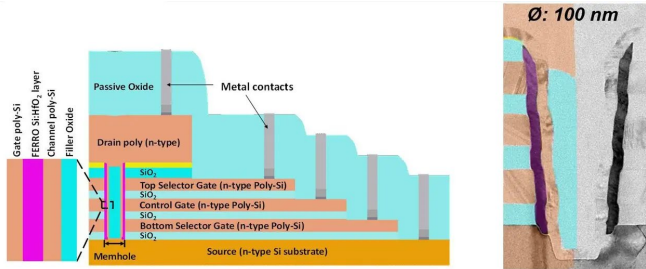
Source: Koji Hamada, "DRAM Technology and Challenge --," in ADMETA Tutorial 2020.

DRAM

Target device: 2. Create market with new applications

- ◆ Join in imec memory program for the feasibility study of ferroelectric memory
- ◆ Understand the annealing process as a viewpoint of the physical phenomena of materials by industry-academia collaboration, and train our engineers through development of FLA technology prototype which have high affinity with devices

imec memory program

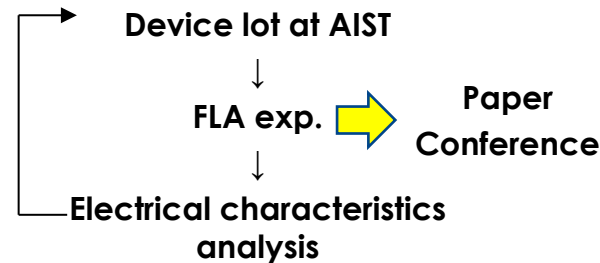


Source: imec, Web-site
The 3D FeFET: contender for 3D-NAND Flash memory and machine learning

Industry-academia collaboration

SCREEN × University of Hyogo

◆ Study of Ferro-crystallization



◆ Improve HfZrO film by 2 step FLA

• SSDM Conference 2023 @Nagoya, Sep.8

Enhancement of the Polarization Properties in Thin Ferroelectric $\text{Hf}_{0.5}\text{Zr}_{0.5}\text{O}_2$ Films by Two-Step Flash Lamp Annealing

Hideaki Tanimura^{1,*}, Yuto Ota^{2,**}, Hikaru Kawarazaki¹, Shinichi Kato¹, Takumi Mikawa¹ and Yasuo Nara^{2,***}

¹ SCREEN Semiconductor Solutions Co., Ltd., 480-1 Takamiya-cho, Hikone, Shiga, 522-0292, Japan

² University of Hyogo, 2167 Shosha, Himeji, Hyogo, 671-2280, Japan

*E-mail: tanimura@screen.co.jp, ** Currently in Toshiba Electronic Devices & Storage Corporation, ***Currently in Tokyo City University

Abstract

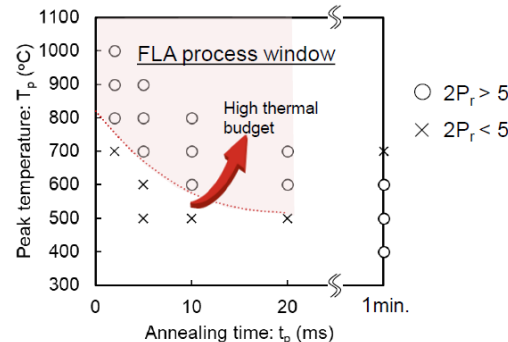
In this study we systematically studied the polarization properties of thin ferroelectric $\text{Hf}_{0.5}\text{Zr}_{0.5}\text{O}_2$ (HZO) films annealed using flash lamp annealing (FLA) with wide ranges of millisecond annealing times and annealing temperatures. We used a unique annealing method, two-step FLA, for which the highest observed remanent polarization for 5nm thick HZO was $24.2 \mu\text{C}/\text{cm}^2$.

3. Results and Discussions

First, we measured the P-E curves using conventional FLA, as shown in Fig. 3. Hysteresis loops originating from the ferroelectricity were observed in both the 10 and 5nm thick samples. The value of $2P_r$ in the 5nm thick HZO is approximately half that in the 10nm thick HZO. Fig. 4 shows XRD spectra in the 5nm samples. Focusing on the peak around 30° , stronger signal intensity is shown in the sample annealed at 894°C compared to that annealed at 800°C . There-

Source: SSDM2023

※Patent applied



Source: SSDM2022

- ◆ New structure
 - 3D-FeFET
- ◆ Scaling trend
 - Limit of Ferro thin film
- ◆ Acquire knowledge by device demo
 - HfSiO
 - High temp. Short time
 - Integration of BEOL

Benchmark with competitors

Source: SCREEN estimation

SPE

◆ SCREEN FLA has high productivity and low environmental impact

◆ Provide superior process performance by a closed chamber (Low-O₂, Low pressure)

	SCREEN SPE	Competitor A	Competitor B	Competitor C	SCREEN LASSE
System	FLA	Laser anneal	FLA	RTP	Laser anneal
Application	Si	Si	Si	Si	SiC (Power device)
Typical range	<1300°C 1-1000ms	<1300°C 0.2-1ms	<1300°C 1-5ms	<1150°C 0.1sec.~ min	~3000°C ~200nsec
Light source	Xe-lamp + Halogen lamp	Green laser or IR laser	Xe-lamp	Halogen lamp	XeCl excimer laser
Throughput	◎ 60WPH	20-25WPH	40WPH	30WPH	-
Running Cost	◎ 1	3	5	1	-
Energy consumption	◎ 1	1	1	10	-
O ₂ conc.	◎ <0.1 ppm	300-500ppm	200-300ppm	10ppm	-
Pressure	5kPa	100kPa	100kPa	0.1kPa	-
Uniformity	◎ <1%	<2.5%	<2.5%	1~2%	-

- Expand business of FLA with precise control in milliseconds for the delicate thermal energy design by scaling
- Applicable to advanced logic and memory and Explore new applications which is highly related annealing
- SCREEN FLA has high productivity and low environmental impact to differentiate from our competitors

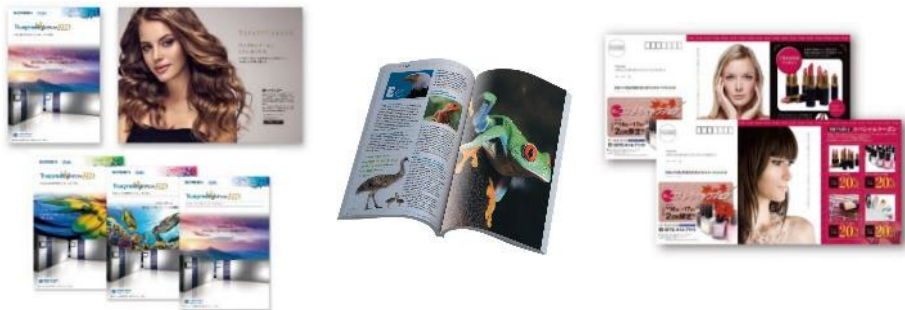
Growth strategy for GA business

Yukiyoshi Tanaka

President

SCREEN Graphic Solutions Co., Ltd.

Colors enriching lives and value changes in printing



The whole information printing market is shrinking due to the shift to electronic media, but digitization is proceeding as demand increases for greater efficiency and value-added creation. Investment in digital equipment is expected to grow steadily in the future

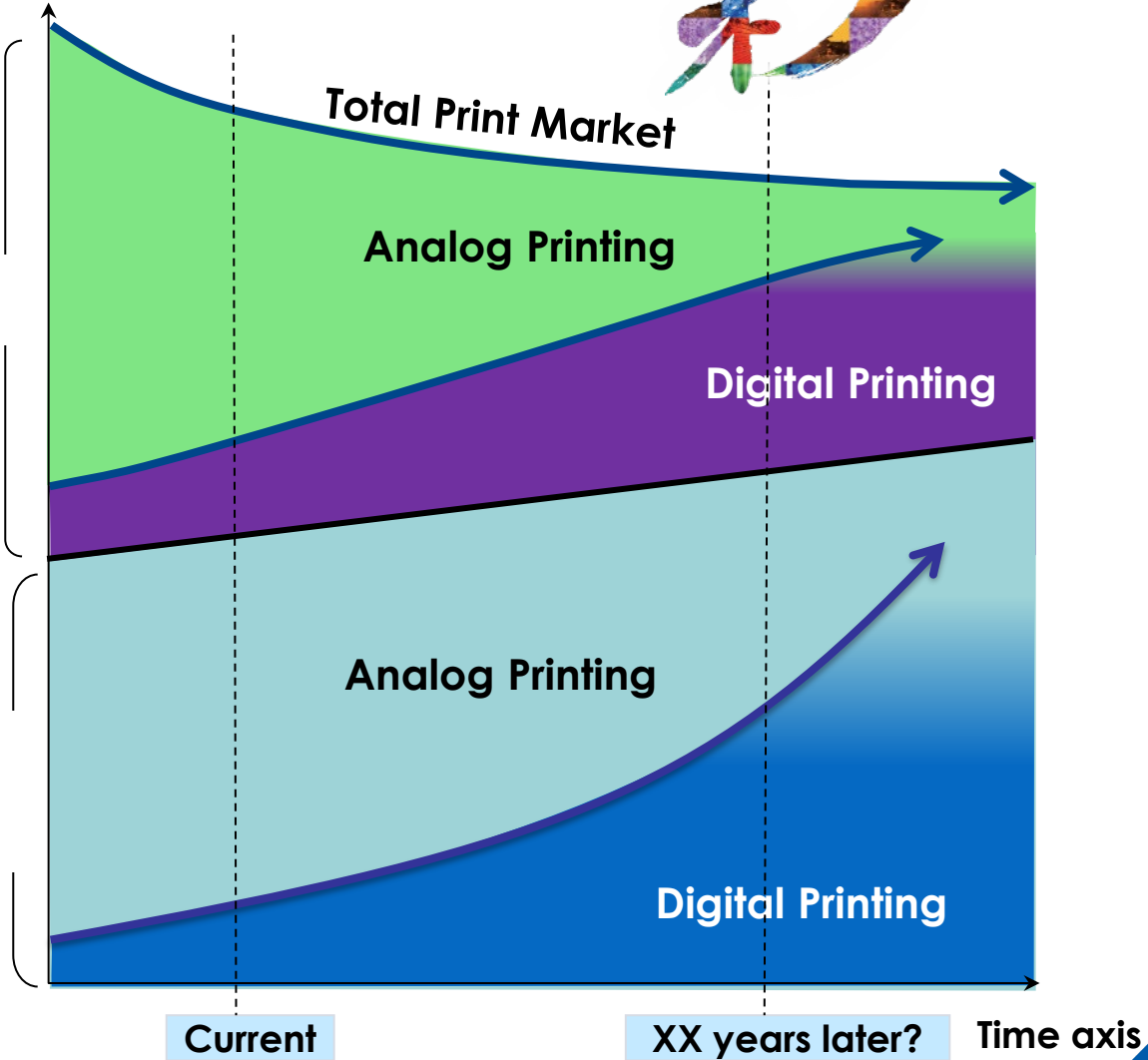
Information printing market



The essential industrial printing market, including packaging related to food, clothing and residence will continue to grow steadily. Although there is a need for digitalization, it is still in its infancy and is expected to grow rapidly in the future.

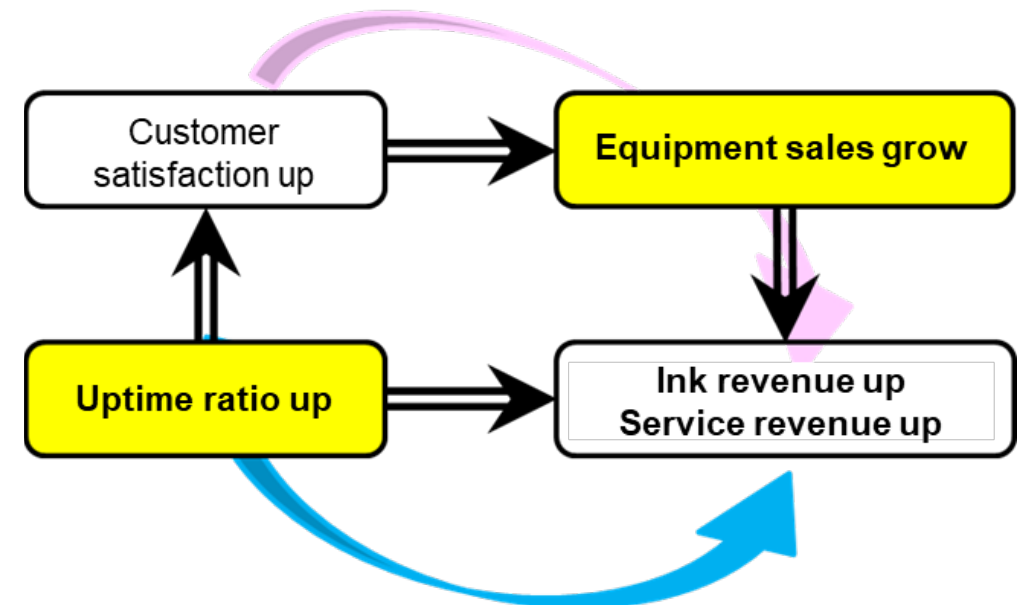
Other Printing fields related to food, clothing and residence

Printing volume



Shift from keeping a positive spiral which is carried out by enhancing recurring business while expanding equipment sales and improving utilization rates to new business

1. Grow recurring business by increasing equipment sales and operating rates
2. Develop the package printing business to a commercial level, as a second pillar of GA's business
3. Strengthen solution services worldwide and capture business opportunities from major clients
4. Invest for the future generation; identify and develop new business opportunities



Offering futuristic printing solutions to customers from 4 bases



Europe



New GPEU office & Innovation Center



New GPAM office & Innovation Center



North America



Japan
Kyoto



Kumiya Kyoto Innovation Center



Mon-Naka Tokyo Innovation Center



Japan
Tokyo



GA CSV :

**Enriching lives and
continuing to make the world more colorful
through printing**



Growth strategy for FT business

Atsushi Sonoda

President

SCREEN Finetech Solutions Co., Ltd.

Display market environment (long-term market size forecasts)

■ Bottoming out in CY2023 and recovering from CY2024

The oversupply situation will be end and recovery will begin in 2H of CY2023, with growth expected to be +7.2% YoY in CY2024 in a display area basis and +4.4% YoY in terms of monetary basis.

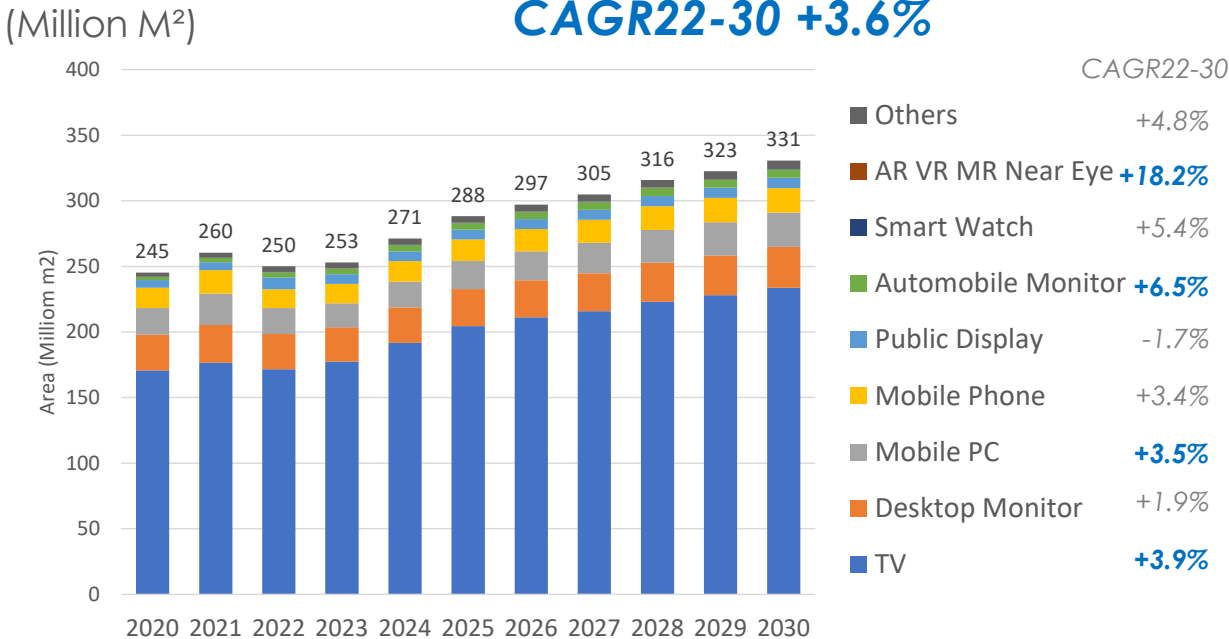
Compared with the previous forecast announced in January 2023, major applications such as TVs and notebook PCs are expected to be lesser but be drivers for the recovery. The monetary value decline is due to an increase in low-priced phones such as feature phones, although the quantitative figures of mobile phones are revised upward.

■ Long-term forecast: growth for TV, Mobile PC, Auto and XR in both monetary and shipment bases

- ✓ In a display area basis: As TVs become larger in size and lower in price, demand to replace the previous peak in 2018-19 is expected to be mainly 55" and above.
- ✓ In a monetary basis: CAGR22-30 will be +4.3% and +2.0% for TV and mobile PC each, contributed by OLED adoption rate in high-end TVs/notebooks and AI notebooks

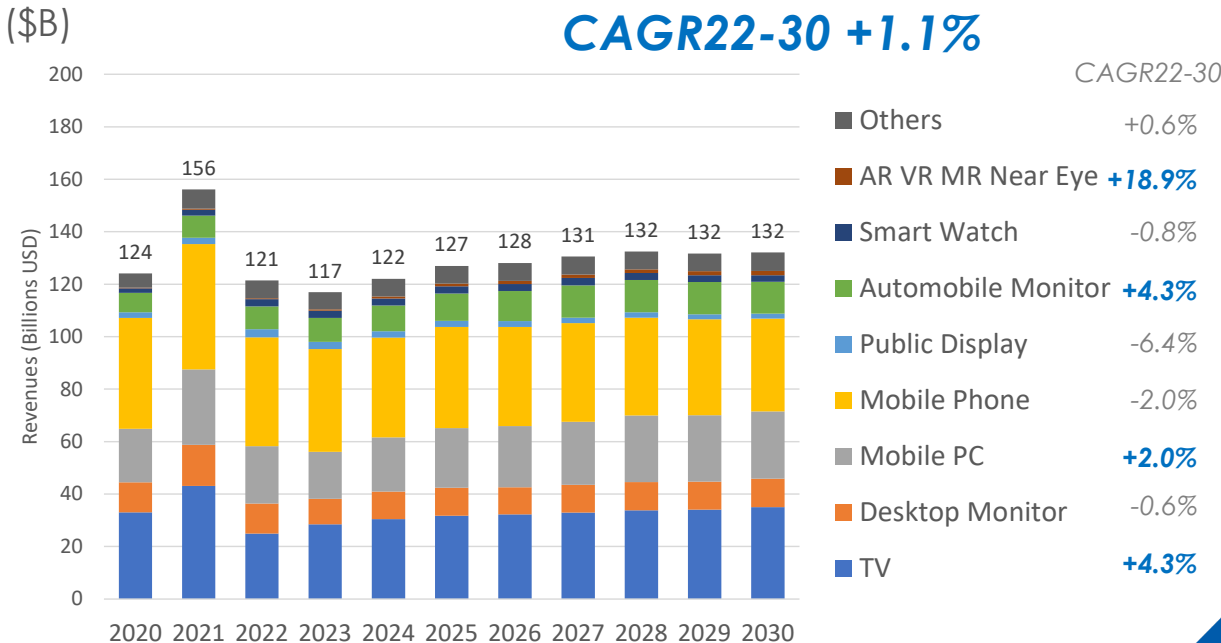
Shipments in a display area basis

CAGR22-30 +3.6%



Monetary value of display shipments

CAGR22-30 +1.1%

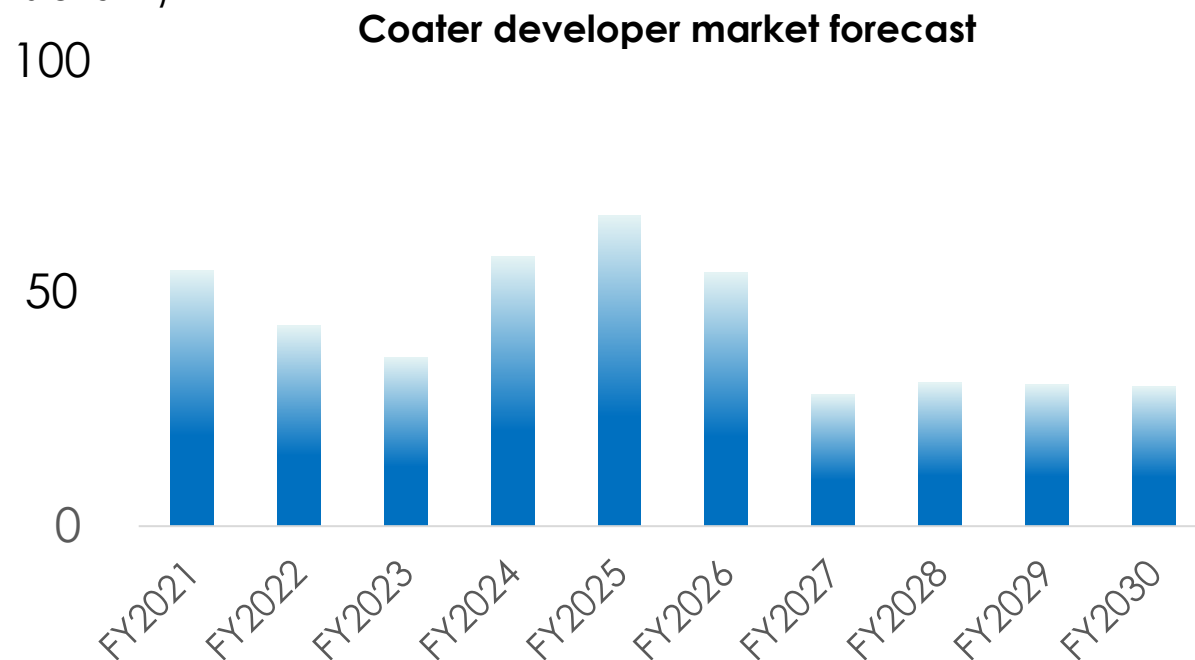


Coater/developer market forecasts

■ Coater/developer market is expected to be around 30-40 billion yen in the medium to long term

- ✓ Investment in display production equipment is expected to be stimulated from 2024 to 2026. It is due to an expectations of demand for TV replacement and strategic investment by panel manufacturers with an anticipated recovery in business performance.
- ✓ A continuous investments of a certain level are expected due to demand in a display area basis even after 2027.

(Billions of JPY)



Our company survey

Our response



Increased number of photolithographic processes

- ## Penetration of OLED panels

- ## Coater-developer processes supported by us



- # SCREEN

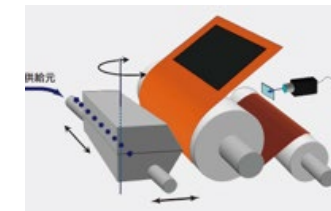
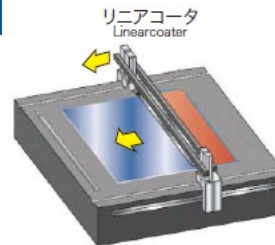
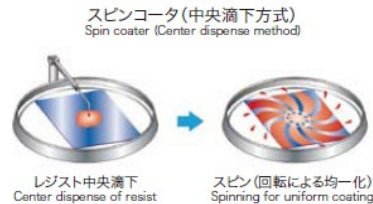
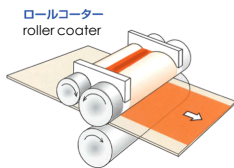
Creating a better future with advanced devices, by improving coating techniques, layer by layer



Application of coating technologies



Development of coating technologies



Roll-to-roll coating

Levicoater™
(air-floating conveyor system)

Growth strategy for PE business

Masato Suemori

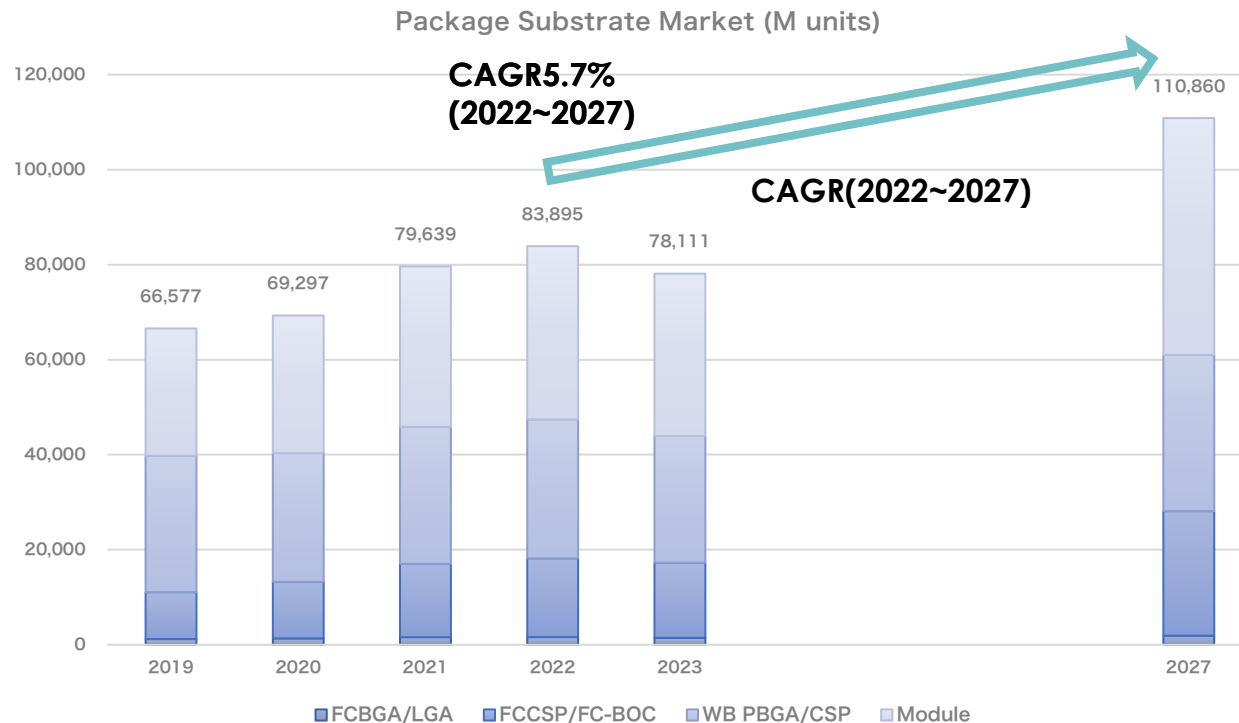
President

SCREEN PE Solutions Co., Ltd.

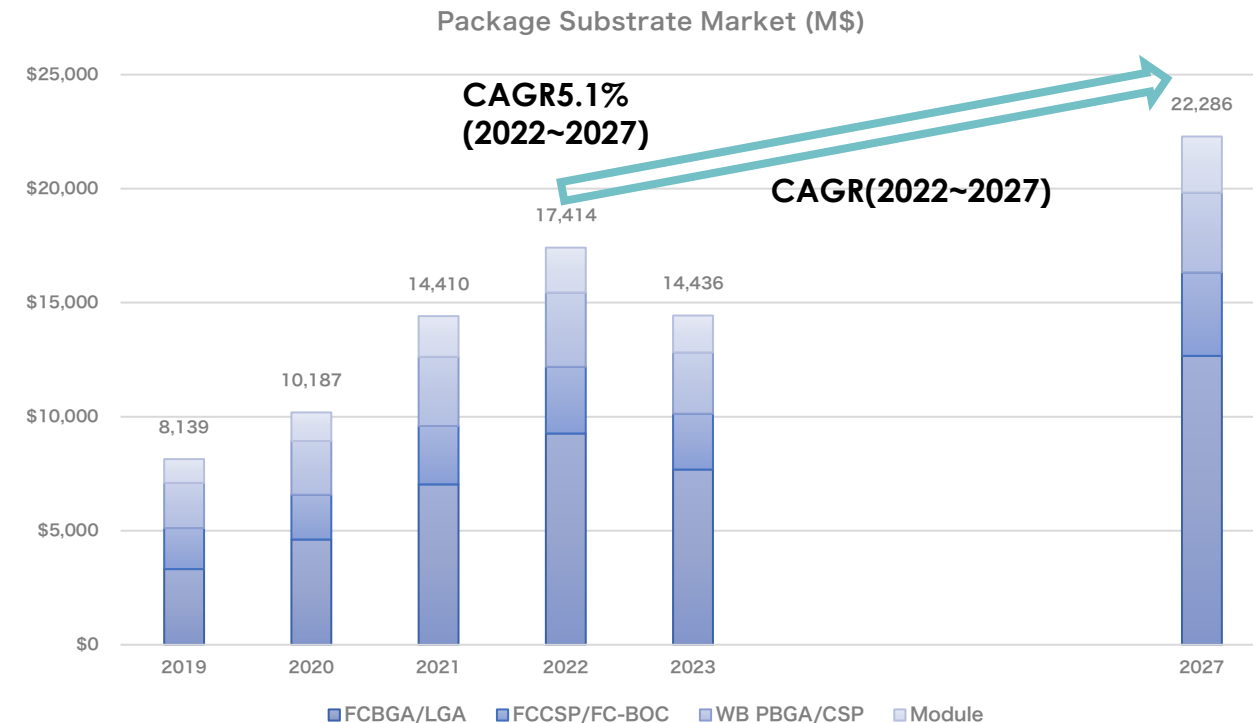
Growth synchronized with semiconductor transition forecasts

- CAGR of 5.7% for production volume and 5.1% for sales volume are expected over the five-year from 2022 to 2027
- FCBGA growth driven by server and data center demand
- Automotive substrates driven by module substrates

◆ The amount of square meter of packaged boards market

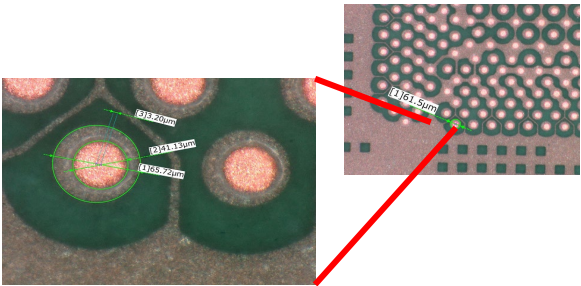


◆ The sales volume of packaged boards market



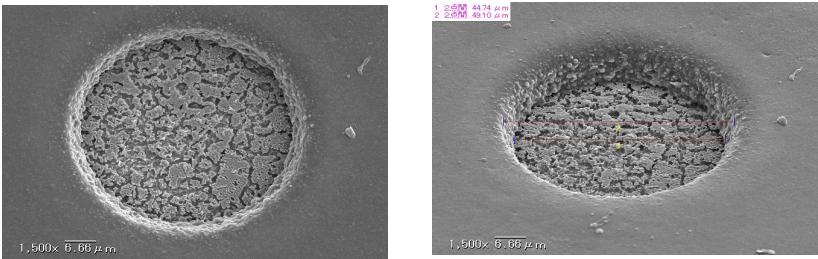
Development of the next generation of high-definition direct-imaging systems

High-end packaging board applications

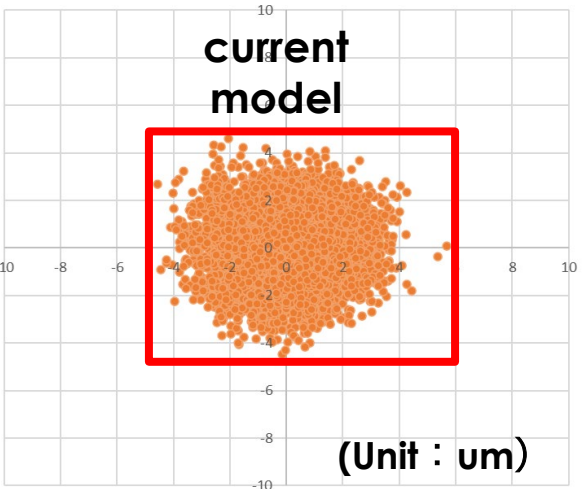
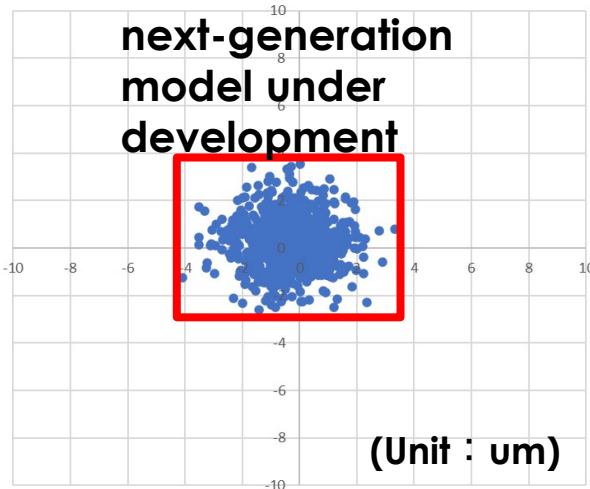


BGA SR aperture positioning

High-end BGA substrates



Neat and functional solder aperture



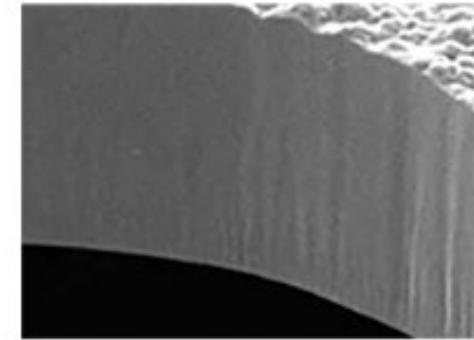
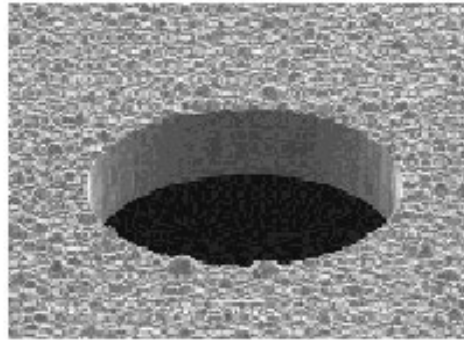
Achieved accuracy of imaging position as 5 μm (3σ)

Development of the next generation of high-definition direct-imaging systems

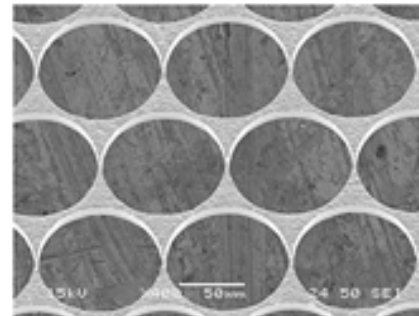
Metal masks for high-definition components, etc.



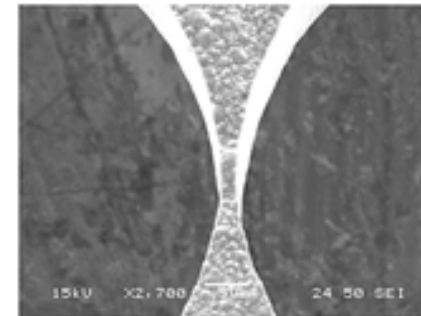
Metal mask for PKG bump formation



Narrow pitch metal mask



100 μ m pitch t = 15 μ m

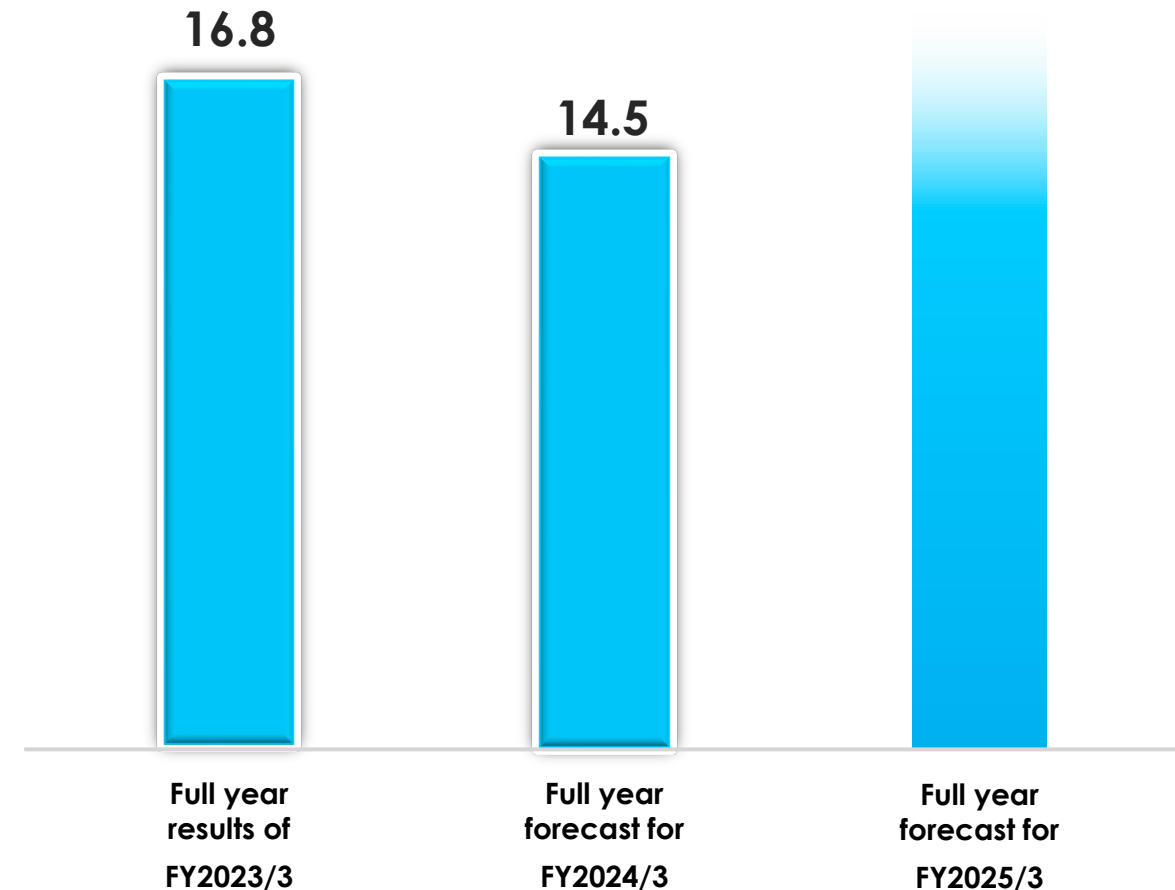


Aperture diameter is 95 μ m

Adjustment phase, preparing for memory recovery

- ◆ Our direct imaging systems have gained a high market share in the high-definition area of solder resist applications
- ◆ We will increase both sales and market share by developing and launching systems that responds to future miniaturization

Our sales in billion yen



Exploring different approaches and technologies for controlling light to provide solutions that will support a better future

Business strategies

1. Concentrate resources on high-end circuit board/package board solutions

- Secure a market share of 50% or more in both the SR and circuit pattern markets by continuously launching exposure systems with superior performance and expanding their use among high-end users
- Provide comprehensive solutions (pattern, via, repair) for package board inspection

2. Explore and develop new business areas by integrating optical, mechanical, and software technologies while enhancing process technologies and utilizing external expertise

3. Promote autonomous preventive maintenance and introduce non-stop equipment services

4. Pursue cost effective production by maintaining manufacturing capabilities and optimizing infrastructure

5. Establish mechanism to motivate individuals to actively raise questions with curiosity and generate ideas

Activities to create new businesses

Energy

Life Science

Advanced package

Toshio Hiroe

CEO, President

SCREEN Holdings Co., Ltd.

Application and development of core technologies to create solutions

>> Accelerating the commercialization of each projects towards the next medium-term plan

New business area introduce today

Energy



- Water electrolysis media
- Fuel cell media

Life Science



- Personalized Cancer Therapies
- Reducing the onset of chronic heart failure

Advanced Package



- Direct imaging system
- Low temp. hybrid bonding machine

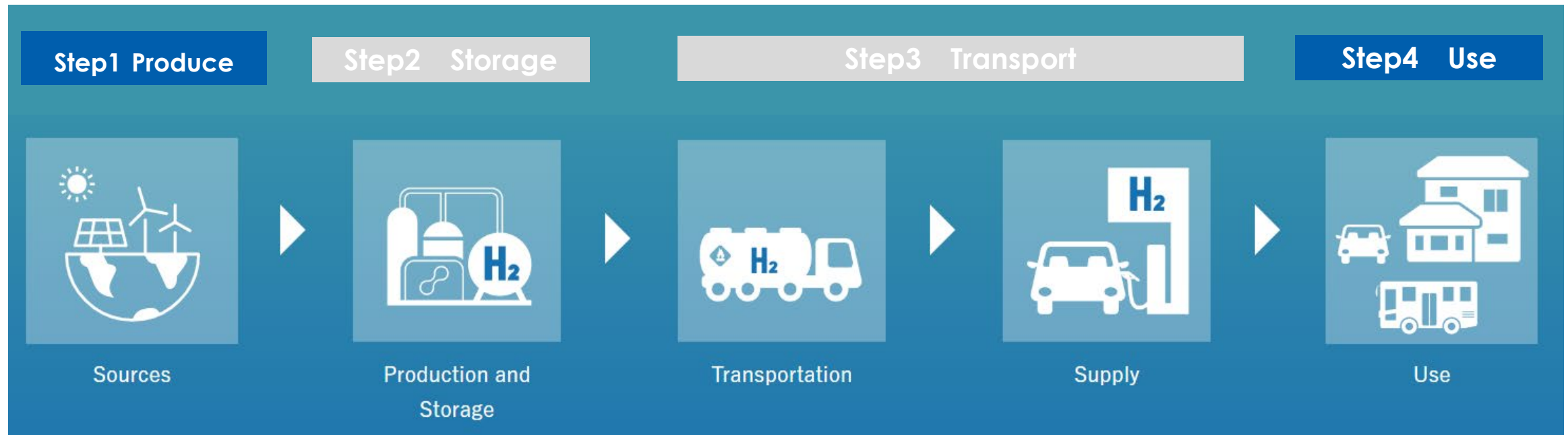
Energy: Toward a decarbonized and hydrogen society

To provide the solution which uses the hydrogen as an eco-friendly energy source, we are developing water electrolysis technologies for hydrogen production and fuel cell technologies for hydrogen use.

◆SCREEN's area of activities for hydrogen production

We develop manufacturing technology and parts which used in important section of

Produce and **Use**

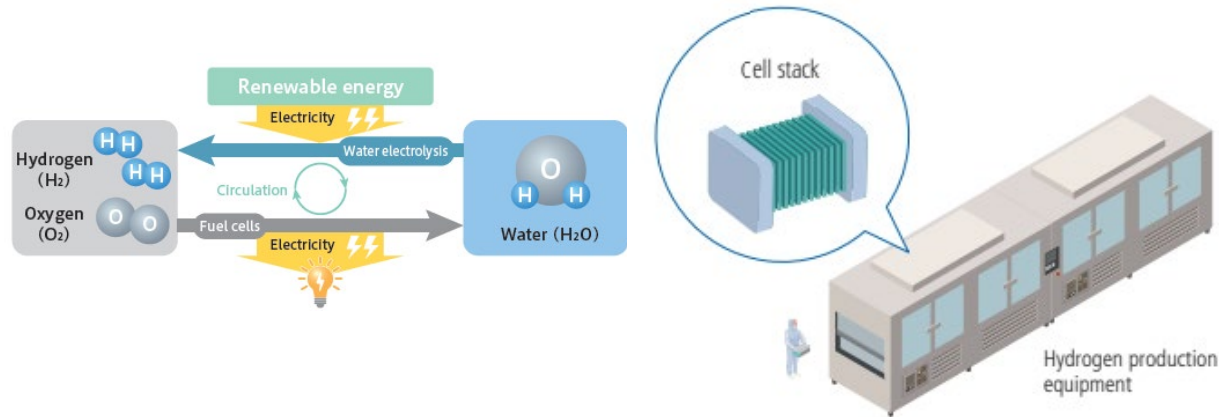


Energy: Toward a decarbonized and hydrogen society

Produce Hydrogen

Develop a Water Electrolysis Cell Stack for Low-cost Green Hydrogen Production

SCREEN will be in charge of developing water electrolysis cell stack production technology and production equipment that applies continuous production technology using its proprietary roll-to-roll methodology (Joint development with Tokyo Gas)



*1: Membrane electrode assembly (MEA): An important component that affects the durability and performance of polymer electrolyte fuel cells. It is composed of an ion exchange membrane, catalyst membranes and gas diffusion layers.

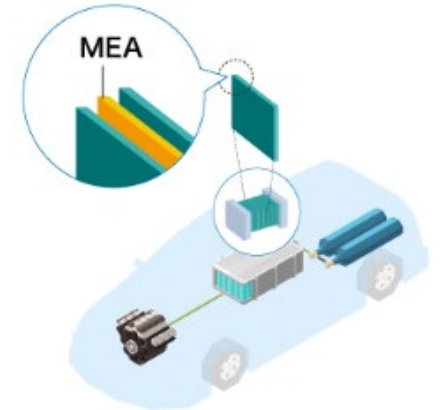
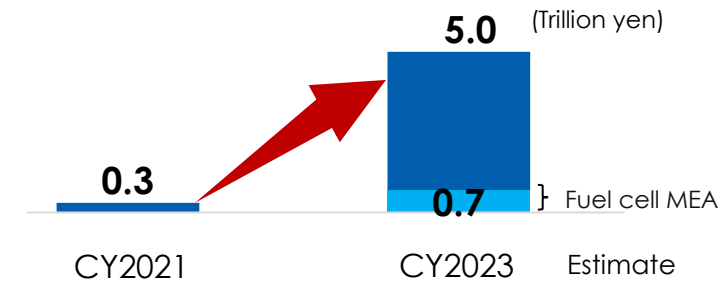
*2 A selection by the Ministry of Economy, Trade and Industry of companies that are boldly taking on innovation aimed at realizing a decarbonized society.

Use Hydrogen

Began a mass production business for a fuel cell part "MEA" *1

- Using Group expertise of direct coating and drying, we have created an entire manufacturing process for the mass production of high-quality fuel cell MEAs.
- Selected as one of the Companies Taking on the Zero-Emission Challenge *2 by the Ministry of Economy, Trade and Industry for its development of technologies for utilizing fuel cells across a broader range of applications

◆Growth forecast of fuel cell market



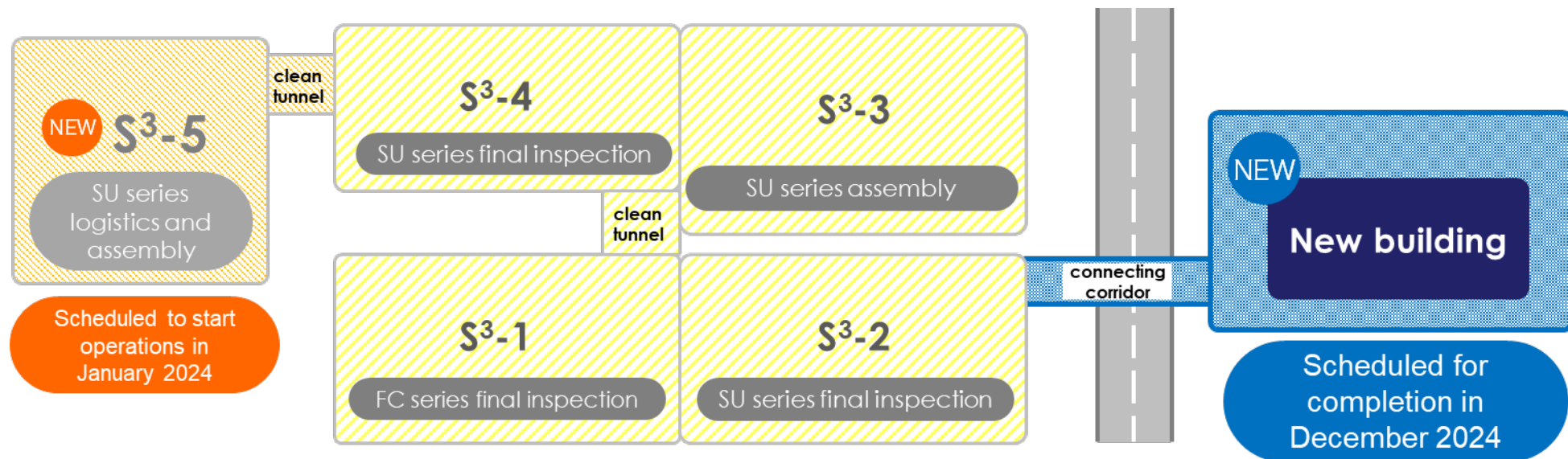
>> Carrying out business development in a new field, the water electrolysis cell stack market

>> Going forward, we aim to build up our track record in the mass production of fuel cell MEAs and become a global leader in MEA manufacturing.

Outline of new building construction plan in Hikone site

■ Plan to build a new building for office of SPE engineers, clean room for Hydrogen related business's experiment and production in Hikone site.

- Three-storey. Connected with SPE's S3-2 factory on 2nd floor.
 - 1F : Space for experiment, workshop etc.
 - 2F : Clean room for hydrogen related business
 - 3F : Office space for SPE engineers and hydrogen related business



- >> Prepare the space for production and experiment of hydrogen related business which supports our 10-year vision.
- >> Expand office space for SPE and utilize the space as facility for further expansion of business as well.

Life Science: Improving QOL – Realizing personalized cancer therapies

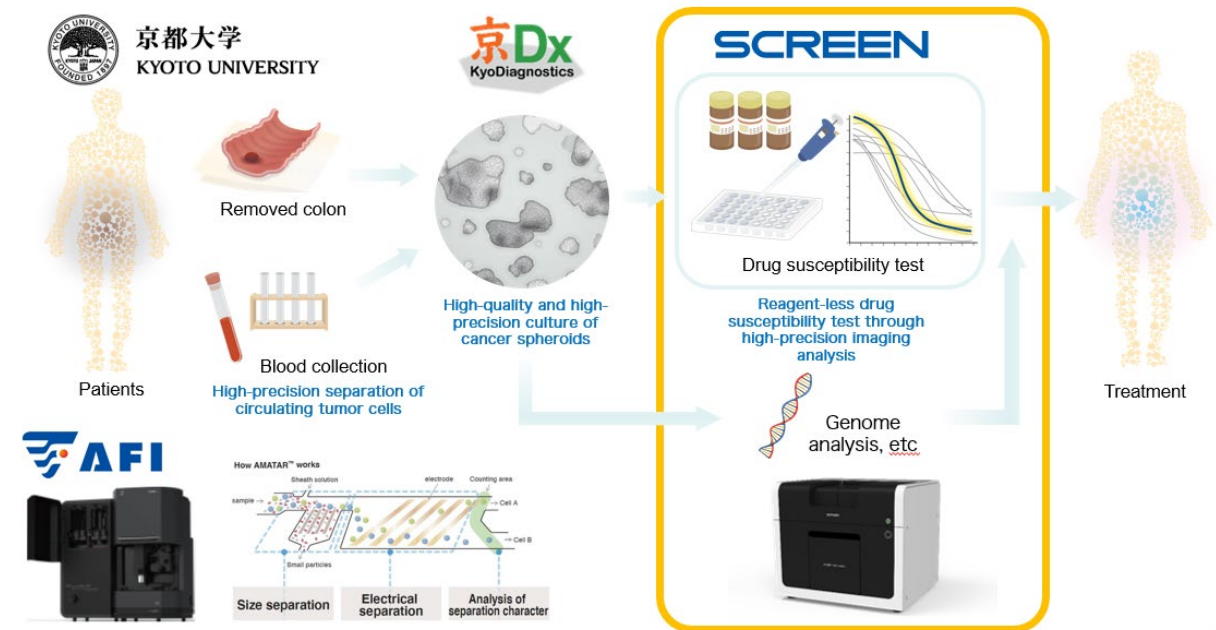
Our core technology “image processing” is expanded to life science field.

Promoting "personalized cancer therapy" that uses cancer cells collected from patients to confirm the effectiveness of treatment in advance

⇒ **Providing patient-friendly solutions that reduce physical and financial burdens**

Our activities

- ① 3D analysis of cultured cells in a living state
Developed “Cell3iMager” that enables confirmation of medicinal ingredients (August 2013)
- ② **Joint research began to realize “personalized cancer therapy”** (December 2021)
⇒ Isolate and culture cancer cells. Kyoto University observed and evaluated using our equipment (①)
- ③ **AFI Technology, which has cell separation technology, became a subsidiary** (July 2022)
⇒ Promoting the launch of personalized cancer therapy business



>> **Aiming for the early practical application of innovative personalized cancer therapies, promoting the development of various cancer treatments, and expanding into the medical field.**

Life Science: Improving QoL – Reducing onset of chronic heart failure

SCREEN Acquires Shares in Adriakaim, a Leading Startup Company in the Medical Device Field

SCREEN Holdings Co., Ltd. has acquired shares in Adriakaim Inc. (hereafter referred to as “Adriakaim”) mainly through the underwriting of a new third-party allotment. This investment takes SCREEN’s equity ratio in Adriakaim beyond 20%, making the company an equity method affiliate.

- Adriakaim is a startup company engaged in the development of the world’s first vagus nerve stimulation device for reducing the onset of chronic heart failure resulting from acute myocardial infarction (AMI)
- The device being developed by Adriakaim is a minimally invasive medical device that suppresses expansion of the area of myocardial infarction by applying a very weak electrical stimulus to the vagus nerve near the patient’s heart. While chronic heart failure has been a significant problem worldwide, it is not possible to prevent its onset with currently available medication. Adriakaim aims to achieve a higher therapeutic effect by using the electrical stimulation to activate the vagus nerve. It has already completed non-clinical studies and will soon begin a clinical trial.

<Details of investment partner>

1. Company name: Adriakaim Inc.
2. Headquarters: Hachioji Seni Center Bldg. Room 101, 13-1 Minami Shin-cho, Hachioji-shi, Tokyo, Japan
3. Representative: Masatoshi Kobayashi, Representative Director
4. Established: November 2018

Please visit our [website](#) for more information

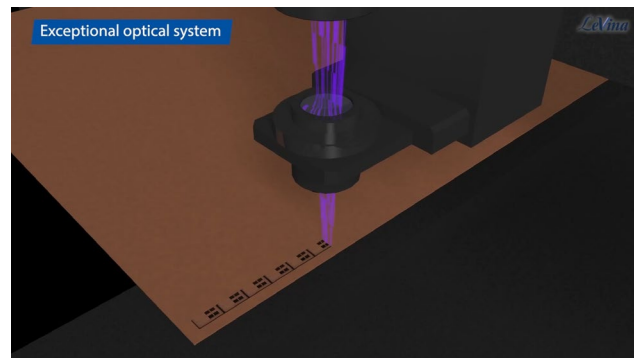
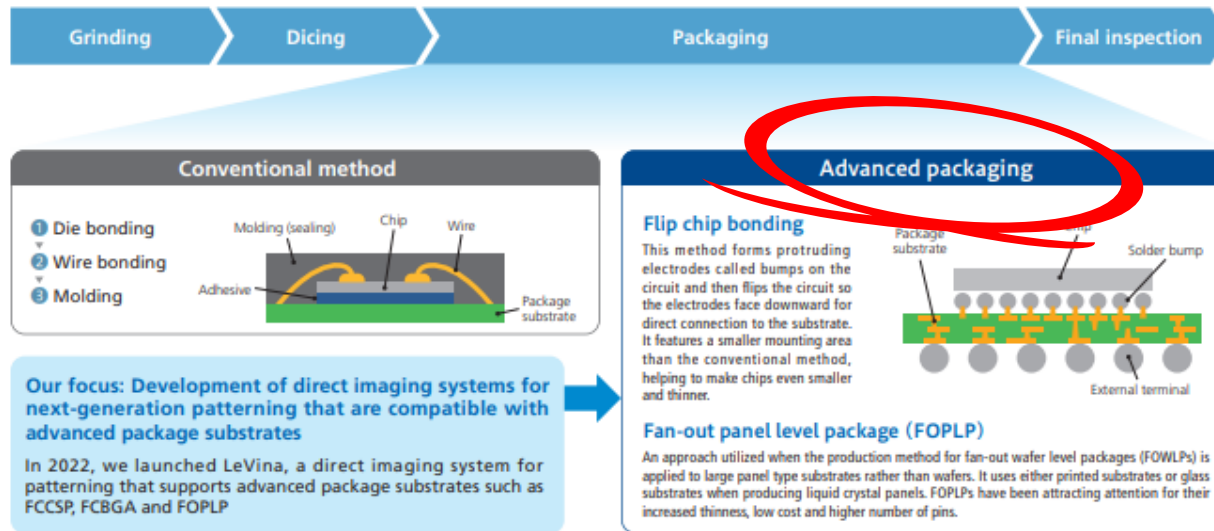
>> With this latest investment, we expect to enable a deeper integration of the technologies and knowledge possessed by our two companies. In terms of our future medical business, this should allow us to streamline and strengthen our internal pharmaceutical-related systems and achieve a wide range of synergies.

Advanced Package: Seeking More than Moore

With continuing progress in the areas of 5G/post-5G, IoT infrastructure and DX, GX, ever higher performance is needed from package substrate technologies

◆Our activities

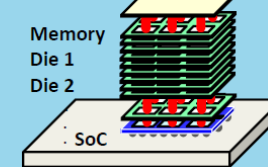
Direct imaging system



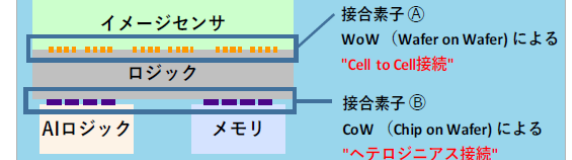
Development of Low temp. hybrid bonding machine

【参考】先端半導体製造（後工程）プロセス技術の開発 採択テーマ概要（2）～（5）

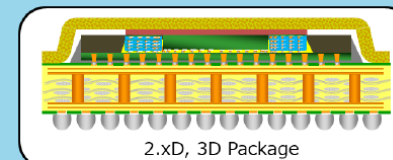
- (2) 実施者：先端システム技術研究組合（RaaS）※1
- 事業テーマ：ダイレクト接合 3D積層技術開発（WoWおよびCoW向け装置・プロセス開発）
 - 概要：Cu-Cuの低温ハイブリッド接合によるWoW（Wafer on Wafer）接合技術及びCoW（Chip on Wafer）接合技術の構築とその実装化に取り組む。



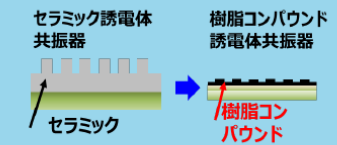
- (3) 実施者：ソニーセミコンダクタソリューションズ株式会社
- 事業テーマ：ポスト5Gエッジコンピューティング向け半導体の3D積層要素技術研究開発
 - 概要：積層モジュールの基本特性および信頼性取得が可能となるピッチサイズ目標を年度ごとに設定し、ロバストな半導体製造プロセスの要素技術を確立する。



- (4) 実施者：昭和電工マテリアルズ株式会社※2
- 事業テーマ：最先端パッケージ評価プラットフォーム創成
 - 概要：基板、装置、材料メーカーによるコンソーシアムを創成、評価プラットフォームを設置し次世代半導体パッケージの評価技術、基板、装置及び材料を開発する。



- (5) 実施者：住友ベークライト株式会社
- 事業テーマ：次世代情報通信向け先端パッケージの材料開発
 - 概要：3次元実装密度向上において重要となる、Wafer Level PKG向け封止材、アンテナ向け封止材、再配線用感光材のファインピッチ対応技術を開発する。



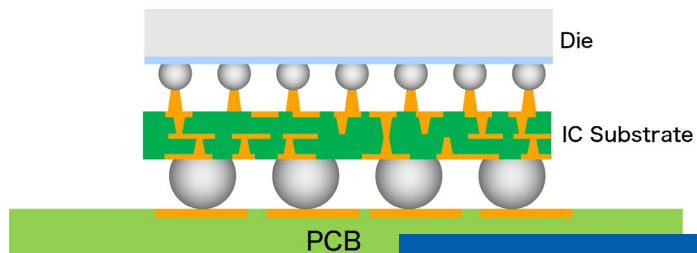
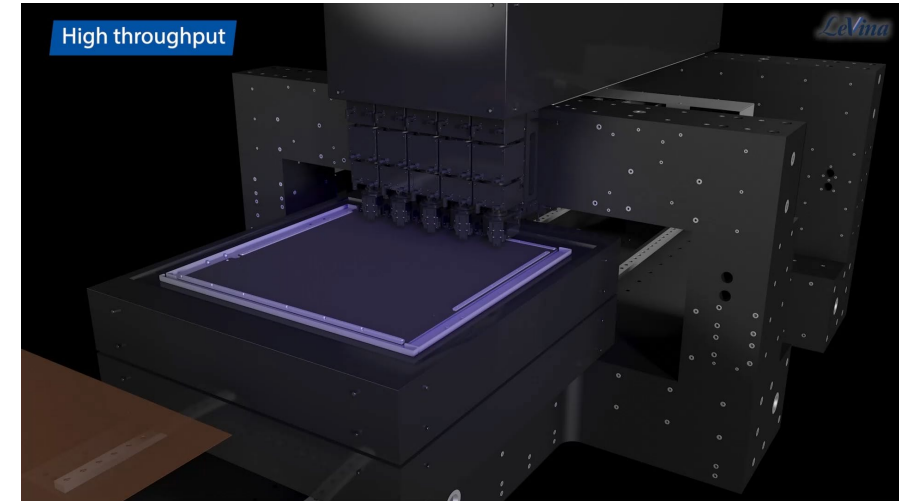
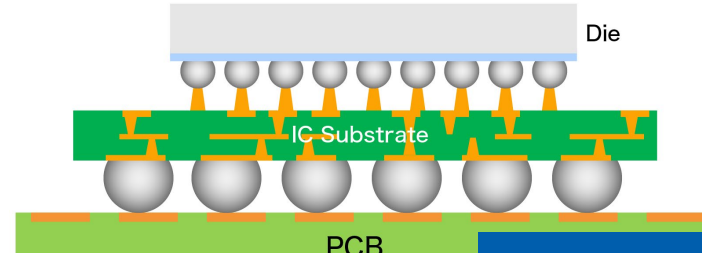
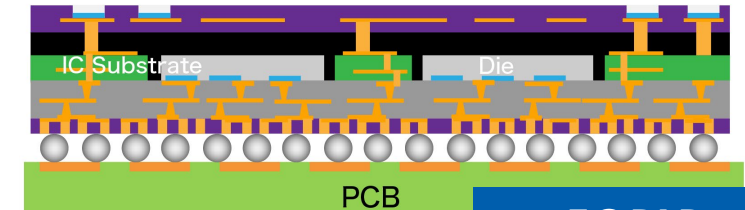
※1（共同実施先、組合員企業等）国立研究開発法人産業技術総合研究所、SCREENホールディングス、ダイキン工業、富士フイルム、パナソニックスマートファクトリソリューションズ、東京大学
 ※2（共同実施先、協力企業等）味の素ファインテック、上村工業、荏原製作所、新川、新光電気工業、大日本印刷、ディスコ、東京応化工業、TOWA、ナミックス、パナソニックスマートファクトリソリューションズ、ヤマハロボティクスホールディングス

Source : METI

<https://www.meti.go.jp/press/2021/05/20210531002/20210531002-2.pdf>

Advanced package: Seeking More than Moore

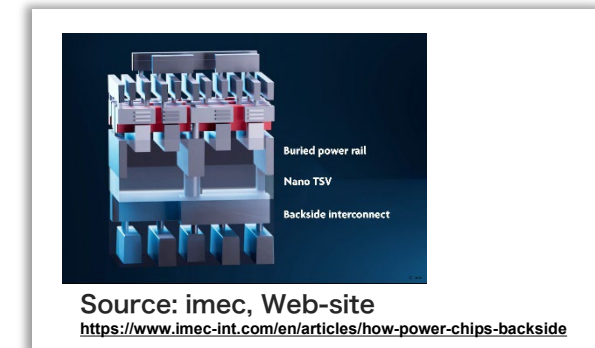
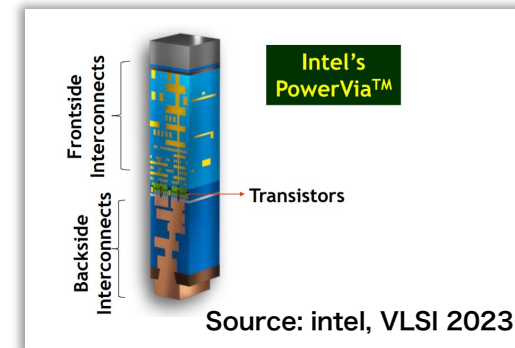
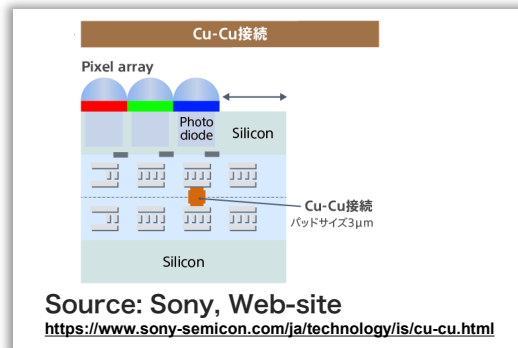
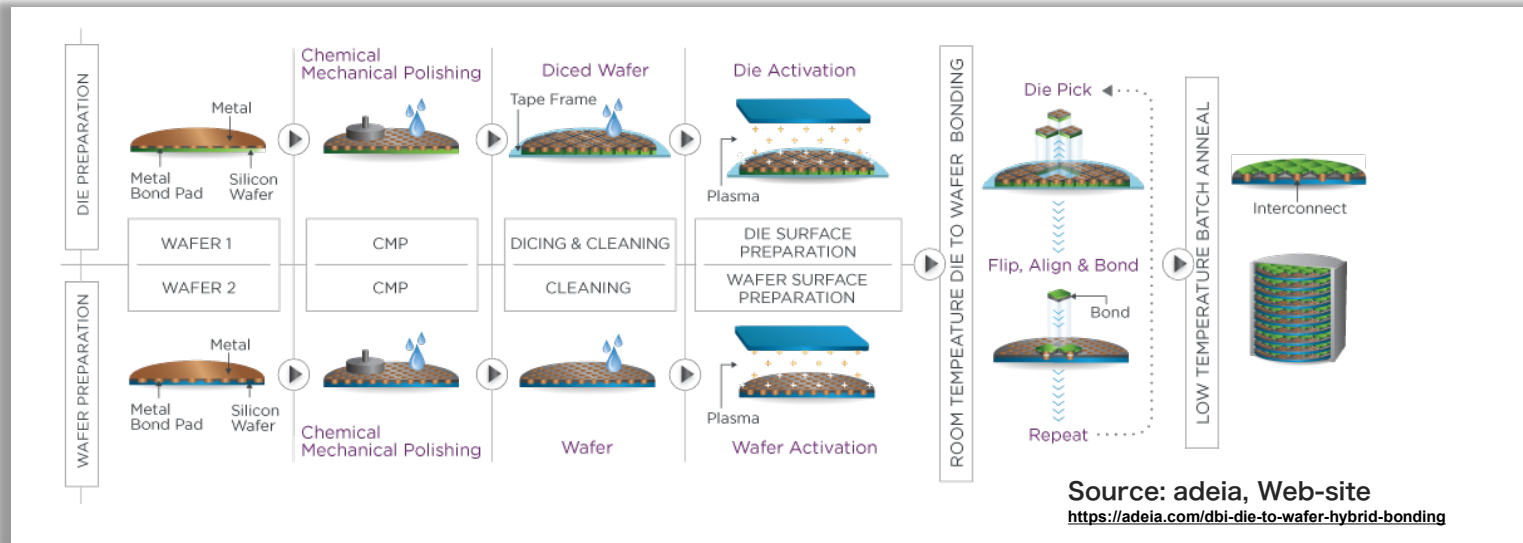
Application of direct imaging system "LeVina"

**FCCSP****FCBGA****FOPLP**

- >>Accelerate SCREEN's expansion into the package substrate market, which continues to enjoy strong growth due mainly to the ongoing deployment of IoT infrastructure as well as 5G and post-5G related technologies
- >>Remains fully committed to meeting the diverse needs of the semiconductor package industry and contributing to its future development

Advanced package: Seeking More than Moore

Application of Cu-Cu low temperature hybrid bonding



- >> Participated in RaaS project and developing process equipment for Cu-Cu low temperature hybrid bonding by collaborating with outside parties and internal resources
- >> Will contribute yield improvement by adapting suitable cleaning technology for the process (target market release in FY2027)

- In innovation management, we are promoting new business creation activities that allocate growth investments to each phase and visualize progress, as well as acquiring new businesses through collaboration with other companies.
- We will continue these activities, which we have cultivated through exploration activities centered on our focus areas, and aim to create new businesses that will help us realize our 10-years vision.



Innovation for a Sustainable World