



SCREEN Group

IR Day 2022

We have
the power to
change the world

We, SCREEN Group is working
to solve many issues facing society.
Using our combined strength, based on our core technologies,
we create solutions that offer the world new value.

Core Technologies

Surface processing technology

Technologies for modifying surfaces
using coating, cleaning and etching
material application devices

Direct imaging technology

Technologies for directly forming
patterns and images on substrates
using lithographic and inkjet devices

Image processing technology

Technologies for retouching,
verifying and converting image data

Precautions on handling this material

- The sales estimates we provide orally and in this material are based on the information we have obtained as of the presentation day and on a certain assumption that is judged to be rational, and we do not intend to promise that it will be achieved. The actual numbers may vary greatly, depending on various factors.
- The numbers provided in this material are rounded down to the nearest full unit. The ratios are rounded off.
- In this material, for example, "FY2023/03" refers to the accounting term of April 1, 2022 to March 31, 2023.

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

Agenda

■ Enhancing SCREEN's value — Discussion on semiconductor demand and WFE growth

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

■ Expanding the cleaning process from the perspective of market and technological trends

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

■ High-Value-Added Cleaning Technology that Enhances SCREEN's Value

Hiroaki Takahashi

General Manager, Clean Technology Development Operations, SCREEN Semiconductor Solutions Co., Ltd.

■ Q&A

■ Upcoming event news



Enhancing SCREEN's Value – Discussion on semiconductor demand and WFE growth

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Toshio Hiroe

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

1. Enhancing SCREEN's Value

- Creating SCREEN Group's value
- Innovation management and portfolio management
- Progress of ROIC management
- Medium-term management plan – Revision of the final year's targets

2. Discussion on semiconductor demand and WFE growth

1. Enhancing SCREEN's Value

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Creating SCREEN Group's value



- To realize a consistent vision for the next 10 years that is derived from both our current megatrends and corporate philosophy, we carefully identify the material issues affecting our management and strive to be a corporate entity that can continuously create solutions for the future.
- We are constantly working to promote the growth of our existing businesses and also to create new businesses through our portfolio management, which incorporates innovation management and business portfolio management based on our core technologies and guided by our Founder's Motto of "Shi Kou Ten Kai".
- We hope to use our business activities to resolve the issues affecting society, with the ultimate goal of building a prosperous and sustainable society and strive to create new solutions using our accumulated tangible assets, refers to human resources, facility and equipment, funding and intangible assets, refers to knowledge, technology, know-how, that have been accumulated in this cycle to in order to enhance our SCREEN Value.

Also refer to our "Annual Report 2022."
<https://www.screen.co.jp/en/ir/annual>

Idea of portfolio management

➤ Business portfolio management

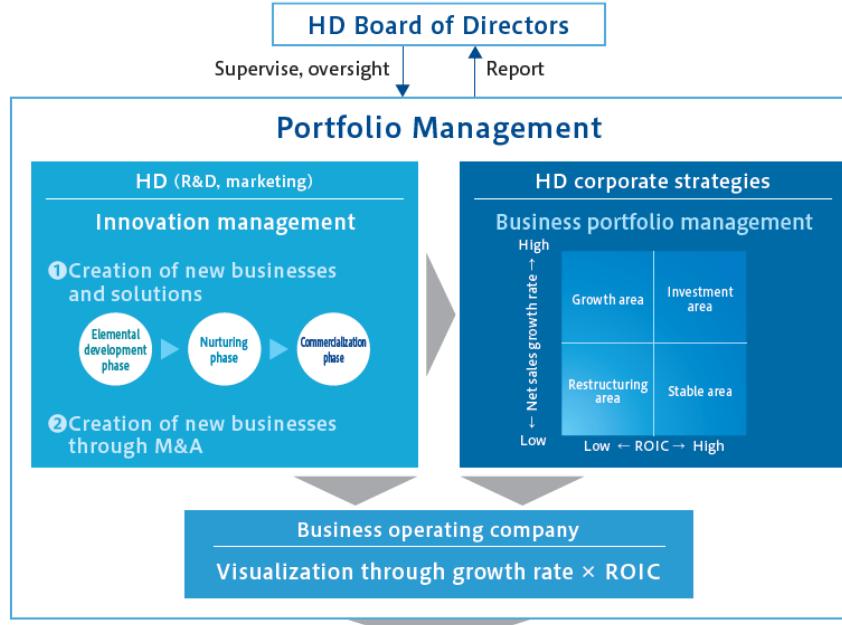
With two axes - ROIC and sales growth rate - we will “visualize” the current position of the business and discuss its future direction.

➤ Innovation management

We will discuss endeavors for creating new businesses in growth areas.

Innovation management Strengthening marketing

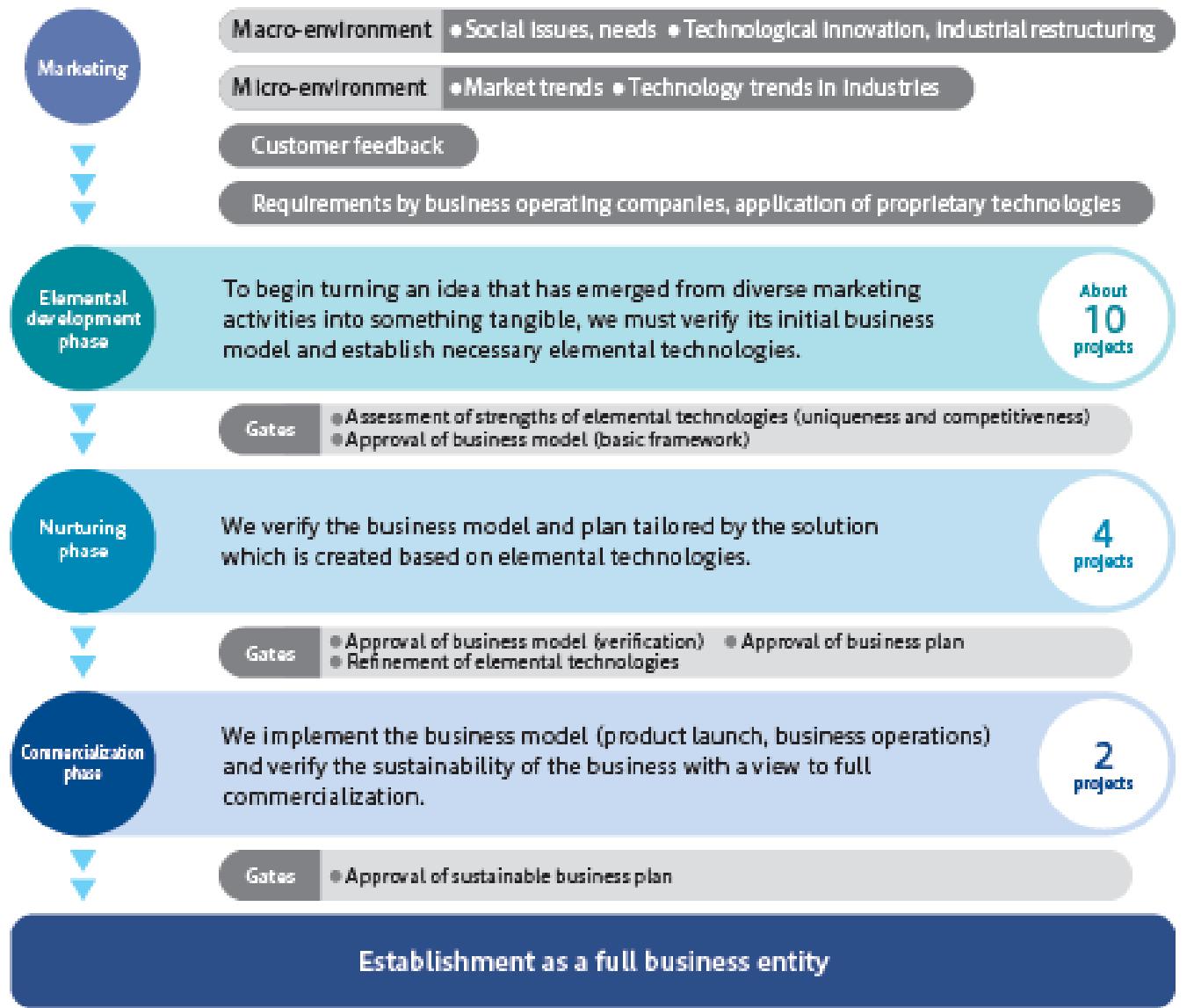
- We will analyze and forecast medium- to long-term market technology trends from both macro and micro viewpoints by using our own marketing method.
- We will promote industry-leading initiatives in growth areas of our businesses



Innovation management

Leverage our “seed” technologies to improve business value

- As part of portfolio management, we will create new businesses in a continuous and efficient manner.
- The holding company will lead in creating new businesses in line with existing operating companies and solutions that will strengthen the existing operating companies.
 - Creation of new businesses and solutions
 - Creation of new businesses through M&A



Applying ROIC to portfolio management

Introducing ROIC to portfolio management

- We will use two axes - sales growth rate and ROIC – to visualize the business's current position. Then, inside the company, we will discuss the direction in which we should lead the business in over the medium- and long- term, and develop measures for doing so.
- We will move businesses into a state where analysis can be done from various perspectives so we can identify operations that need improvement.

Results of introducing ROIC management PFM

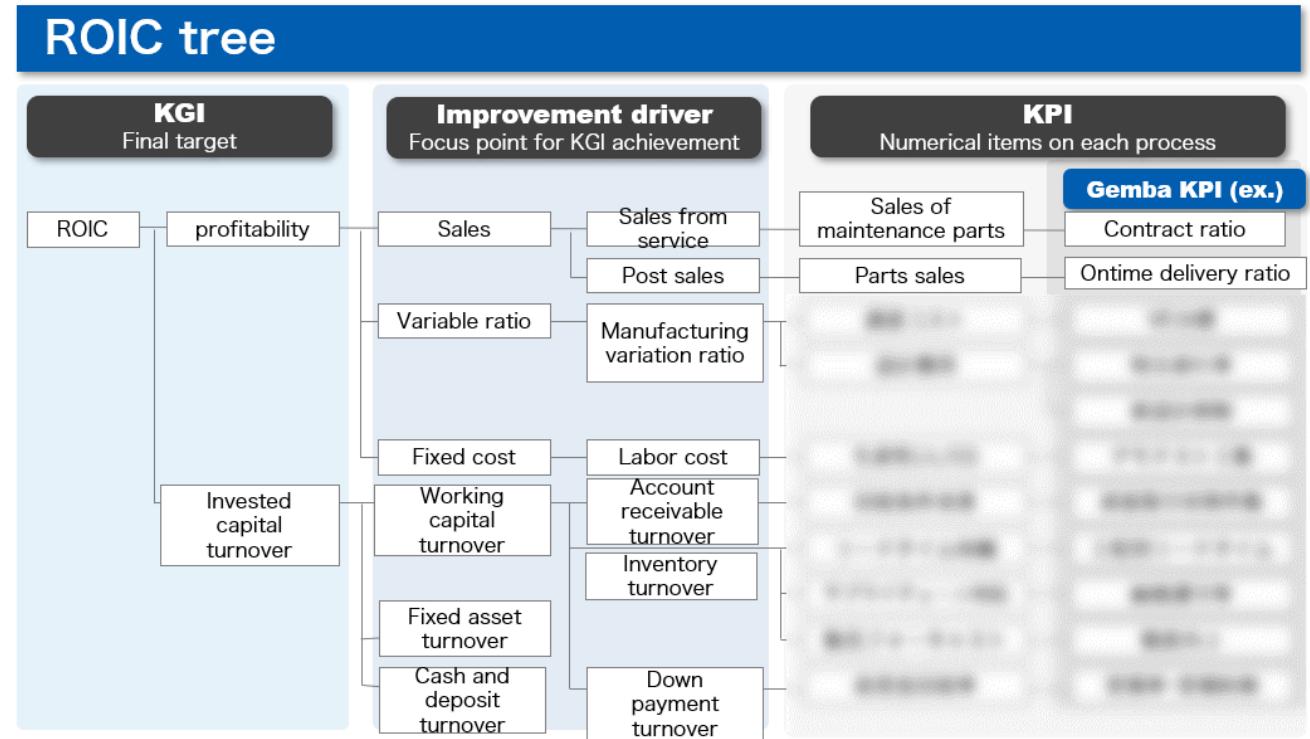
- Transfer resources in non-profitable business in SPE to areas of focus
- Divest from unprofitable businesses in GA and concentrate resources in focused business
- Restructuring unprofitable business in HD
 - Change direction of IM business
 - Optimize resource allocation among subsidiaries

Progress of ROIC management

ROIC improvement and “Gemba KPI”

- By monitoring the *Gemba KPIs*, we analyze not only the increase/decrease in ROIC, but also what has improved and what has deteriorated in which area.
- We attempt to “visualize” what contributions daily workplace activities make to ROIC improvement
- Furthermore, we implement redevelopment in order to reset the *Gemba KPIs* linked to ROIC.

We develop ROIC from the two axes of “profitability” and “efficiency” into a tree shape, and convert it into indexes (*Gemba KPI*) that can be managed on site.



Medium-term management plan - Revision of the final year's targets

We will renew the final year targets of the current medium-term management plan and aim for a next level of growth in the next plan.

Economic Value Targets in the final fiscal year (Initial planned)		FY2021/03 Result (1st Year Result)	FY2022/03 Result (2nd Year Result)	FY2023/03 Forecast (3rd Year Forecast)	Economic Value Targets in the final fiscal year ending March 31, 2024 (After revision)
Net sales	¥400.0 bn or above	¥320.3 bn	¥411.8 bn	¥460.0 bn	¥500.0 bn or above
OPM	15% or above	7.6%	14.9%	16.2%	17% or above
ROE	15% or above	7.9%	19.9%	20% or above	20% or above
Operating CF	¥120.0 bn or above (Four-year cumulative)	¥57.2 bn	¥138.9 bn (Two-year cumulative)	¥170.0 bn- ¥190.0 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%	30.0% or above	Total consolidated shareholder return ratio of 30% or above

*The above figures are predicated on organic growth

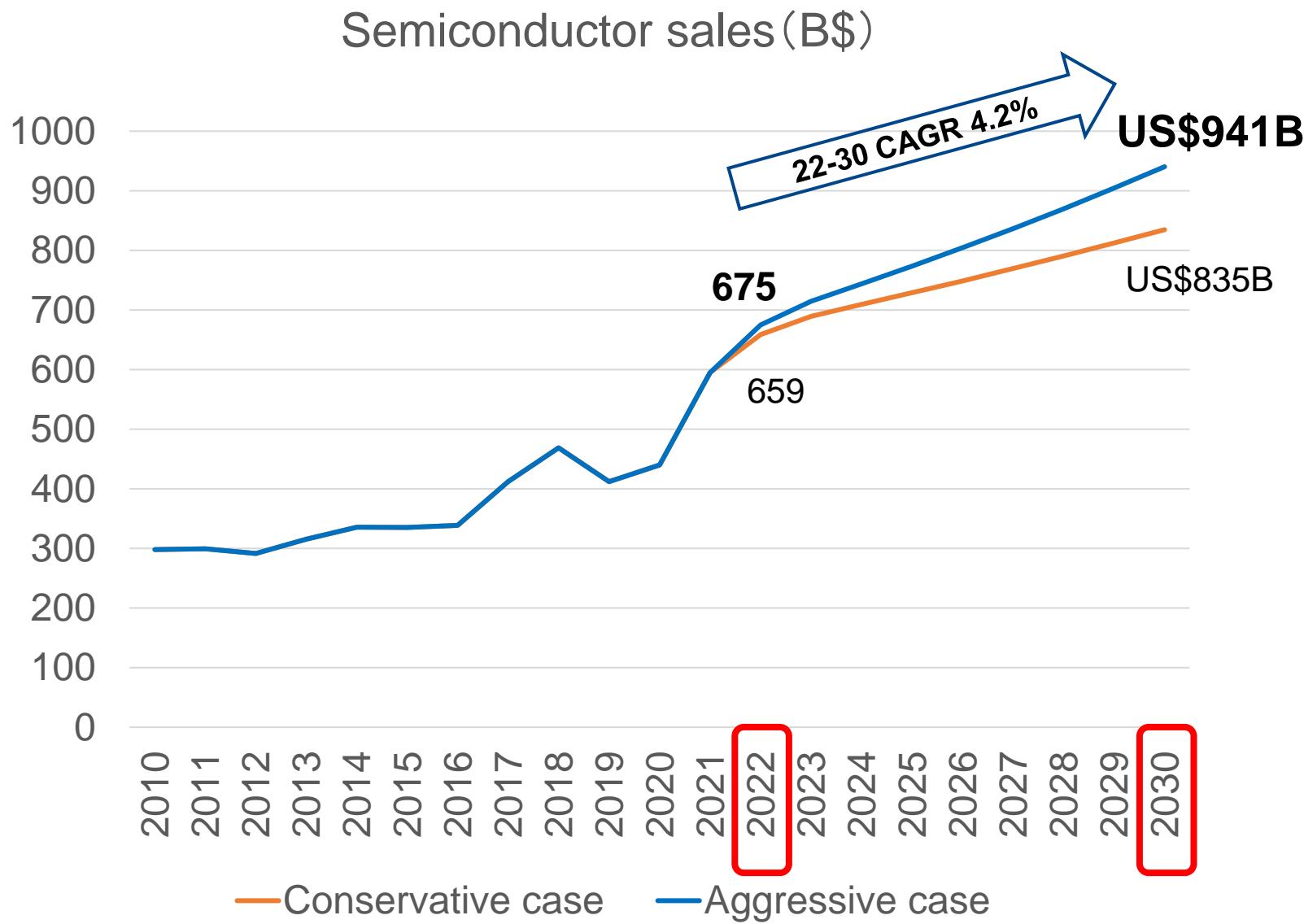
*The shaded background figures of FY2022/03 Result and FY2023/03 Forecast which are the items of initial targets were achieved

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IC market forecast



The IC market size, which is the premise of WFE, is forecast to reach US\$835 billion to 941 billion in CY2030 although there is fluctuate from year to year.

The following factors are expected to start driving a rise in IC demand in CY2027.

- 6G infrastructure
- 6G cell phones will come to have advanced functions.
- Metaverse services will be spread by acceleration of the communication network (which will lead to growth in server demand).
- Popularization of EVs + ADAS 3.0 ~
- Popularization of near-body terminals such as VR haptics

After 2025

2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030

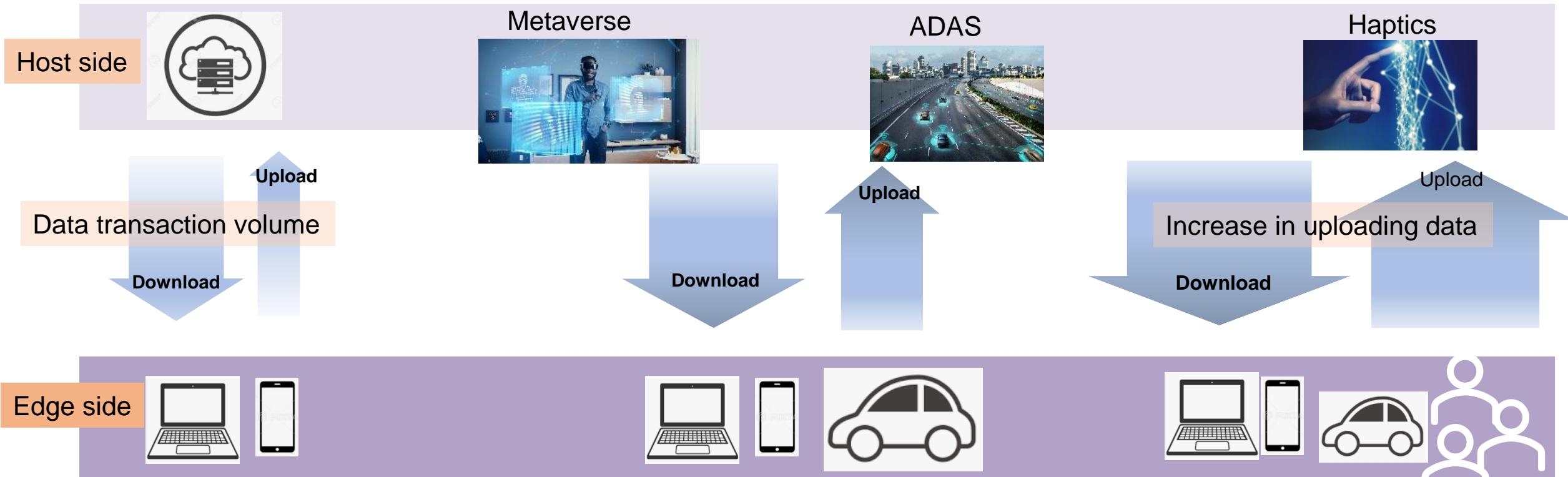
Telecommunications standard

4G & 5G

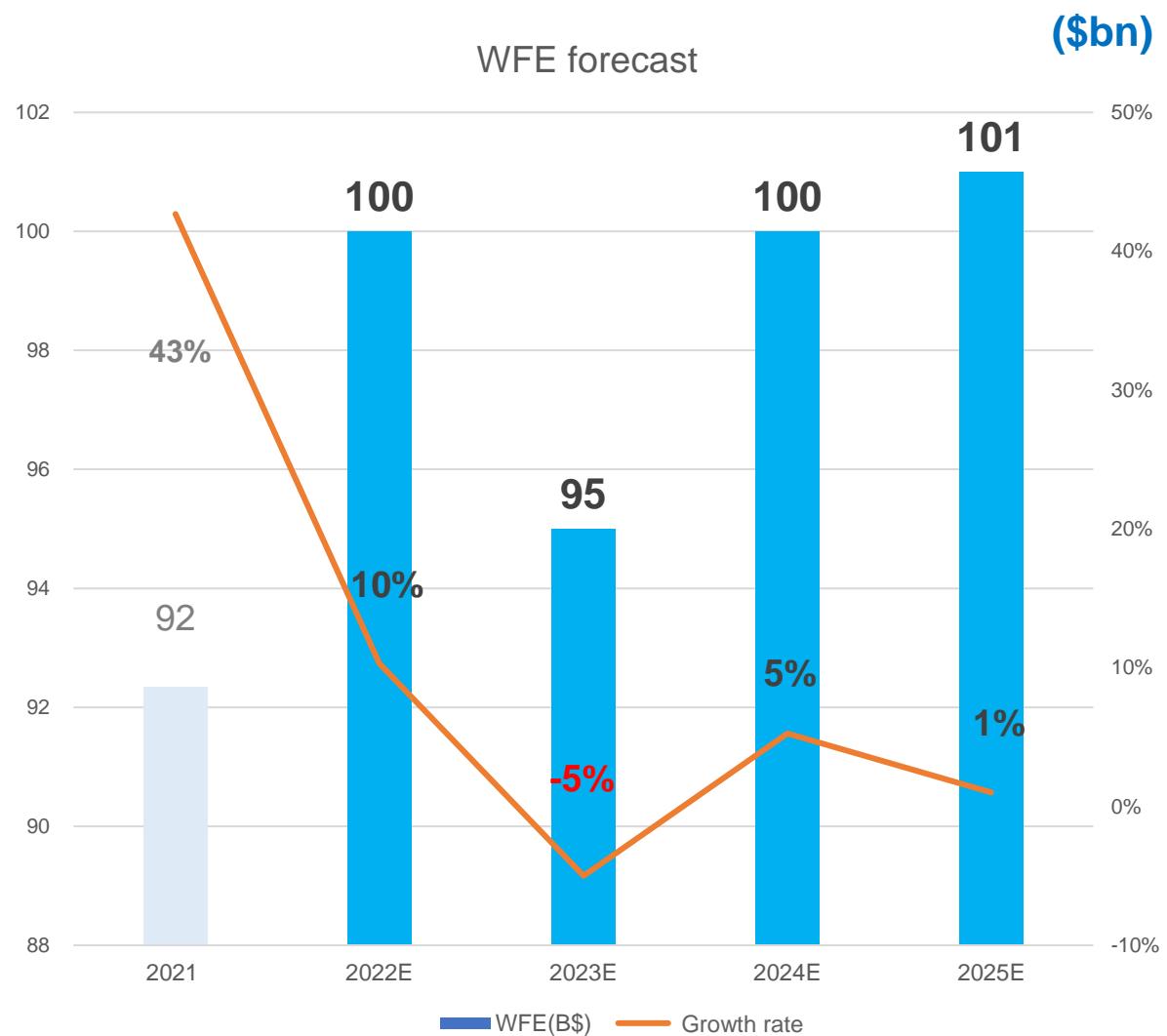
6G

Focus on downloading speed

Focus on uploading speed: Growth of server demand



Growth of WFE



WFE growth forecast

- WFE Market size in CY2022 is forecast to be about \$100 bn.
- The market situation in CY2023 is expected to slow down, mainly with respect to memory, which will affect investment plans.
- Meanwhile, investments in foundries and logic devices are expected to remain steady.

> Recovery in 2024 depends on memory.

Reference: Estimates from third-party forecasts

	2021E	2022E	2023E
B\$	92.6	105.4	99.0
YoY	+42.7%	+13.9%	-6.1%

Summary

- **The semiconductor market will continue to grow in response to needs centered on applications due to the increasing speed of communication networks.**
 - ⇒ It will grow to nearly \$1 trillion by CY2030.

- **WFE in CY2023 is expected to shrink to the size below that in CY2022 due to deteriorating memory market conditions.**
 - ⇒ Since the investments for logic and foundry remain strong, recovery in CY2024 will depend on memory market conditions.



Expanding the cleaning process from the perspective of market and technological trends

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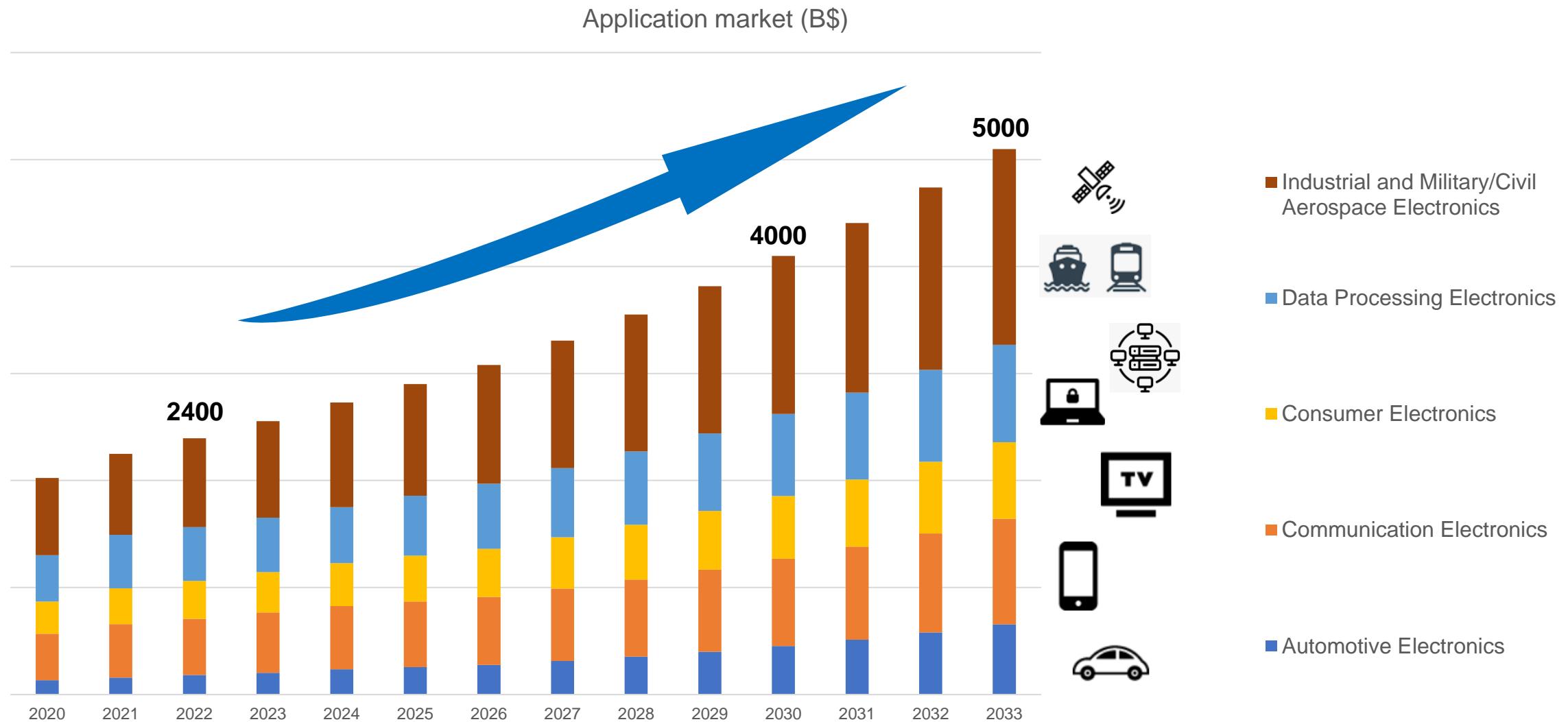
Masato Goto

President

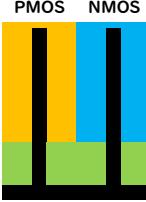
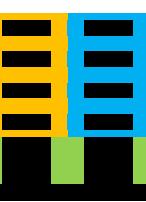
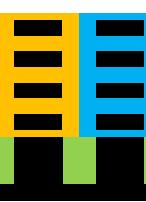
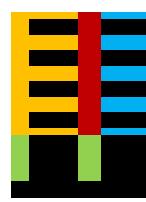
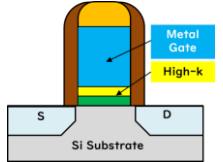
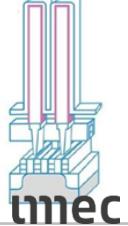
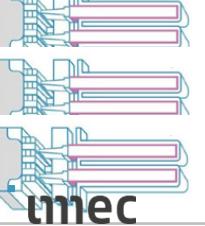
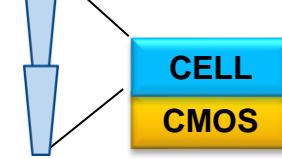
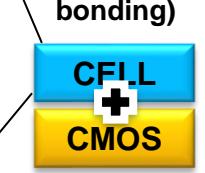
SCREEN Semiconductor Solutions Co., Ltd.

Application market

■ Semiconductor industry continues to grow.



Device roadmap

Device	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
EUV			NA=0.33				NA=0.55			
Ad-Logic		N3		N2		N1.4		N1.0		N0.7
										
DRAM		D1B(13 - 12nm)		D1C(12 - 11nm)		D1D(11 - 10nm) or 3D		D1E(\leq 10nm or 3D)		
										
NAND	160/176L	2XX	3XX	5XX	7XX -					
	(Multi-tier)	(CUA)		(Wafer bonding)						
										

Device roadmap

Device

2022

2023

2024

2025

2026

2027

2028

2029

2030

2031

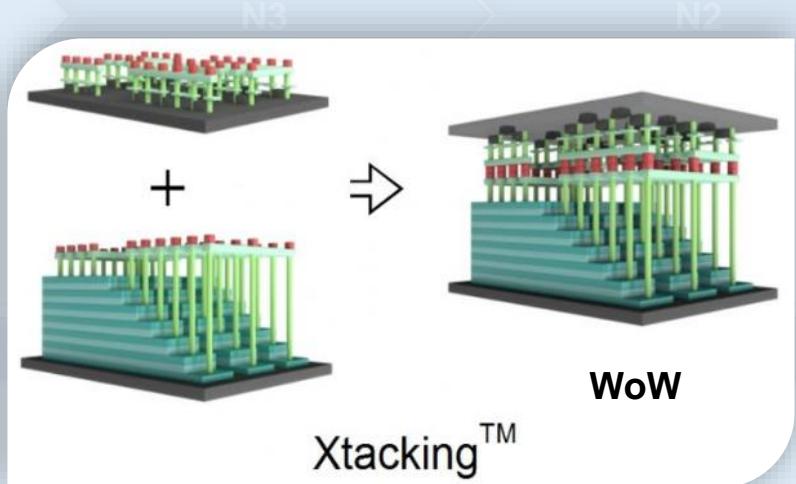
EUV

Ad-Logic

DRAM

NAND

3-dimensionalization/stacking and CoW/WoW



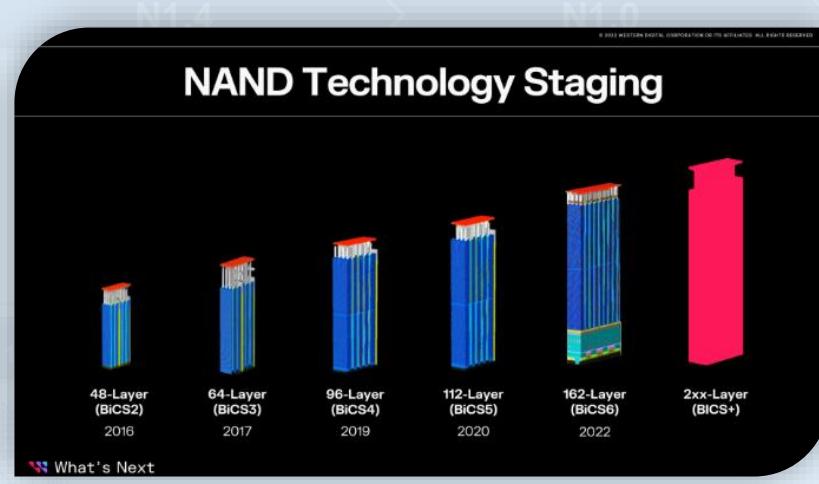
Source: YMTC, FMS 2018

Si Substrate

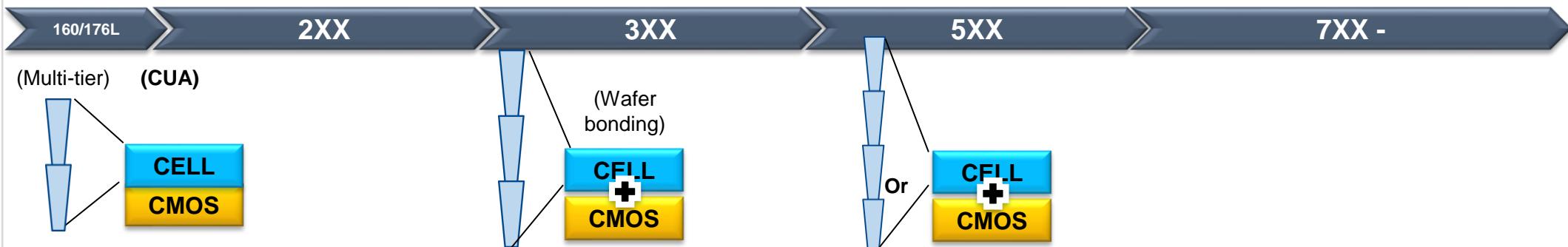
Peri.CMOS/HKMG

Source : IMEC, IEDM 2018

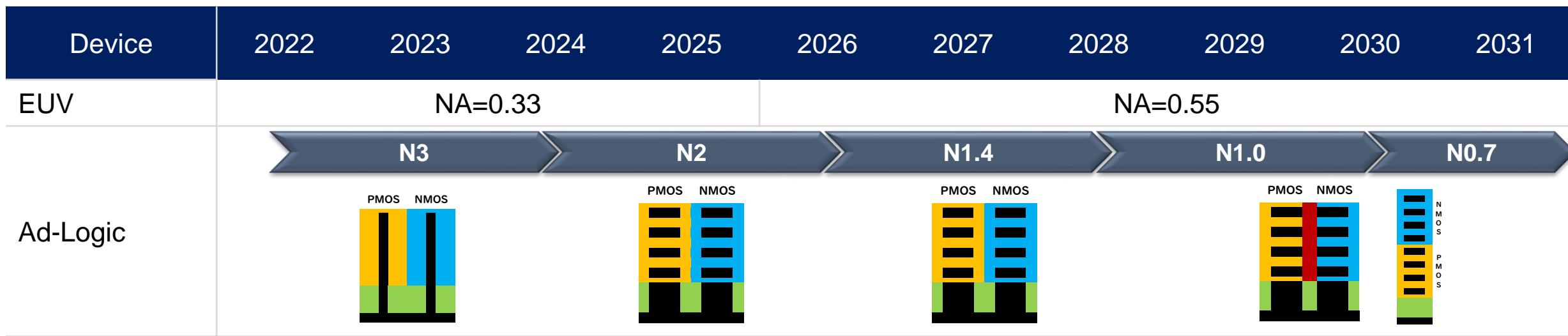
WoW



Source: WD, FMS 2022



Device roadmap

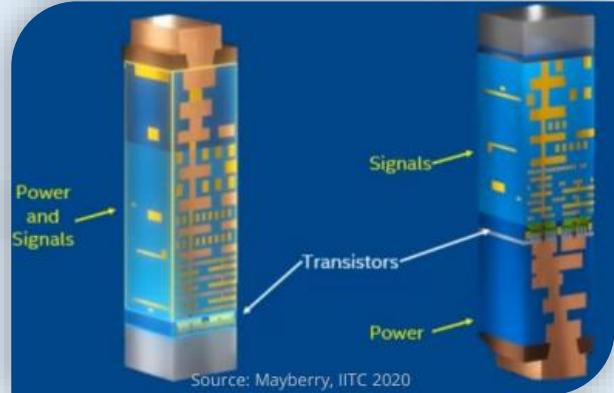
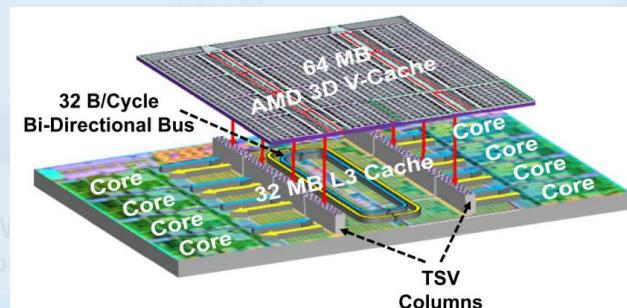


Continued miniaturization

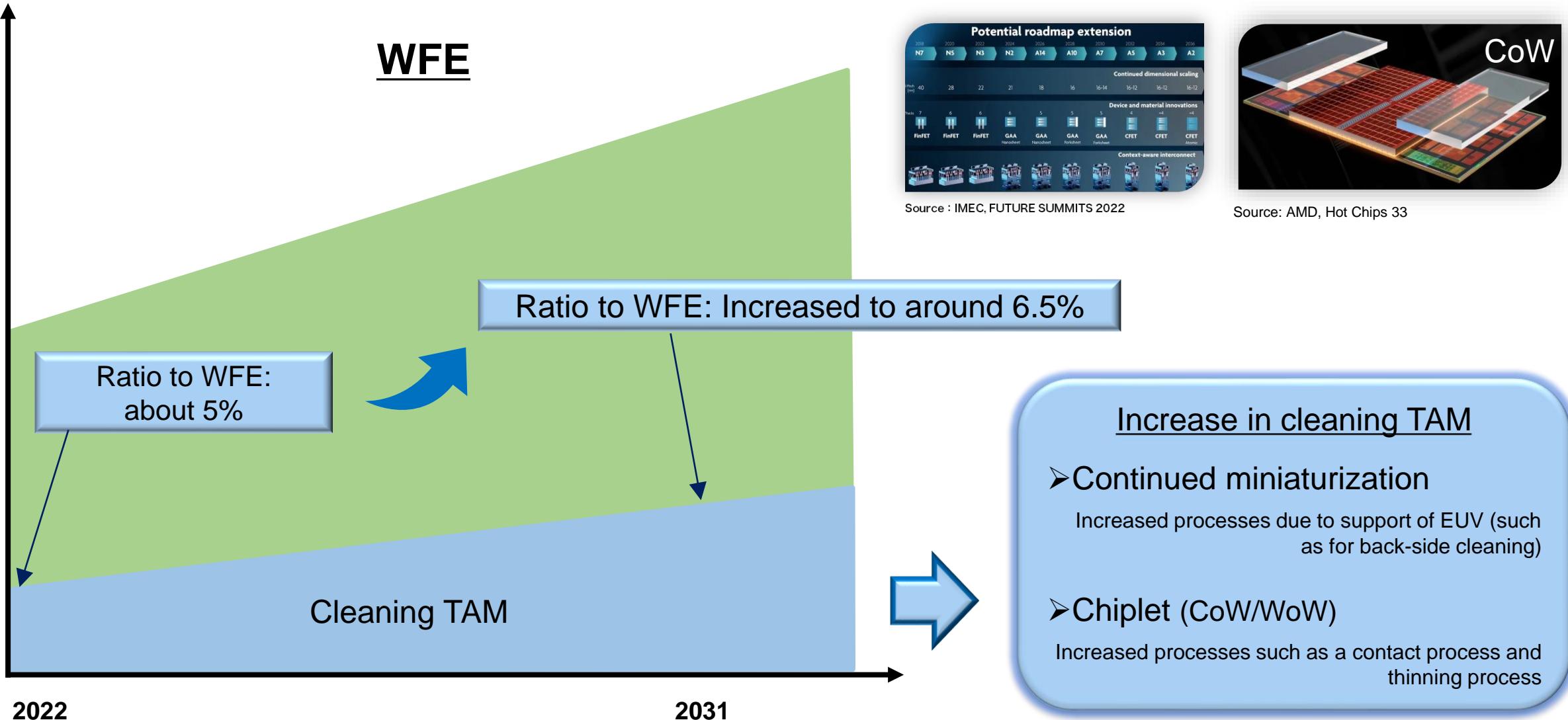


3-dimensionalization/stacking and CoW/WoW

3D V-Cache



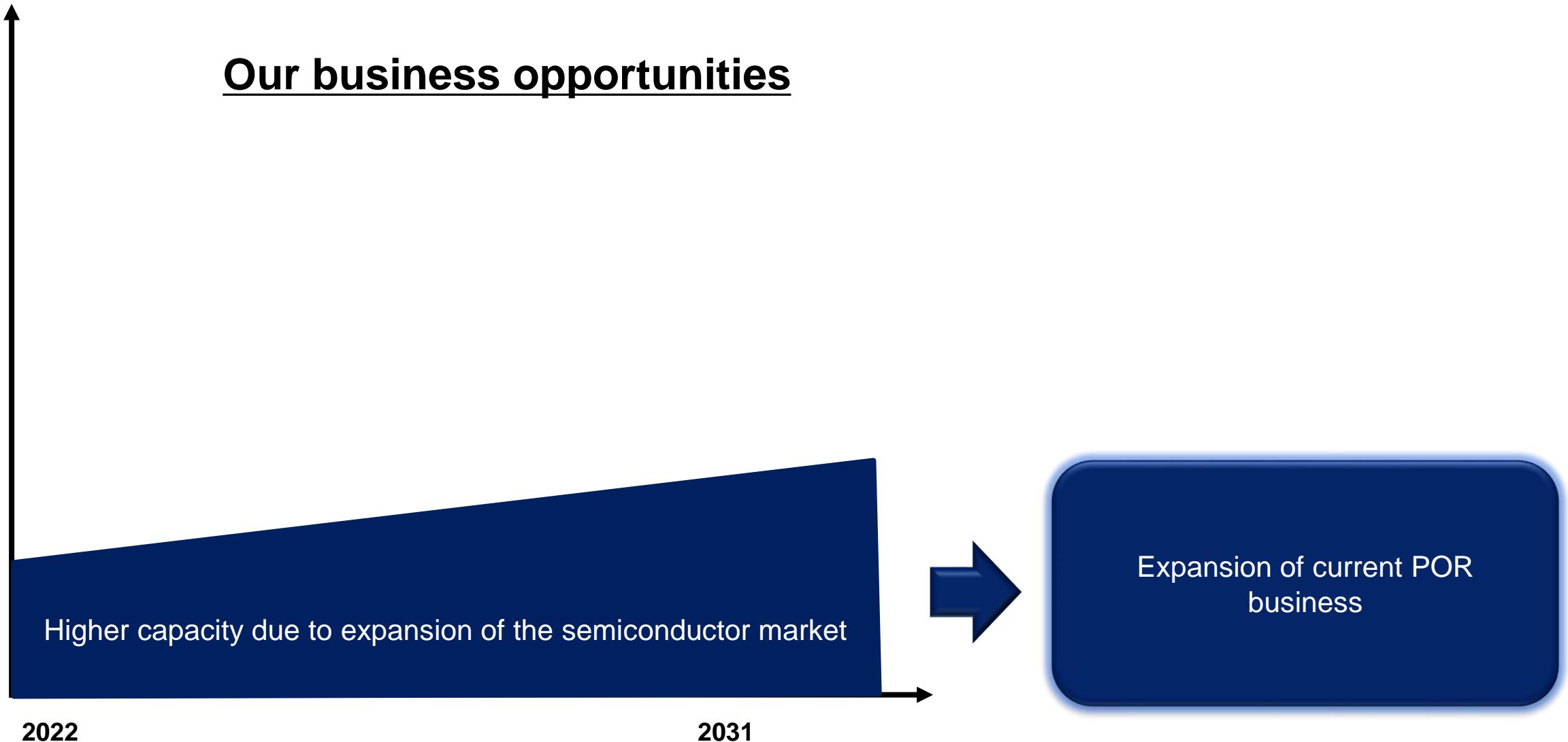
Expanding high-value-added cleaning areas (Increase in cleaning TAM)



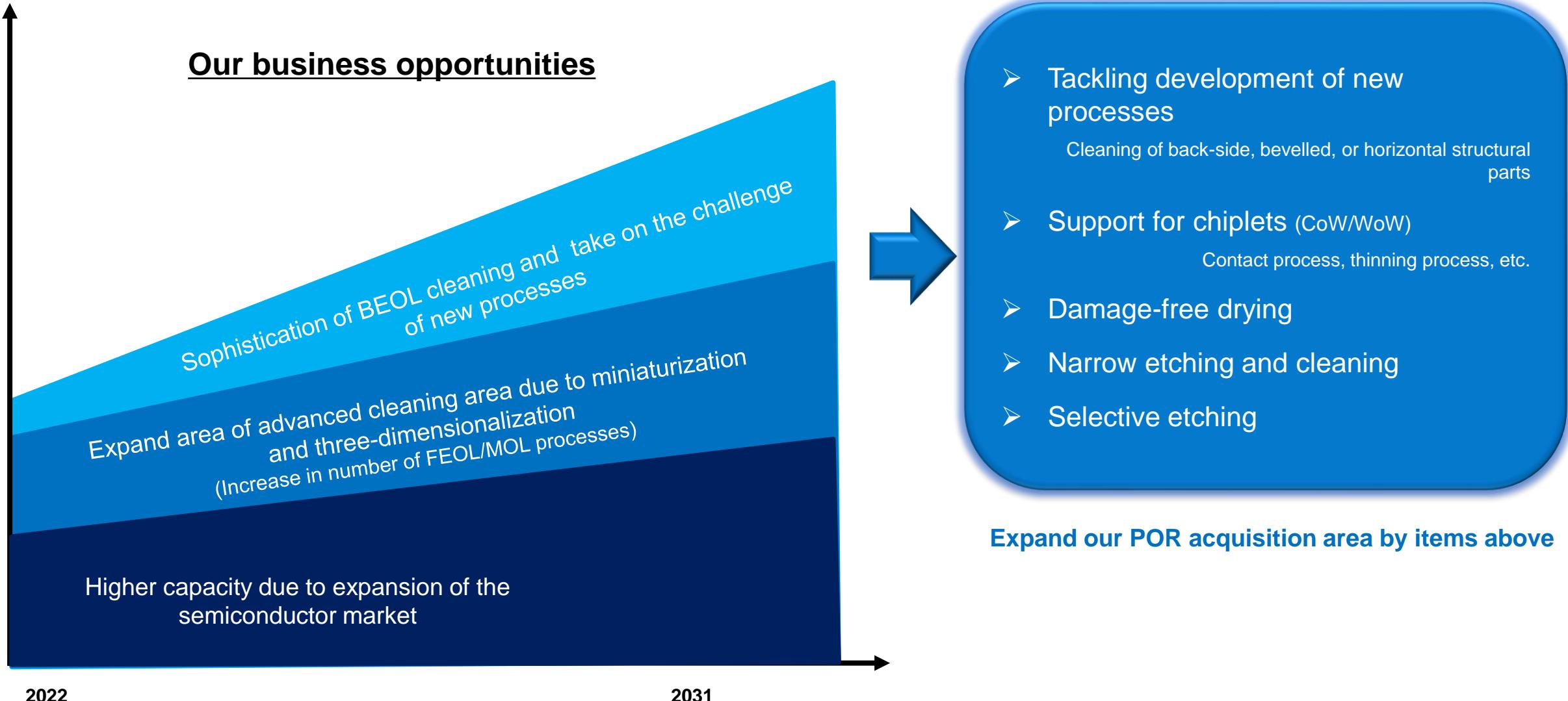
Expanding high-value-added cleaning areas (Expanding our business opportunities)



Expanding high-value-added cleaning areas (Expanding our business opportunities)



Expanding high-value-added cleaning areas (Expanding our business opportunities)



Our forecast

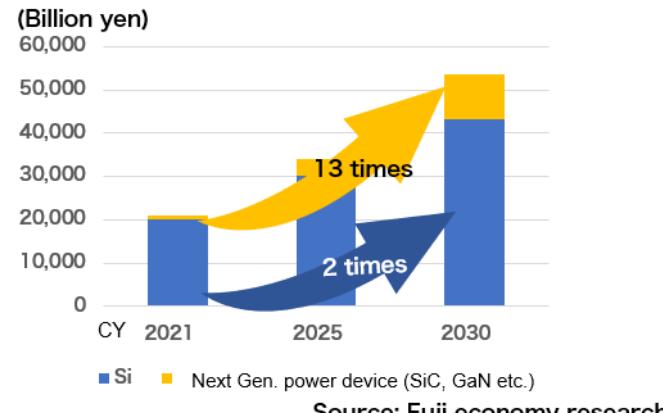
Legacy area - power semiconductors

Power semiconductor market to enter a growth phase.

- Large increase in demand, such as GX investment
- Technological evolution in manufacturing processes and wafer materials as well as larger wafer size

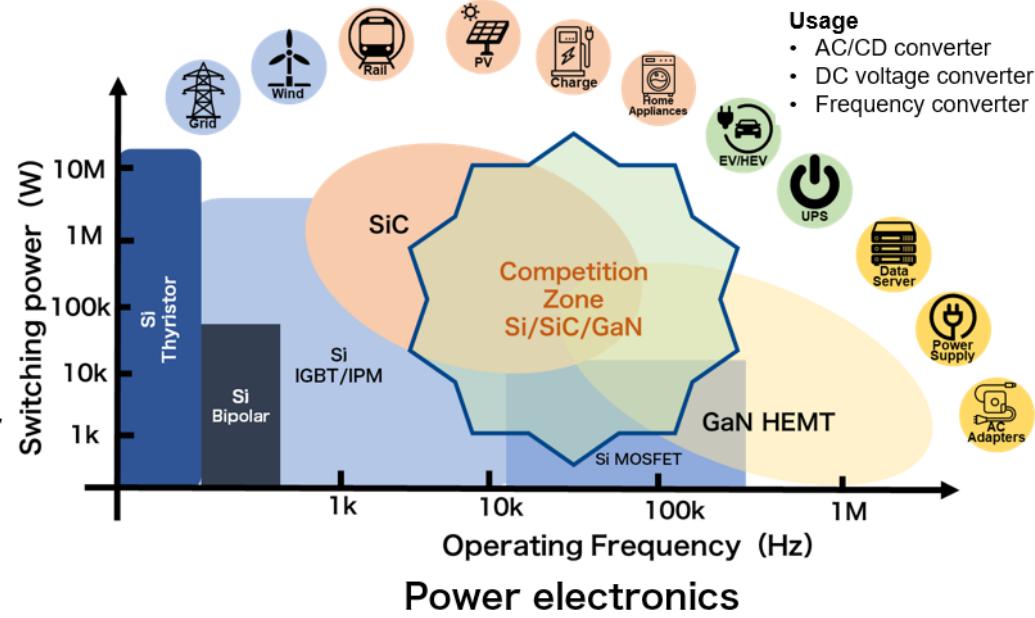
- Develop new equipment that matches customer needs through the Frontier project
- Implement and expand advanced device cleaning technology and expertise

■ W/W Power semiconductor market



- Si device moving to large size wafer
Si => 300mm wafer
- Adoption of compound wafer for next generation high voltage, high frequency application
SiC => 200mm
GaN => 150, 200mm

■ Power electronics products and applications



Summary

- "Investment in increasing capacity" due to expansion of not only the semiconductor market but also the cleaning equipment market
- "Increased number of processes" through device miniaturization, stacking, three-dimensionalization, and chipletization
- "Market growth in legacy areas" such as power semiconductors



We aim to expand our business by continuing to provide solutions that contribute to our customers' technological development



High-Value-Added Cleaning Technology that Enhances SCREEN's Value

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Hiroaki Takahashi

General Manager of Clean Technology Development
Operations,
SCREEN Semiconductor Solutions Co., Ltd.

Agendas

- Maximizing added value for customers
- Technologies in high-value-added areas
 - Cleaning challenge for miniaturization
 - Drying technology
 - Selective etching technology
- Evaluation and fundamental technologies for a competitive edge
- Sustainability
- Summary

Maximizing added value for customers

Technologies in high-value-added areas

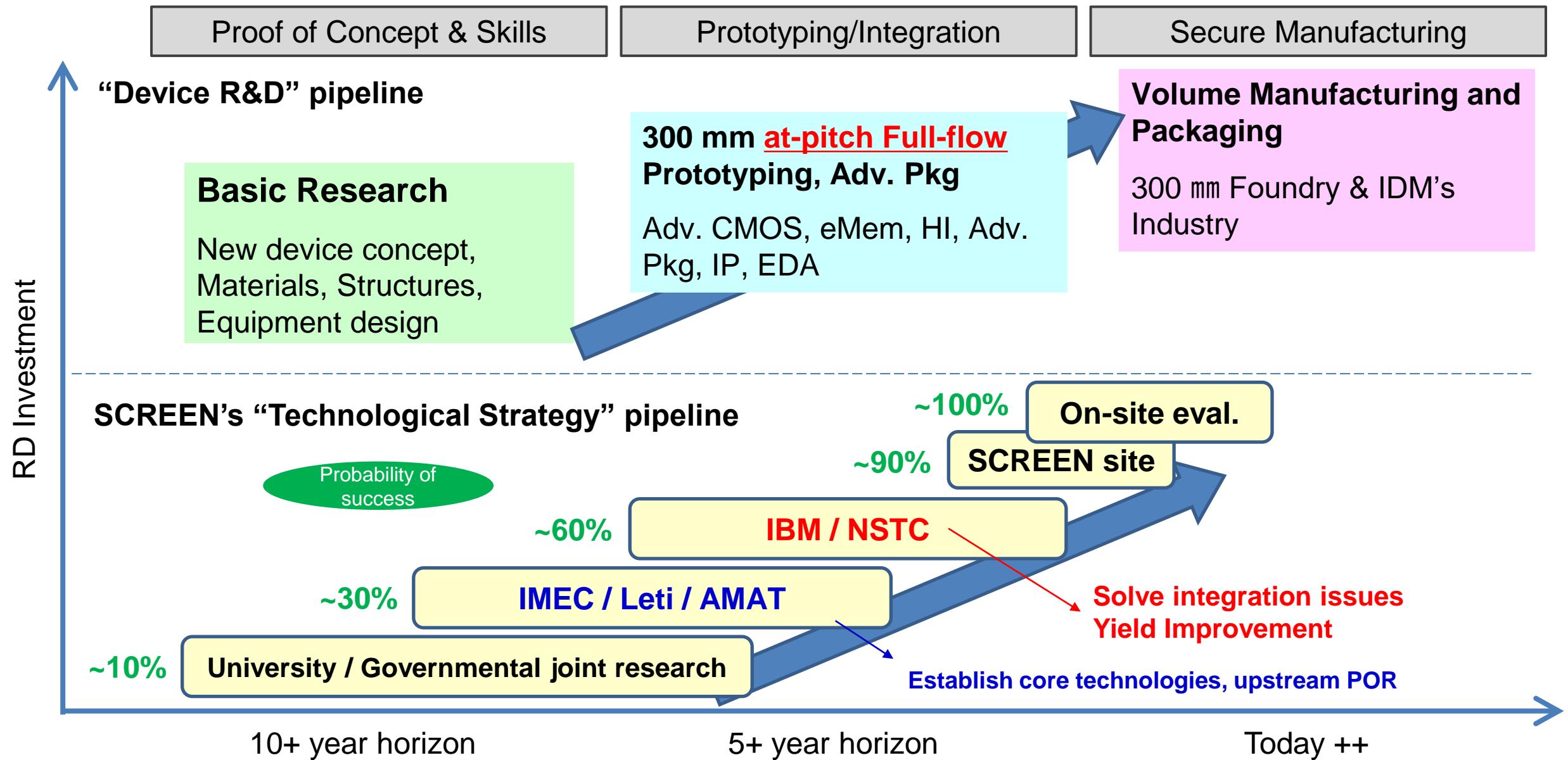
- Cleaning challenge for miniaturization
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Evaluation and fundamental technologies for a competitive edge

Sustainability

Summary

R&D pipelines to enhance added value for customers



■ Maximizing added value for customers

■ Technologies in high-value-added areas

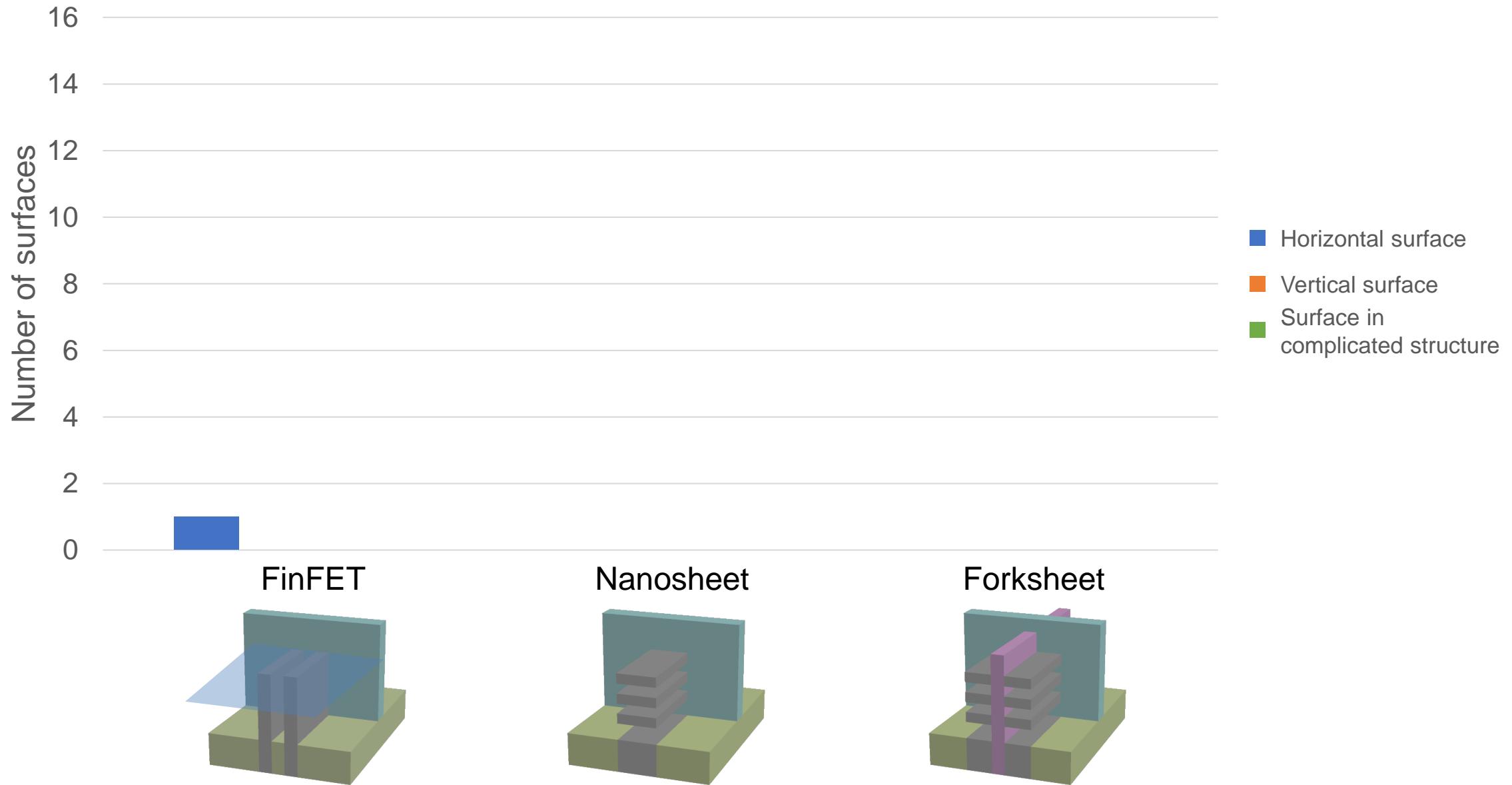
- Cleaning challenge for miniaturization
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■ Evaluation and fundamental technologies for a competitive edge

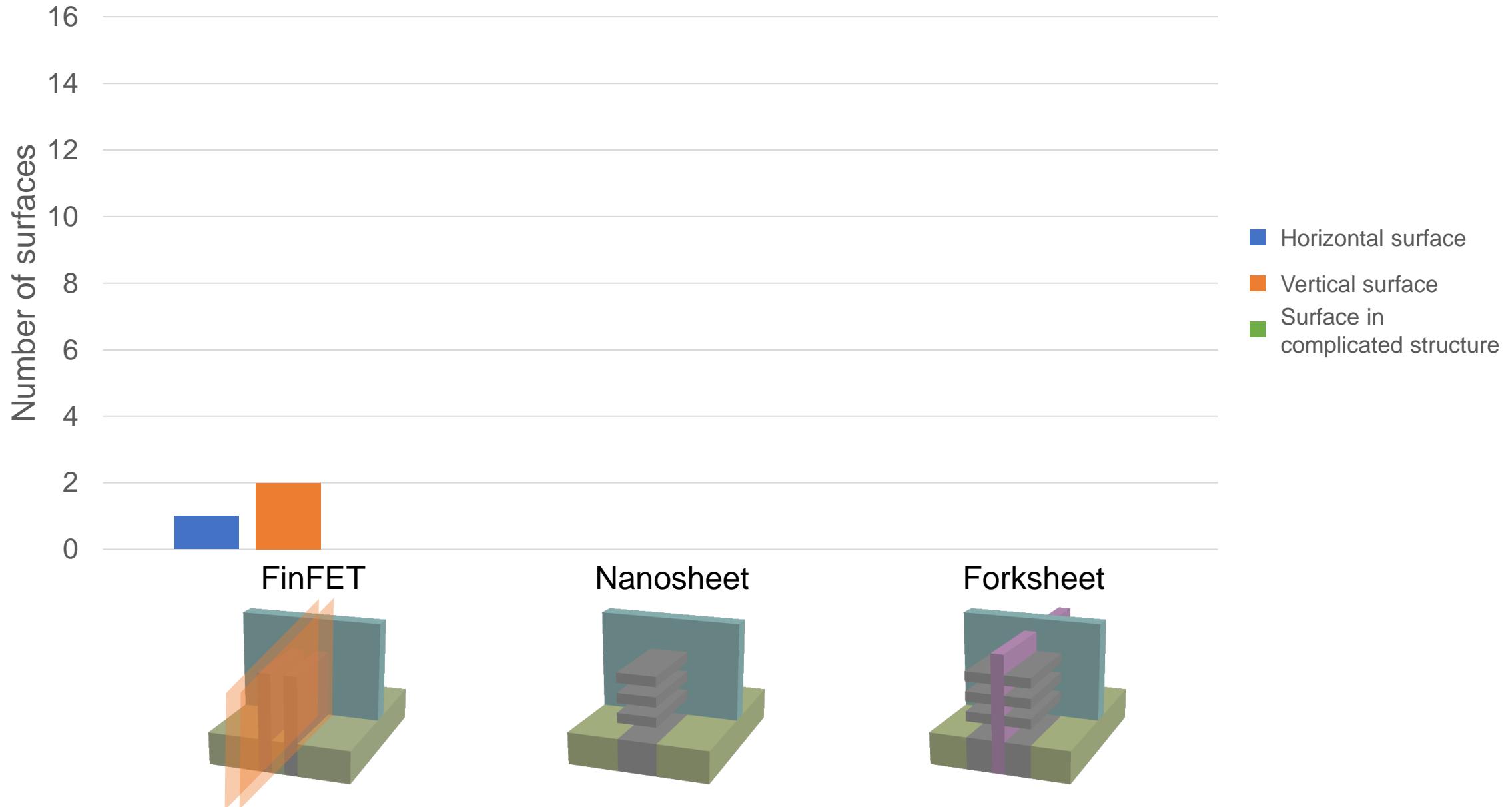
■ Sustainability

■ Summary

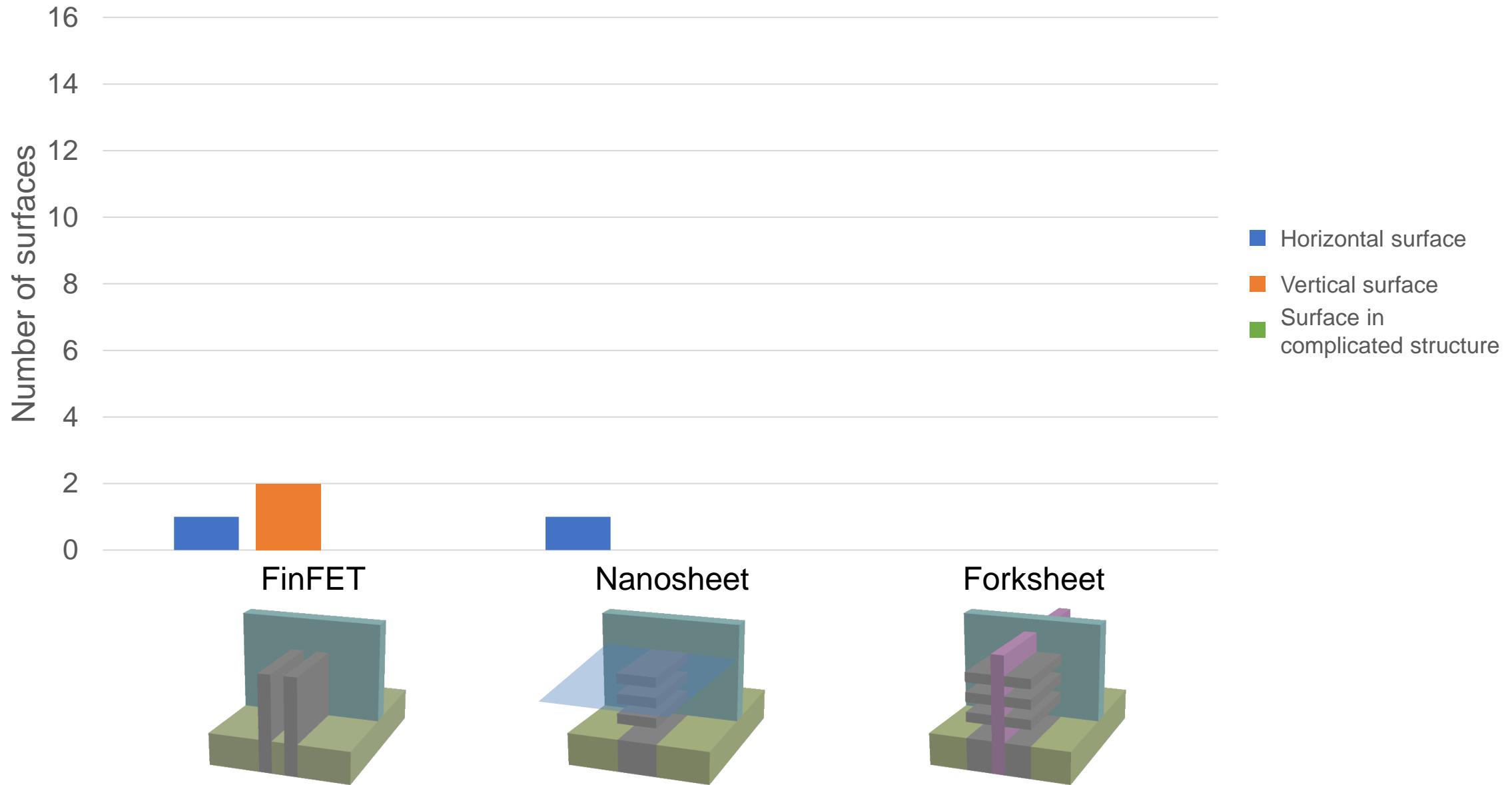
Cleaning challenge for miniaturization



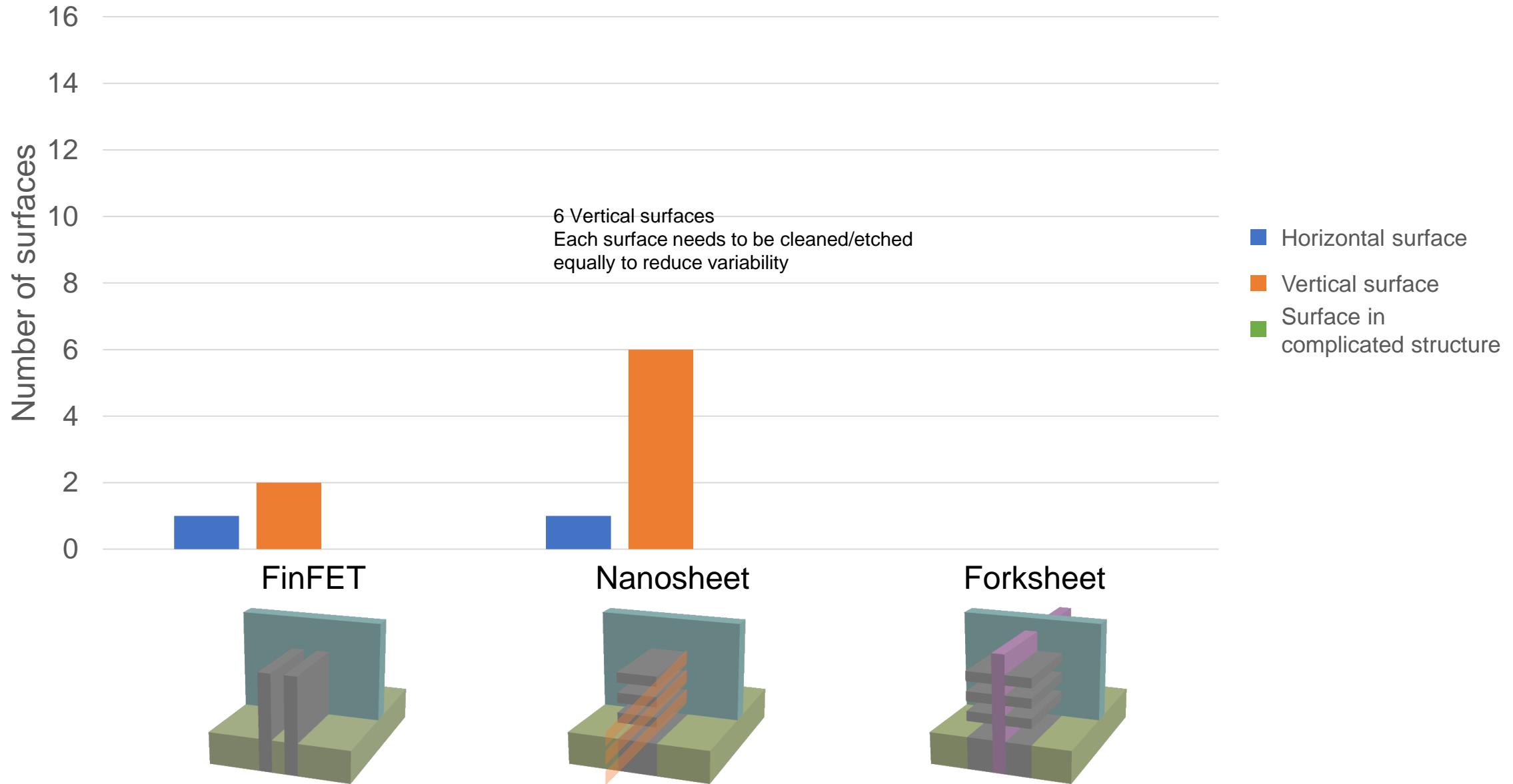
Cleaning challenge for miniaturization



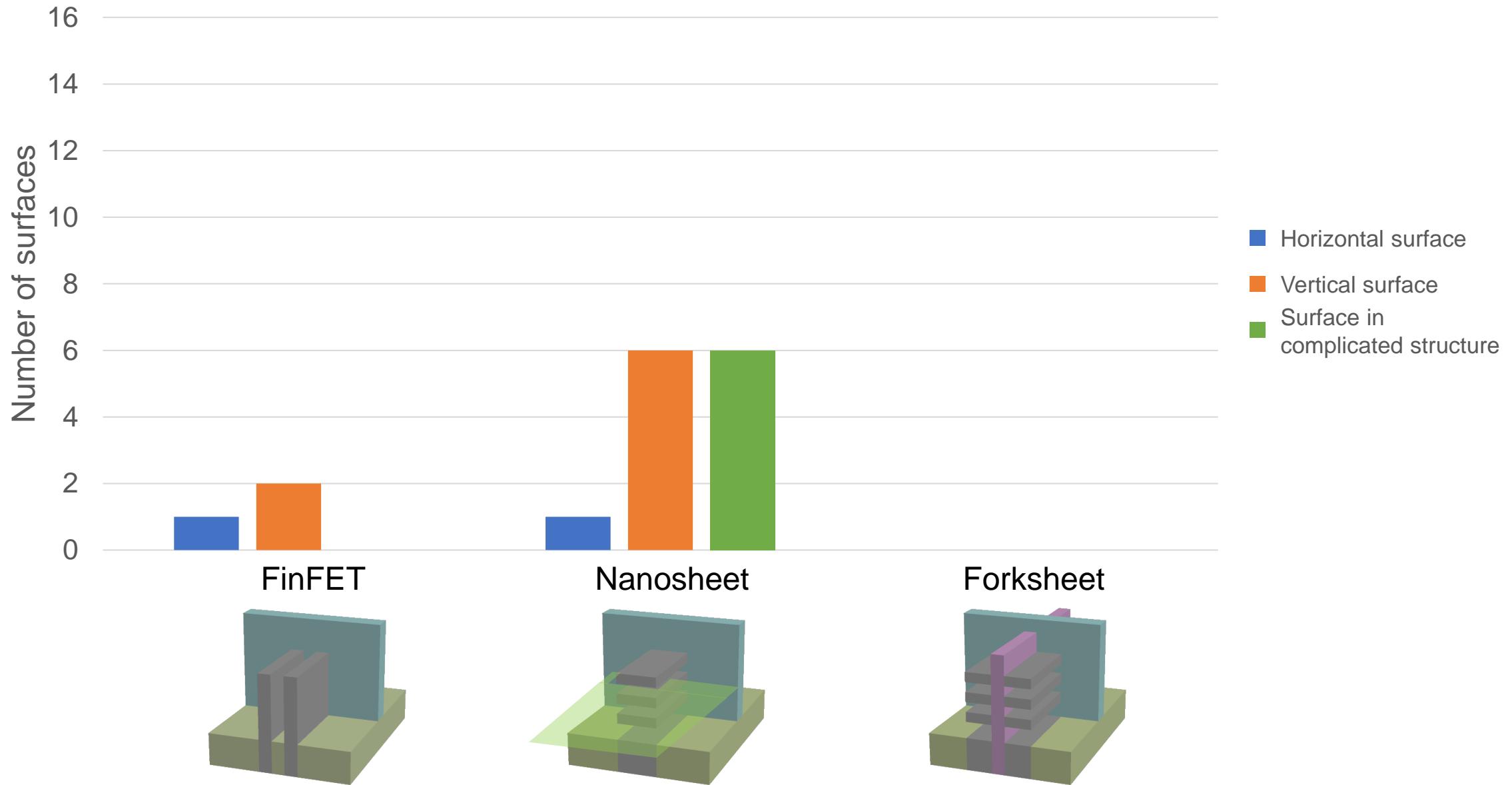
Cleaning challenge for miniaturization



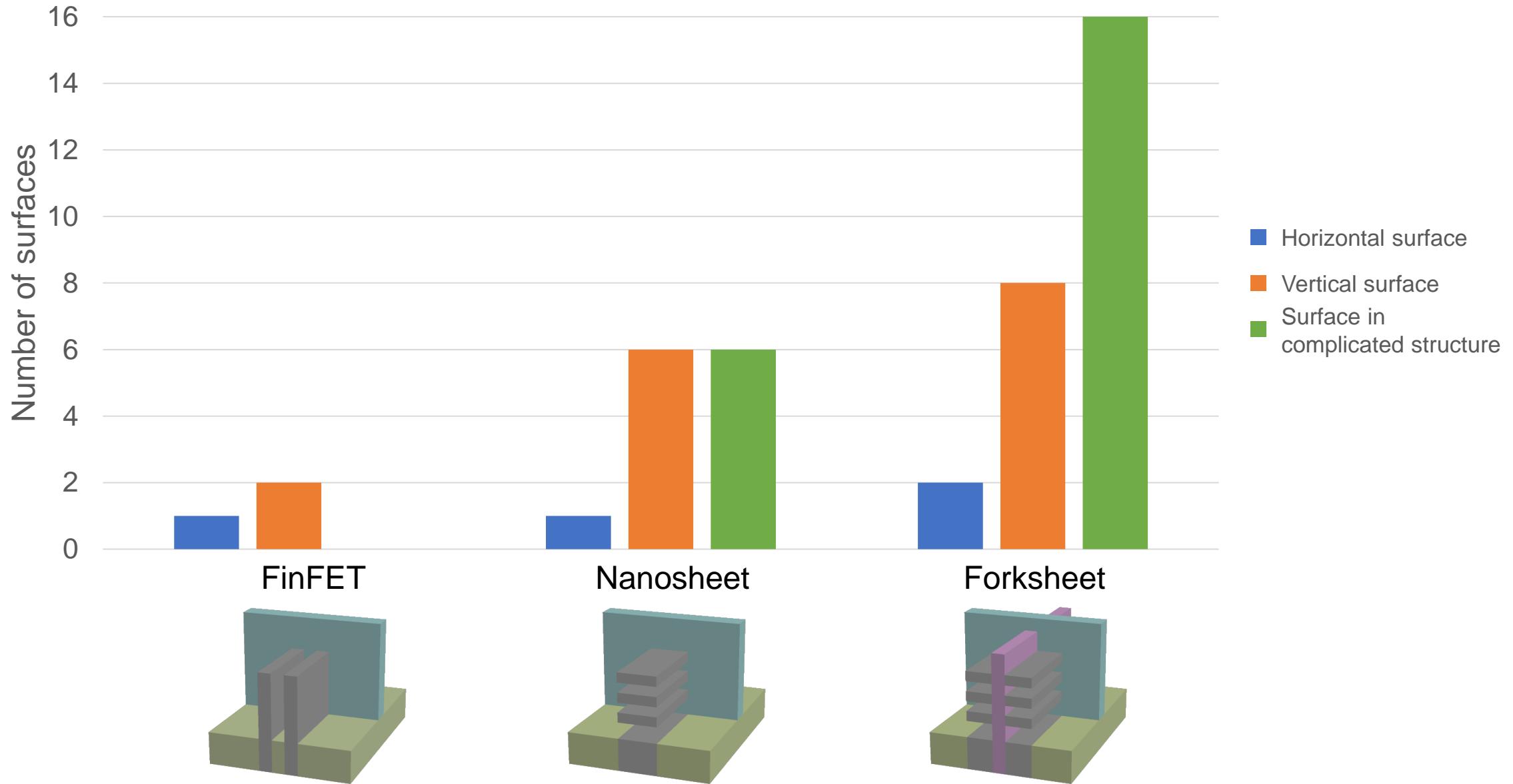
Cleaning challenge for miniaturization



Cleaning challenge for miniaturization



Cleaning challenge for miniaturization



Structural innovation of devices bring cleaning challenge

Drying

Etching uniformity

Cleanliness and removal efficiency

Exposed material (selectivity)

Collapse of vertical structure

3 faces / Fin # fins

Damage (Fin breakage, etc.)

Si / SiO₂ / Si₃N₄

Collapse of horizontal structure

4 faces / Sheet # sheets

Insufficient cleaning inside complex shapes

+ Spacer material
+ PMOS/NMOS

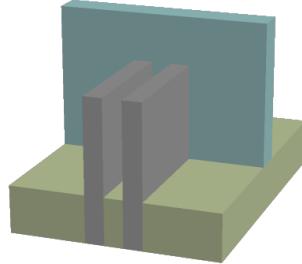
Collapse of horizontal structure

3 faces / Sheet # sheets

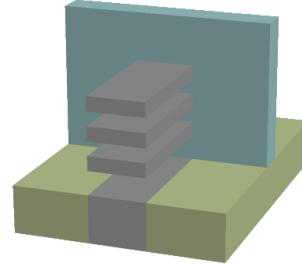
Insufficient cleaning inside complex shapes

+ Spacer material
+ PMOS/NMOS

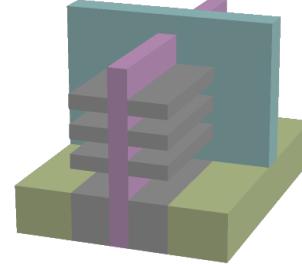
FinFET



Nanosheet

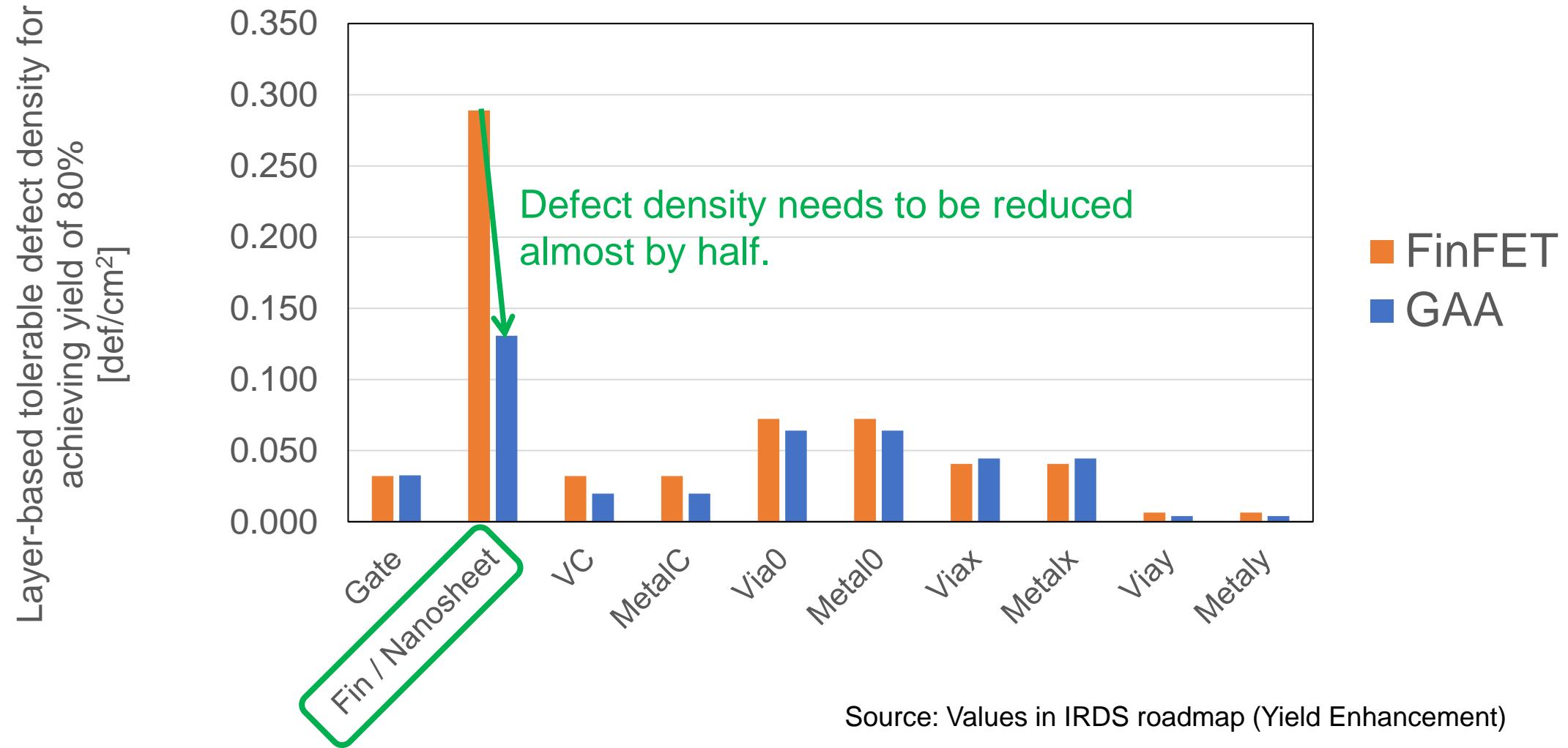


Forsheet



- As miniaturization and stacking (3-dimensionalization) of device advances, the importance of cleaning will increase further.

Suppressing random defects directly affects yield



- Economic scaling is led by “suppression of random defects” = “advanced cleaning performance.”

■ Maximizing added value for customers

■ Technologies in high-value-added areas

- Cleaning challenge for miniaturization
- Drying technology
- Selective etching technology

■ Evaluation and fundamental technologies for a competitive edge

■ Sustainability

■ Summary

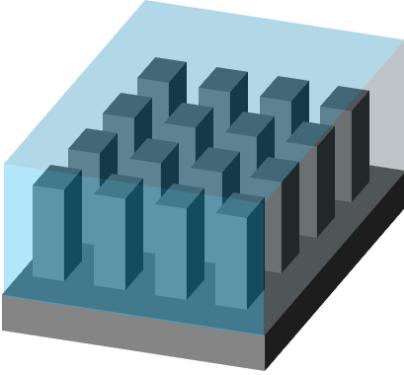
Challenges of drying tiny structures

Wet process

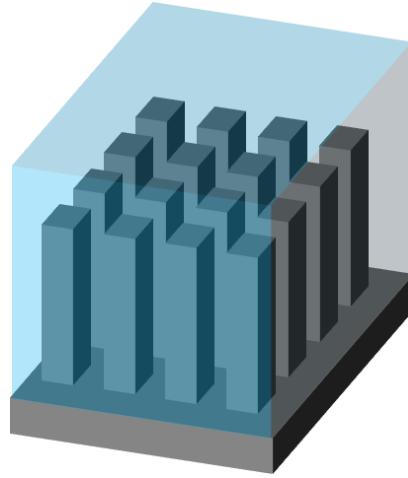


Drying

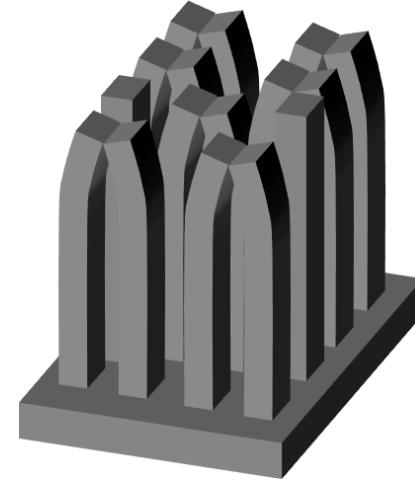
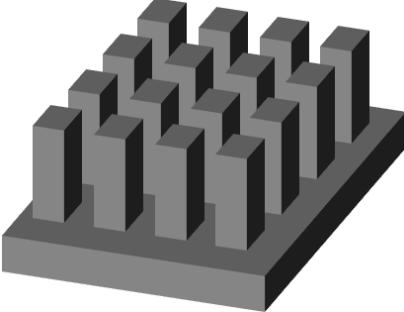
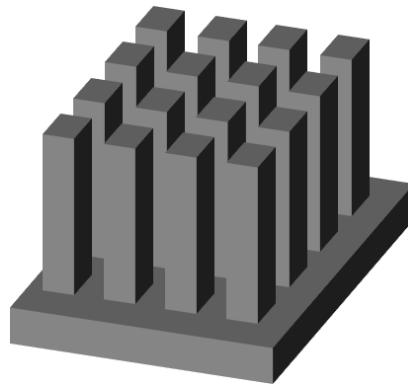
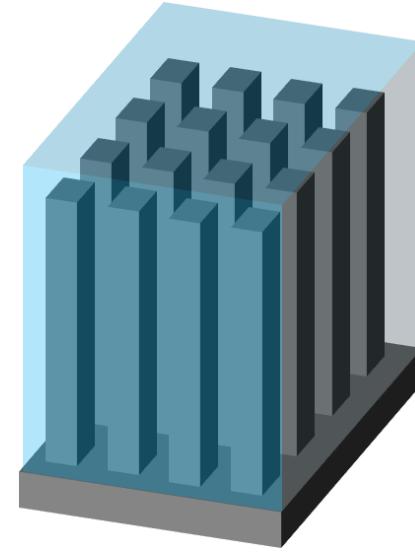
AR <10



AR =10



AR >12

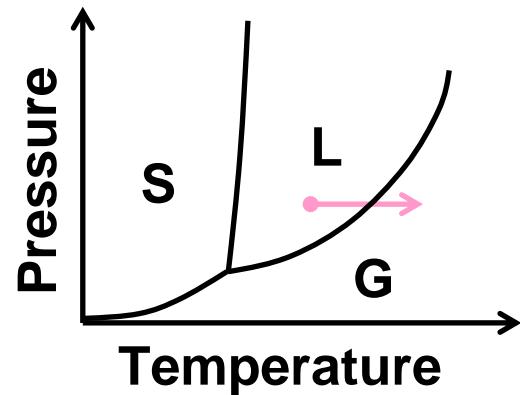


Pattern collapse

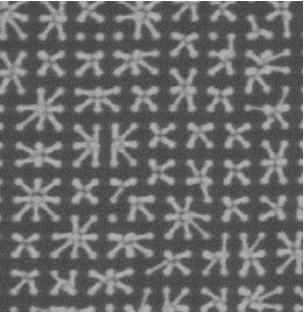
Drying technology

IPA drying

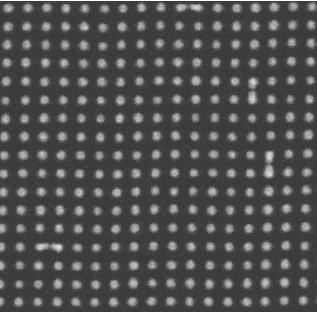
Surface-modification drying



IPA drying

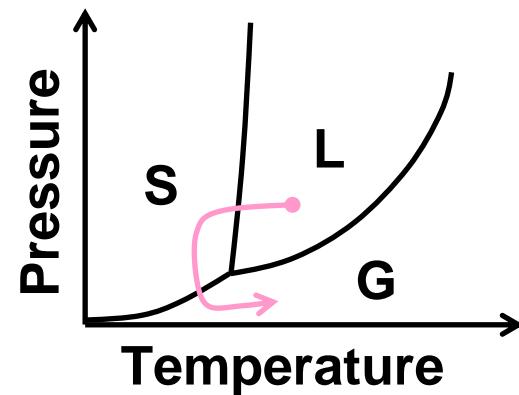


Surface-modification drying

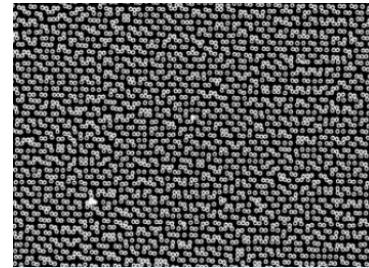


Source: G. Vereecke et al., SPCC 2018

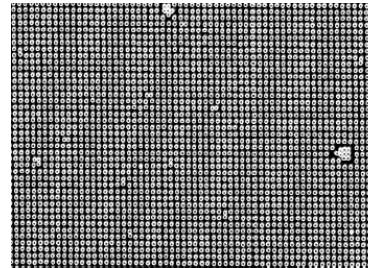
Sublimation drying



DIW



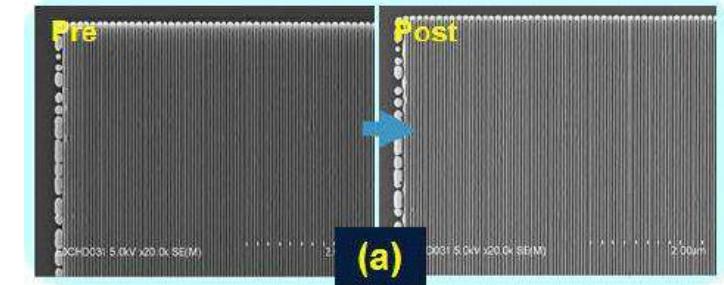
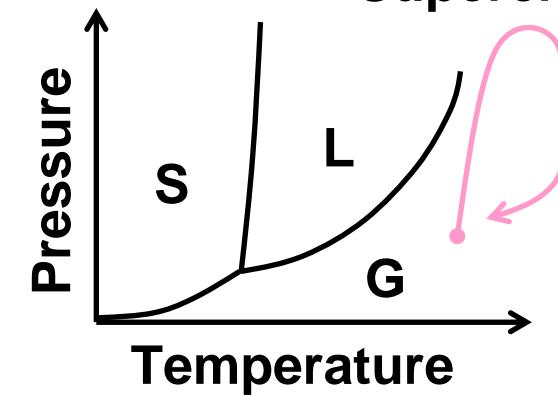
Acetic acid



Source: M. Patel et al., SPCC 2015

Supercritical drying

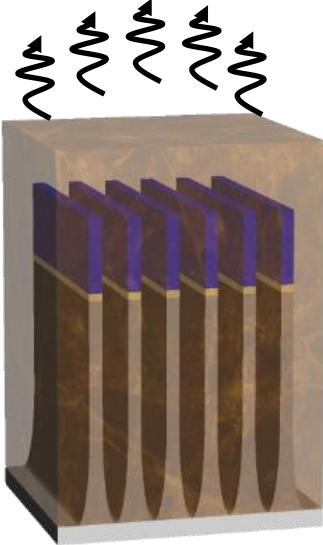
Supercritical



Source: H.W. Chen et al., ECS 2015

Sublimation drying by liquid-phase deposition

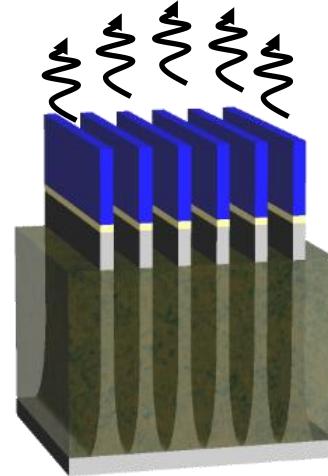
Solvent evaporates



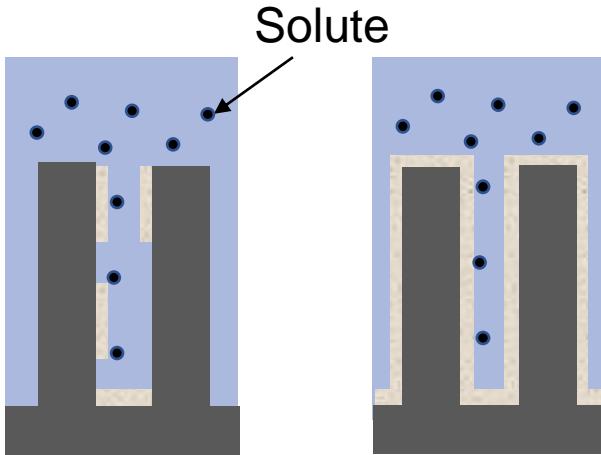
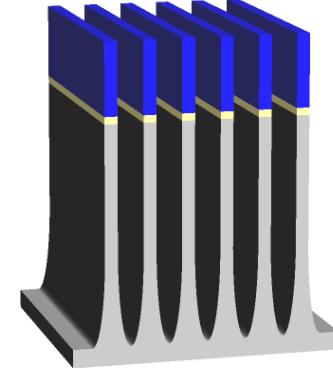
Solute is deposited



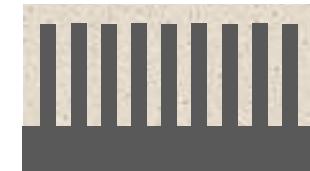
Solute sublimates



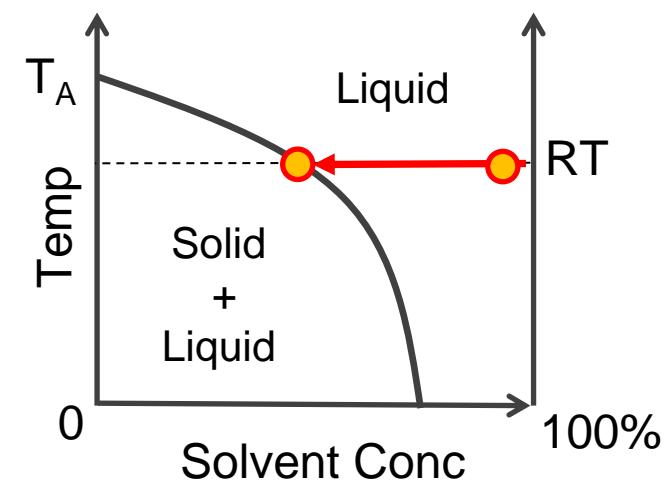
Drying is complete



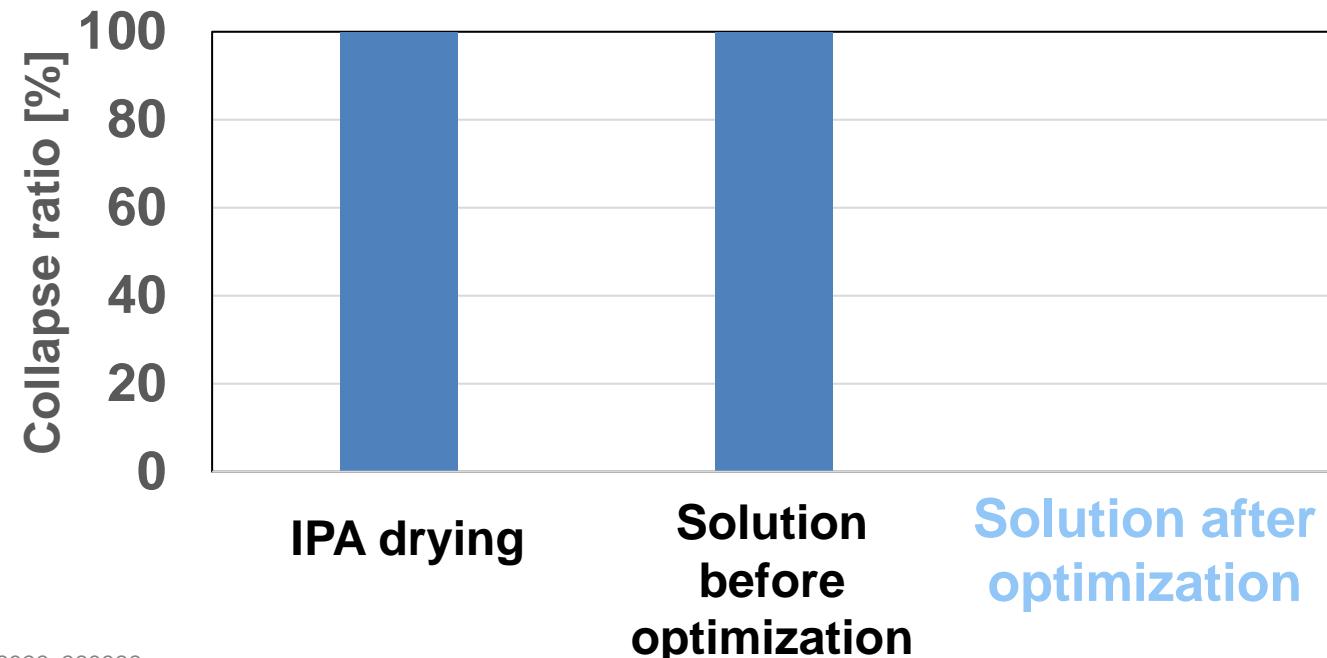
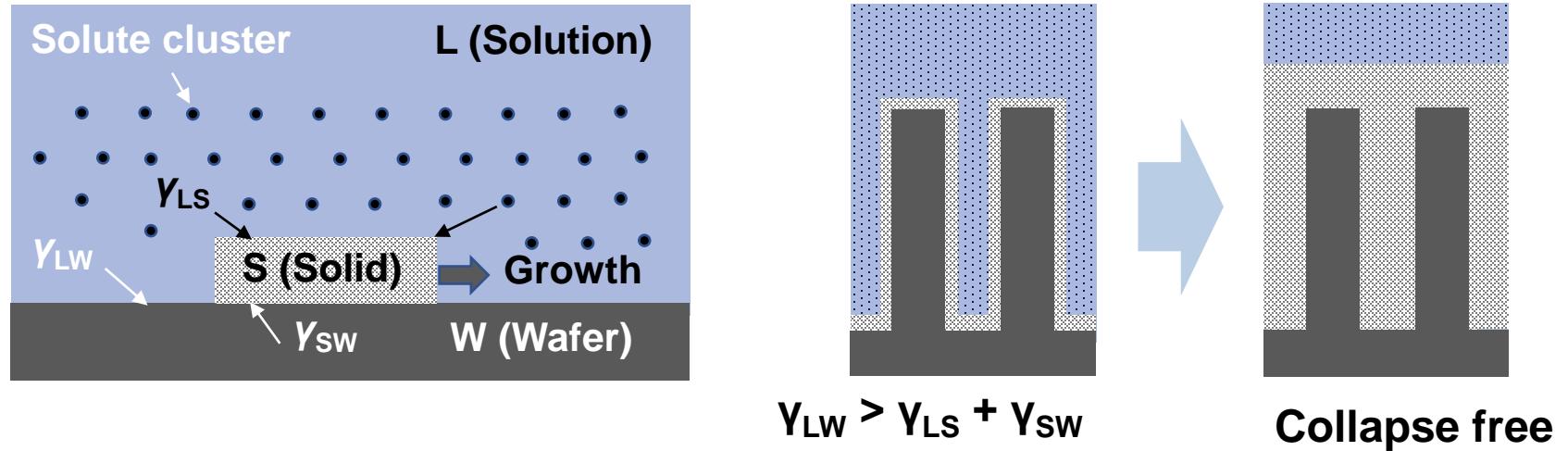
Deposited first on substrate surface



T_A : Melting Point

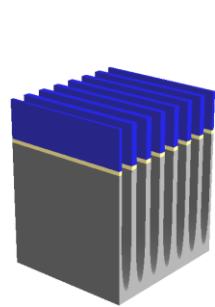


Sublimation drying by liquid-phase deposition

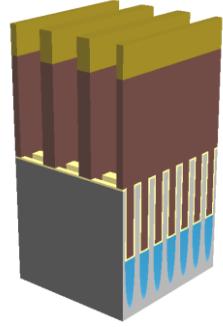


Application of sublimation-drying technologies

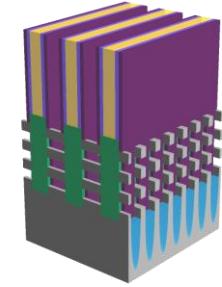
Logic



Post STI etch

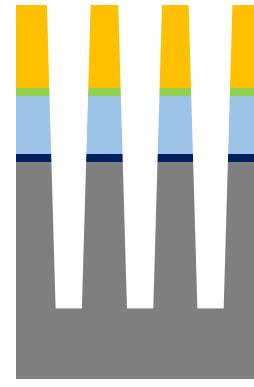


Post Poly etch

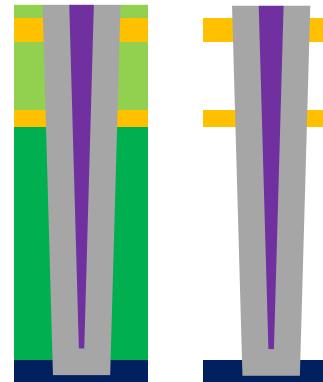


NS release

DRAM

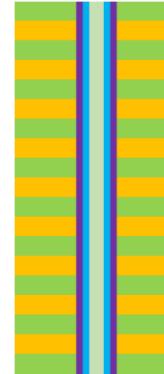


Post STI etch

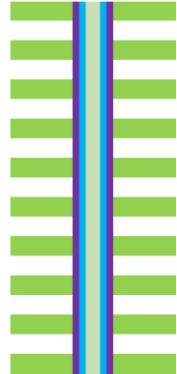


Capacitor

NAND



SiN pull-back



- Obtaining and maintaining the POR of the advanced device drying process by establishing the sublimation drying technologies

■ Maximizing added value for customers

■ Technologies in high-value-added areas

- Cleaning challenge for miniaturization
- Drying technology
- Selective etching technology

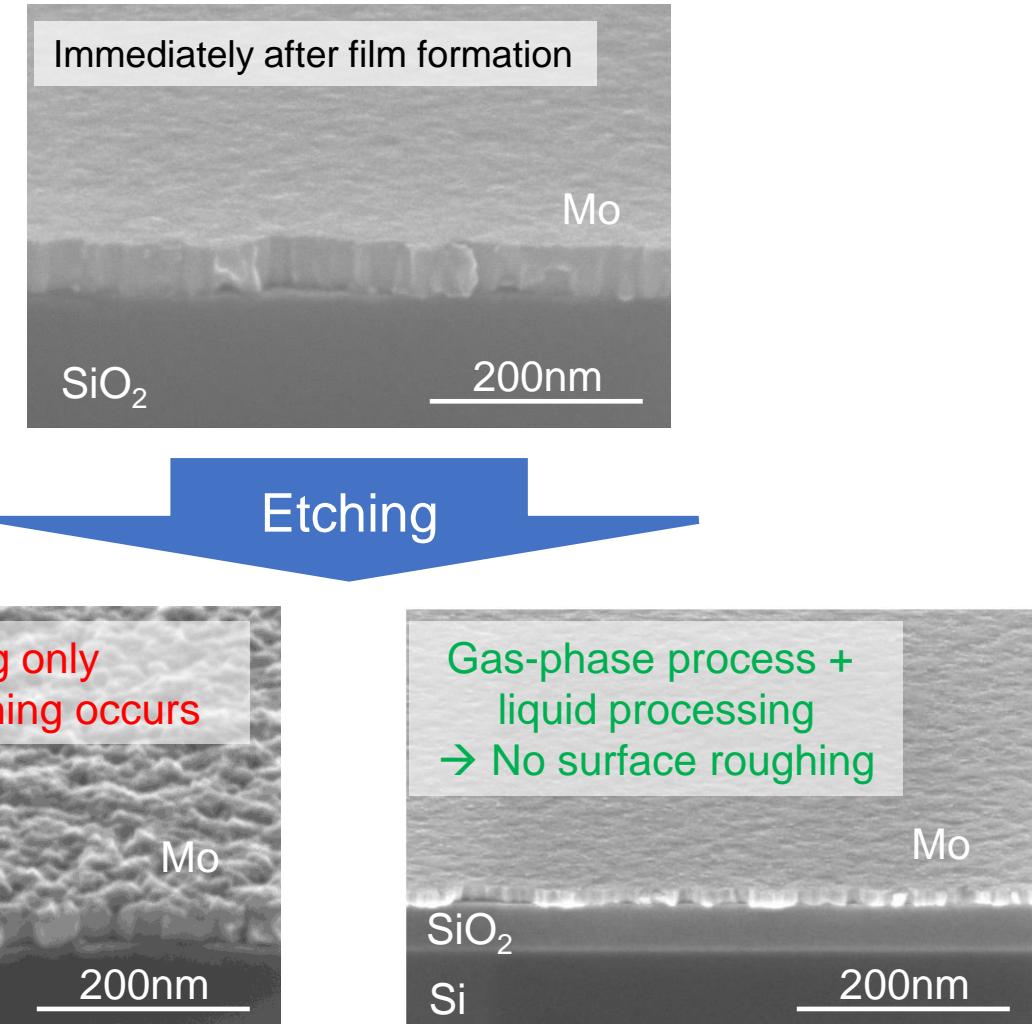
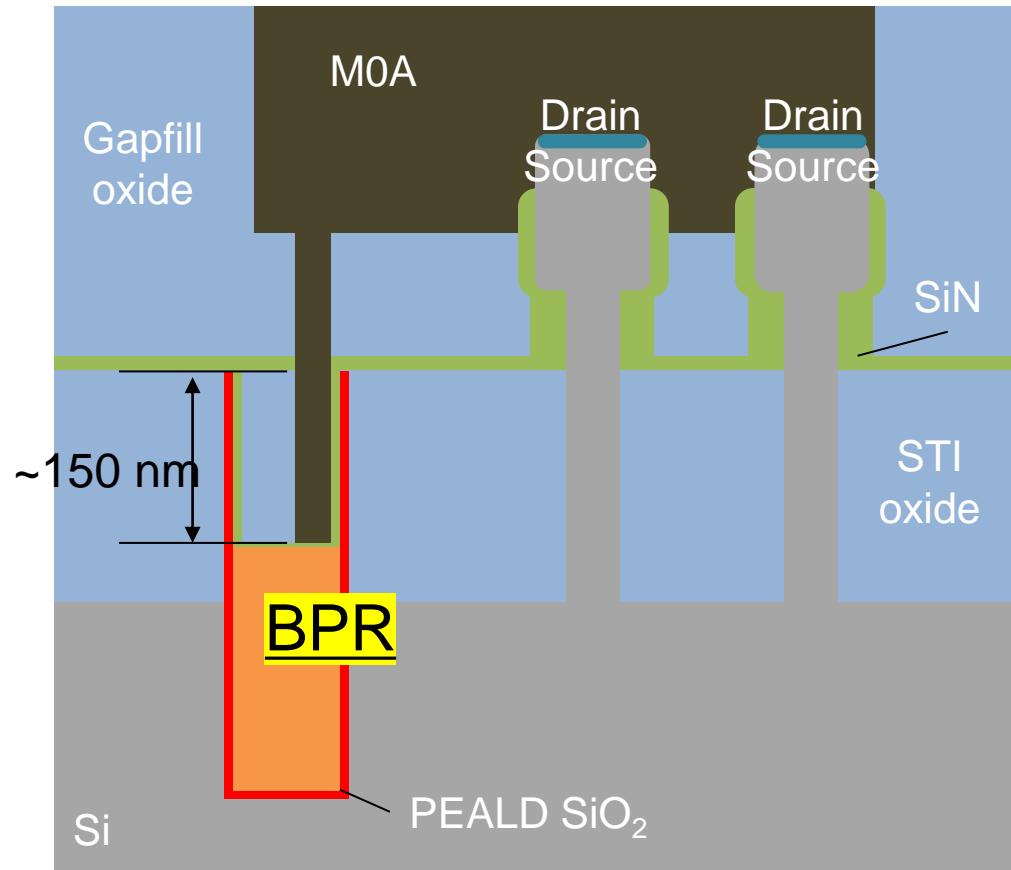
■ Evaluation and fundamental technologies for a competitive edge

■ Sustainability

■ Summary

Selective etching technology: challenge of gas-phase process

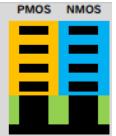
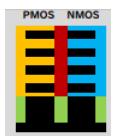
Standard cell with BPR



Source: T. Nakano et al., ECS2022

- Developing surface treatment technology via gas-phase process, which is applicable on SU platform.

Increasing demand for selective etching by device miniaturization and stacking (3-dimensionalization)

2024	2025	2026	2027	2028	2029	Challenge
 NS	 FS	 CFET				
Cavity etching Nanosheet release	Cavity etching Nanosheet release	Cavity etching Nanosheet release Wafer bonding ^{*1}				<ul style="list-style-type: none">➤ Selective etching of SiGe (15 to 20%)➤ Ge cleaning on nanosheets
BDI	BDI		BDI MDI ^{*2}			<ul style="list-style-type: none">➤ Selective etching of SiGe (40 to 45%)
BS-PDN	BS-PDN		BS-PDN & sqCFET ^{*1}			<ul style="list-style-type: none">➤ Si thinning after wafer bonding
	BPR		BPR			<ul style="list-style-type: none">➤ Mo recess for BPR

*1: Challenge for sequential CFET

*2: Challenge for monolithic CFET

- In collaboration with customers, we are promoting the development of advanced cleaning technologies, such as selective etching.

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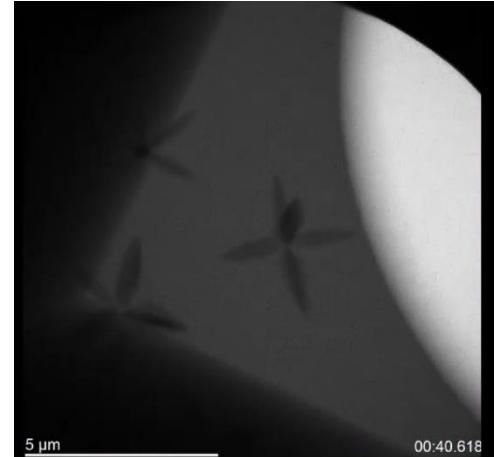
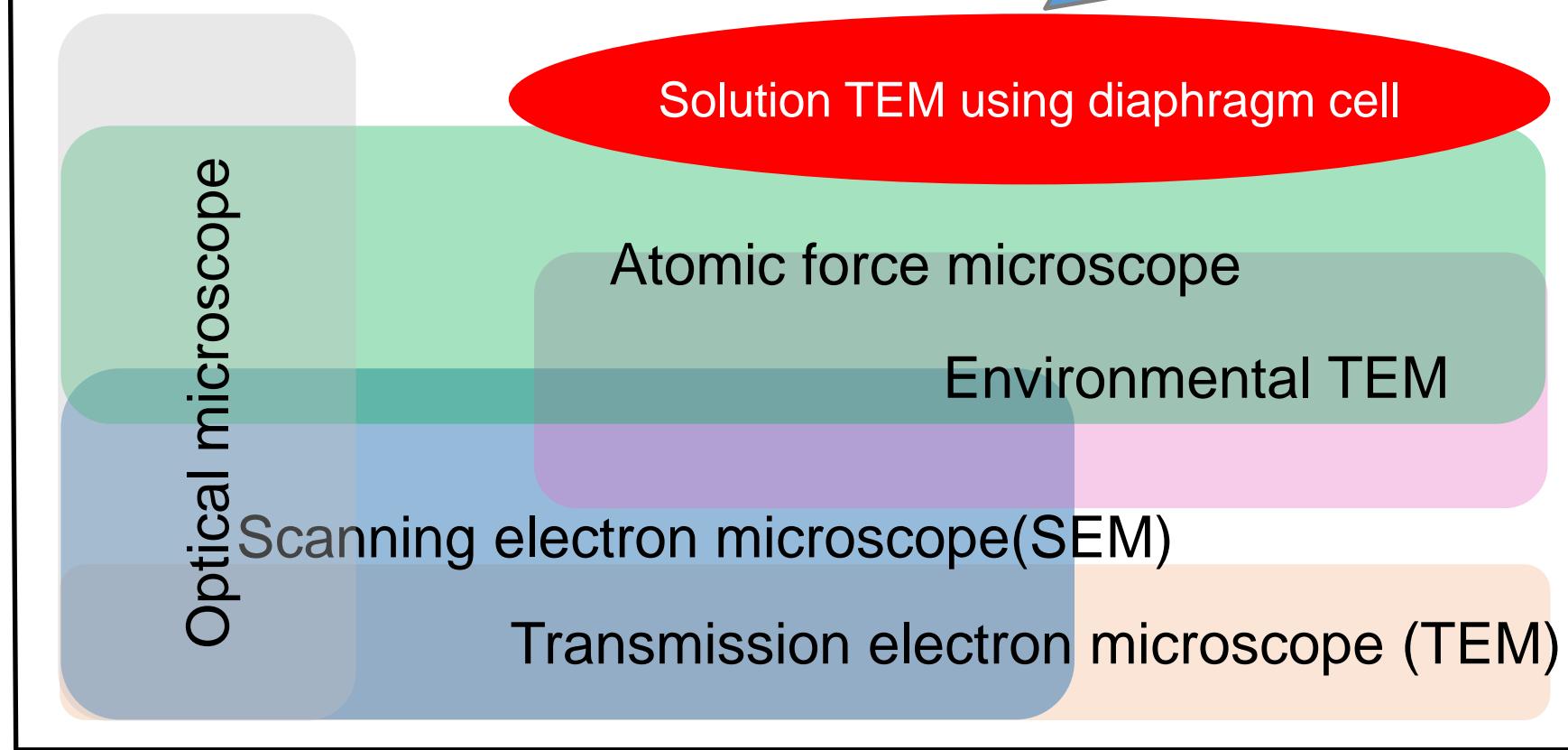
Spatial resolutions of observation methods and specimen environments

Liquid

Wet

Dry

Vacuum



[In-liquid observation via TEM]
Salt crystal precipitated from liquid

Overview of joint research



北海道大学
HOKKAIDO UNIVERSITY

LC-TEM

SCREEN

Substrate observation
technology

Substrate processing
technology

Hokkaido University's
proprietary technology



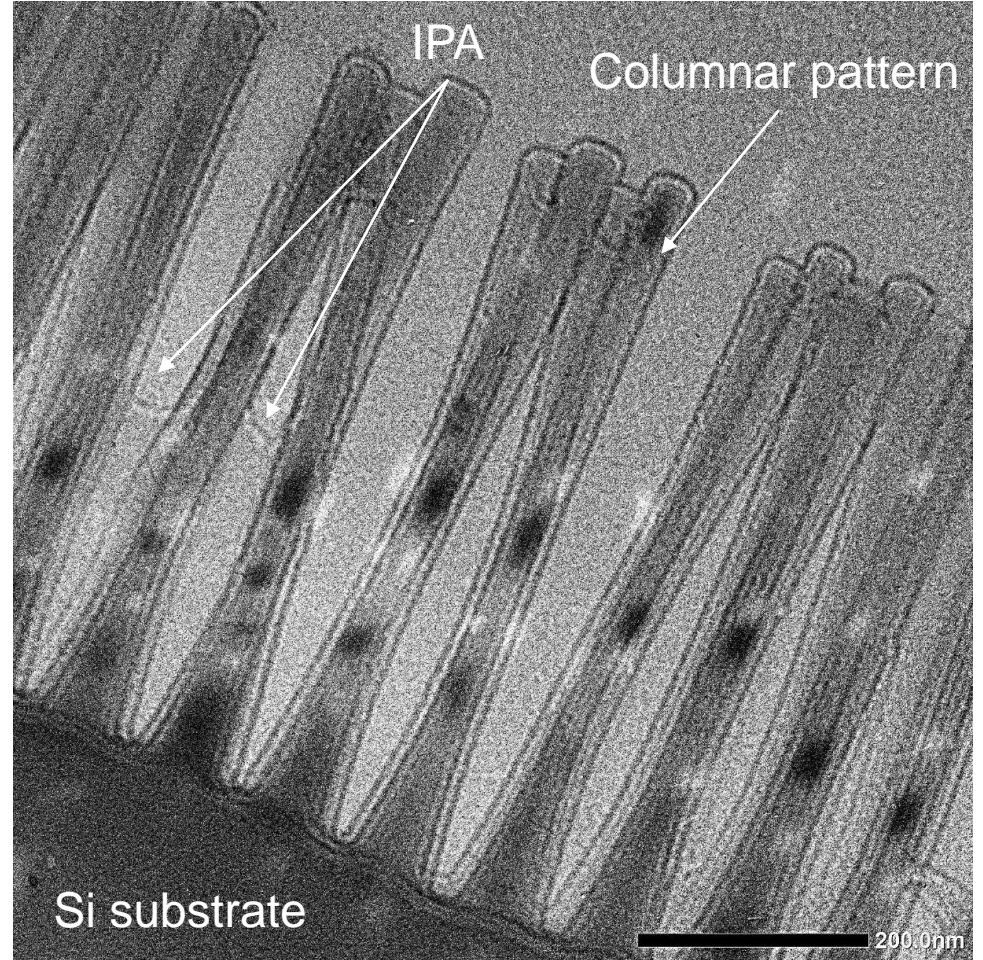
TEM



In-liquid observation holder

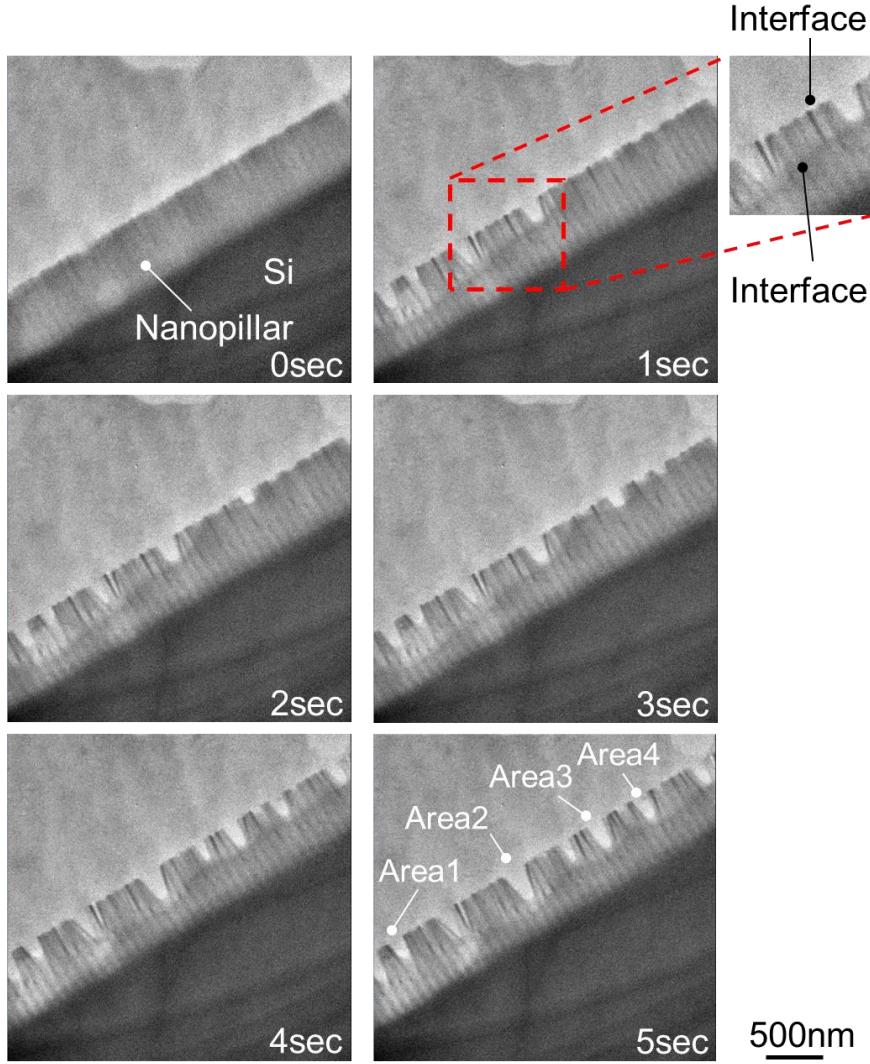
<https://www.protochips.com/products/poseidon-select/>

Purpose: To develop observation technology that is capable of in-liquid observation of nano-scale structures under atmospheric pressure and in real time
<https://www.screen.co.jp/news/NR220729>



Cross-section of Si pattern after IPA drying (TEM image)

In-situ observation of nano-pillar collapse behavior



Source: Y. Sasaki et al., ACS Applied Nano Materials

- Deepening the understanding of drying behavior and seeking sophistication of SCREEN's drying technology

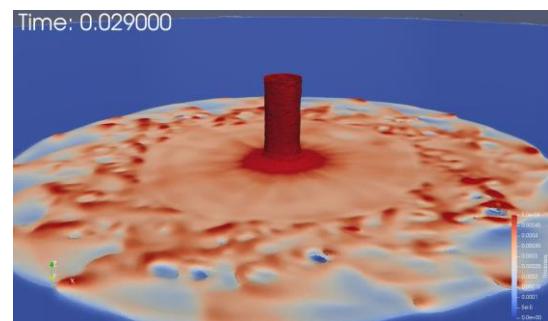
Science-based pursuit of cleaning technology

CFD calculation

size: $\mu\text{m-mm}$

time: sec-min

Behavior of liquid on wafer



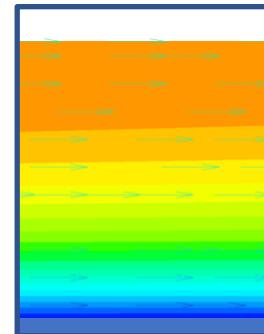
Concentration of chemical on entire wafer surface

CFD calculation

size: $0.1 \mu\text{m}-100 \mu\text{m}$

time: msec

Behavior of liquid in liquid film

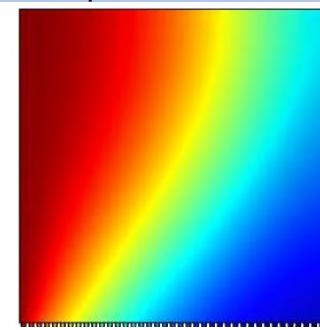


Change of concentration in liquid film

CFD calculation

size: $10 \mu\text{m}-1 \mu\text{m}$
time: μsec

Change of concentration at spot near wafer



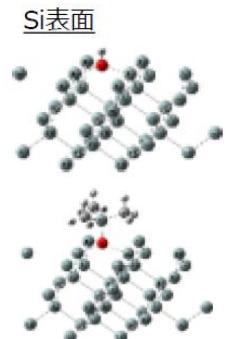
Movement of substances near wafer



First-principle calculation

size: $0.1 \text{ nm} - 1 \text{ nm}$
time: fsec-psec

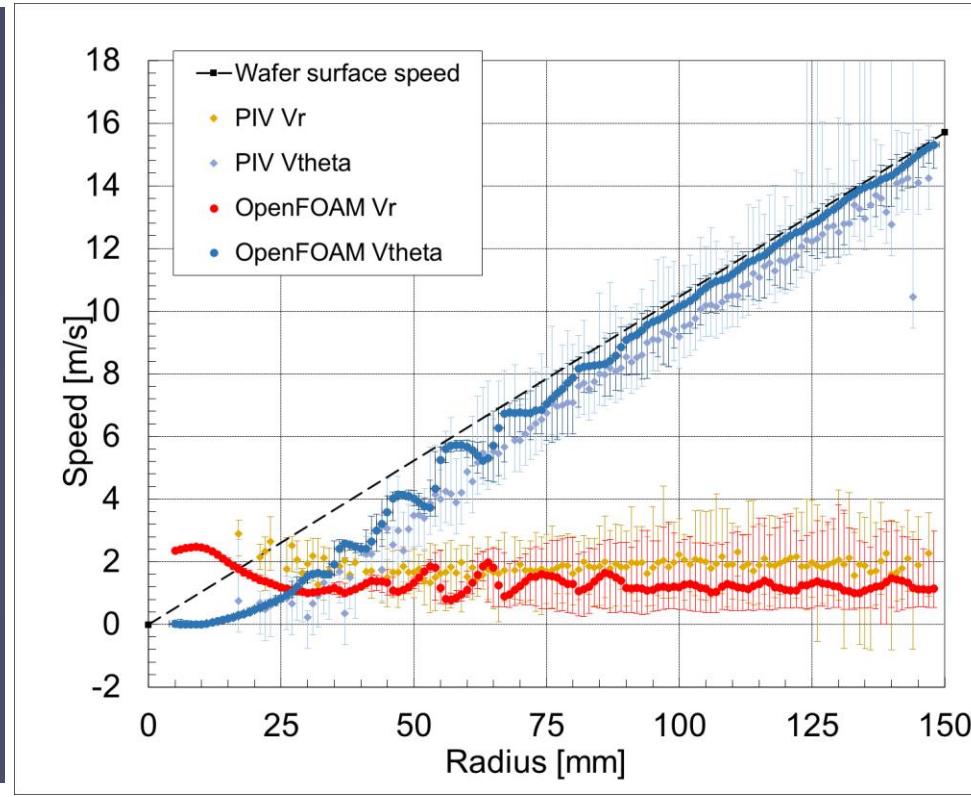
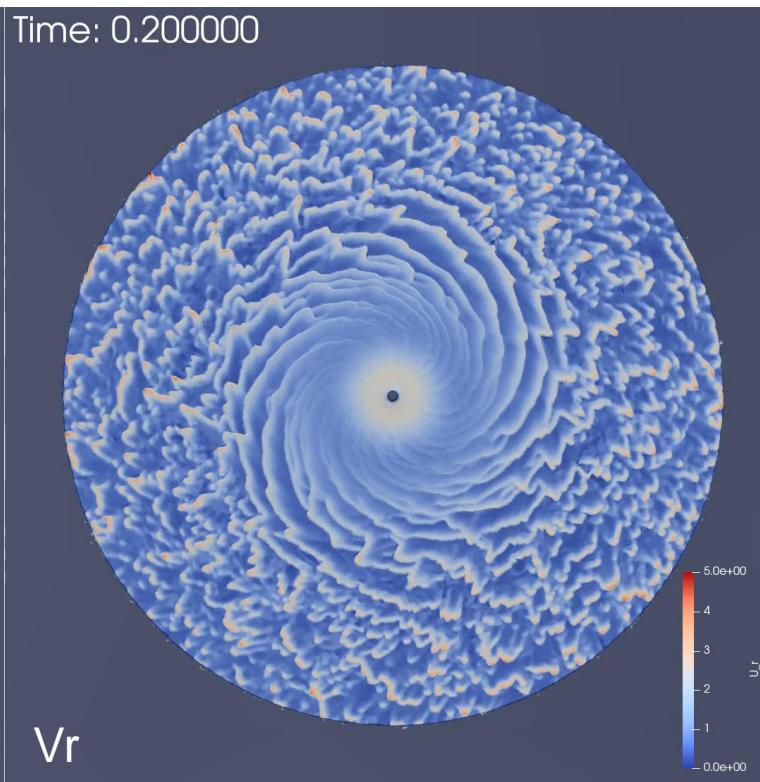
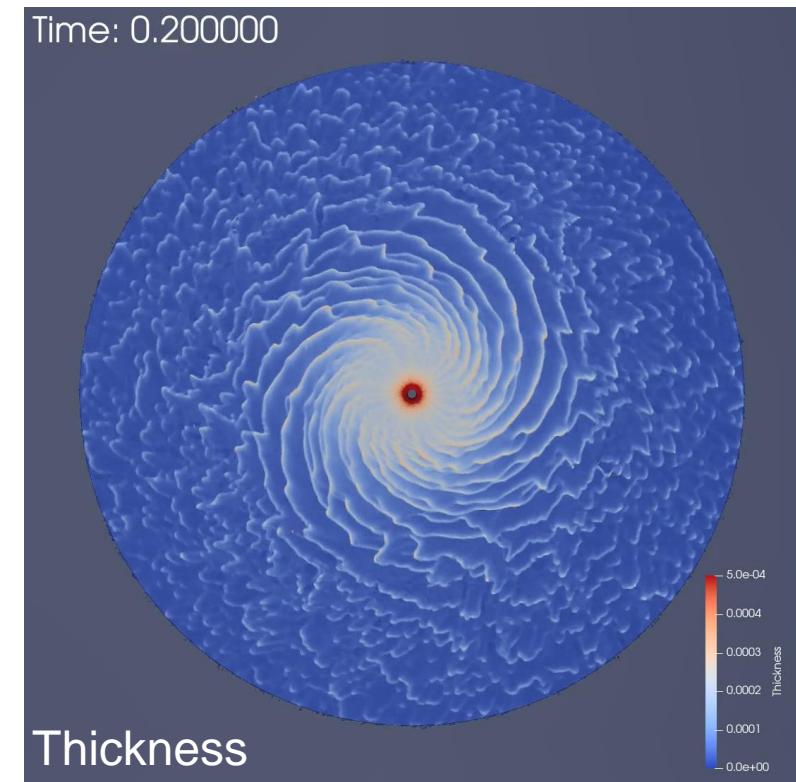
Elementary reaction



- We will deepen the scientific understanding of the cleaning process in real scale to atomic scales.

Simulation of liquid film on rotating wafer: hydrophilic surface

Comparison of calculated and measured values



Source: M. Sato et al., 17th OpenFOAM Workshop

This achievement has been obtained through a subsidized project by the New Energy and Industrial Technology Development Organization (NEDO).

- Achieved a simulation result that closely matches the measured values.
- We will calculate the behavior of liquid on wafer and realize an equipment or process backed up by the calculations.

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■ Evaluation and fundamental technologies for a competitive edge

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Sustainability activities

■ Participation in imec SSTS

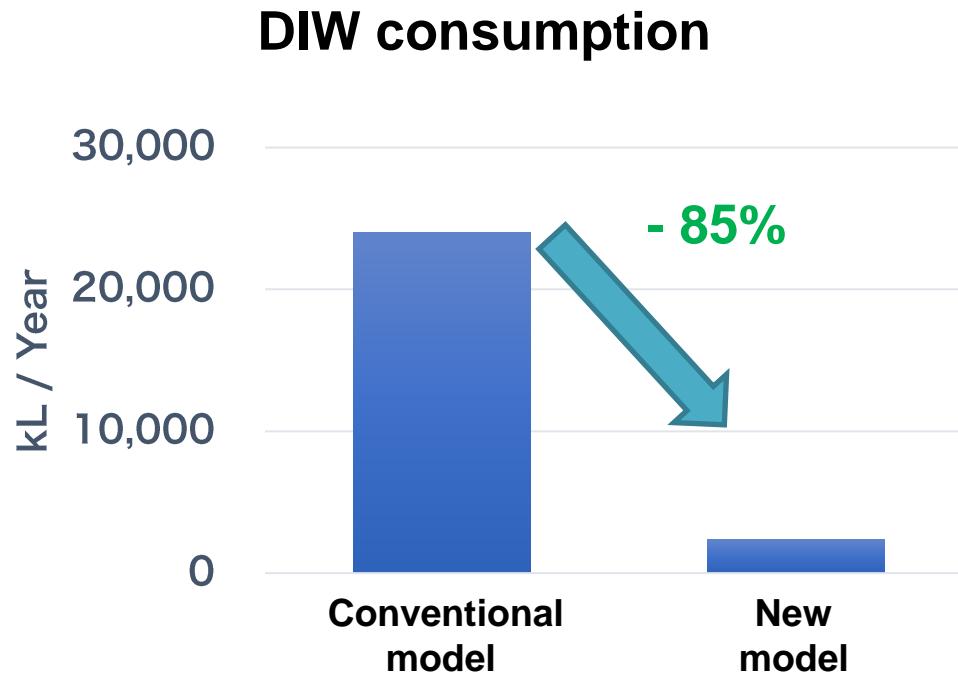
- We strengthen our efforts at reducing environmental loads throughout the entire semiconductor industry.
 - <https://www.screen.co.jp/en/news/NR220526E>

■ Visualization of CO₂ emissions

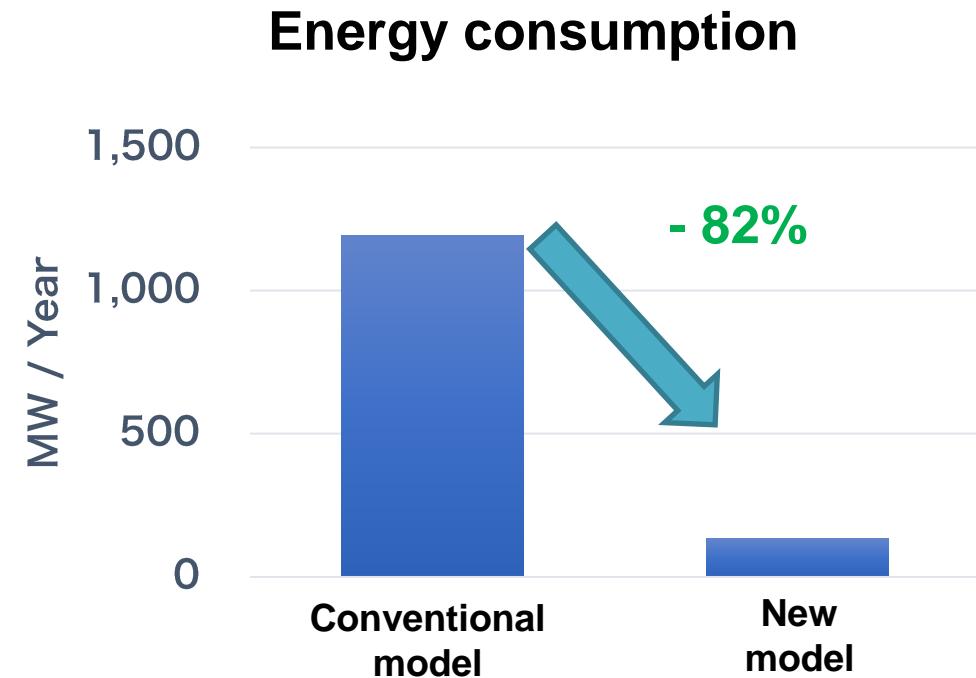
- Becomes first in semiconductor production equipment industry to introduce zeroboard service for profiling CO₂ Emissions
 - <https://www.screen.co.jp/spe/en/information/spe220831e>
- We expanded the scope of calculating CO₂ emissions.
 - Conventional: We calculated CO₂ emissions regarding part of the energy spend when the device is used.
 - Current: We calculate CO₂ emissions with respect to all the energy spent when the device is used, in processes ranging from procurement of raw materials to device disposal.

■ Activities in the roadmap committees including SDRJ

Example of reduction effect by new Hot DIW supply unit



**DIW usage >
Reduced by 20,000 kL/year**



**Power consumption at 60°C HDIW >
Reduced by 900 MW/year**

- The amount of DIW and power consumption have been substantially reduced.
- We are promoting innovative technological developments that fit the hot spot of energy usage.

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Summary

- SCREEN is developing technological strategy pipelines and conducting R&D in line with the device R&D pipelines developed with an eye on the present to 10 years ahead, to maximize the “customer’s added value.”
- Thanks to miniaturization and stacking (3-dimensionalization) of devices as well as conversion into chiplets, the cleaning process’s added value is enhanced through the entire process flow.
- To maximize the added value on the customer side, we will keep providing new solutions.
 - We will establish both sublimation drying technology and selective etching technology.
 - To keep our competitive edge, we will continue pursuing evaluation and fundamental technologies.
 - We will produce sustainable cleaning processes and equipments.



Upcoming event news

- Financial announcement for the second quarter ending September 30, 2022
Date: Friday, October 28, 2022, from 17:30
- IGAS 2022 (International Graphic Arts Show)
Date: Thursday, November 24 to Monday, November 28, 2022
Place: Tokyo Big Sight
- SEMICON JAPAN 2022
Date: Wednesday, December 14 to Friday, December 16, 2022
Place: Tokyo Big Sight



Innovation for a Sustainable World