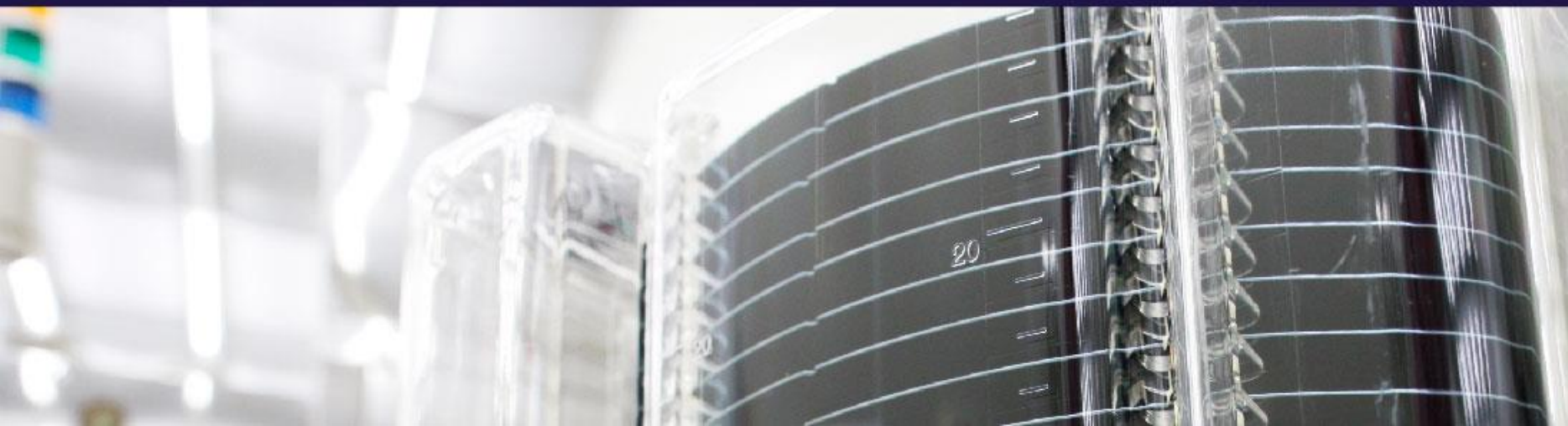


Tokyo Electron Medium-term Management Plan

June 8, 2022



Forward Looking Statements

- Disclaimer regarding forward-looking statements

Forward-looking statements with respect to TEL's business plan, prospects and other such information are based on information available at the time of publication. Actual performance and results may differ significantly from the business plan described here due to changes in various external and internal factors, including the economic situation, semiconductor/FPD market conditions, intensification of sales competition, safety and product quality management, intellectual property-related risks, and impacts from COVID-19.

- Processing of numbers

For the amount listed, because fractions are rounded down, there may be the cases where the total for certain account titles does not correspond to the sum of the respective figures for account titles. Percentages are calculated using full amounts, before rounding.

- Exchange risk

In principle, export sales of Tokyo Electron's mainstay semiconductor and FPD production equipment are denominated in yen. Although some sales and expenses are denominated in foreign currencies, the impact of exchange rate fluctuations on profits is negligible.

FPD: Flat panel display

Medium-term Management Plan Briefing 2022 Program and Participants

- Presentation 4:00pm ~ 6:10pm
 - The New Medium-term Management Plan
 - Review of the Previous Medium-term Management Plan and Financial Strategy for the New Medium-term Management Plan
 - Procurement and Manufacturing Strategy
 - SPE Business Strategy
 - Backend Business Strategy :
Activities for the Development of Wafer Bonding Process
 - Account Sales Strategy
 - Break (5 min)
 - Field Solutions Business Strategy
 - Introducing TELTM's DX Activities and Our Ideal State
 - New Board of Directors Structure and the Corporate Officer System
- Q&A Session 6:10pm ~ 6:45pm

Participants	As of June 8, 2022	As of July 1, 2022
Tetsuo Tsuneishi	Corporate Director, Chairman of the Board	Retired
Toshiki Kawai	Representative Director, President & CEO	Representative Director, President & CEO, Corporate Officer
Sadao Sasaki	Representative Director, EVP & GM GM of Development & Production Division, GM of Corporate Production Division	Representative Director, SEVP & GM, Corporate Officer GM of Development & Production Division, GM of Corporate Production Division
Yoshikazu Nunokawa	Corporate Director, EVP & GM GM of Global Business Platform Division, Finance	Corporate Director, Chairman of the Board of Directors
Seisu Ikeda	Corporate Director, SVP & GM GM of Account Sales Division	Corporate Officer, EVP & GM GM of Account Sales Division
Yoshinobu Mitano	Corporate Director, SVP & GM GM of SPE Business Division	Corporate Officer, EVP & GM GM of SPE Business Division
Takeshi Okubo	SVP & GM GM of Global Sales Division	Corporate Officer, EVP & GM GM of Global Sales Division, GM of Field Solutions Business Division
Hiroshi Kawamoto	VP & GM, Tokyo Electron Miyagi	VP & GM Deputy GM of Global Business Platform Division, Finance
Yohei Sato	ATSBU GM	ATSBU GM
Noritaka Yokomori	Deputy GM of Corporate Innovation Division, DX	Deputy GM of Corporate Innovation Division, DX

The New Medium-term Management Plan

June 8, 2022

Toshiki Kawai
Representative Director, President & CEO

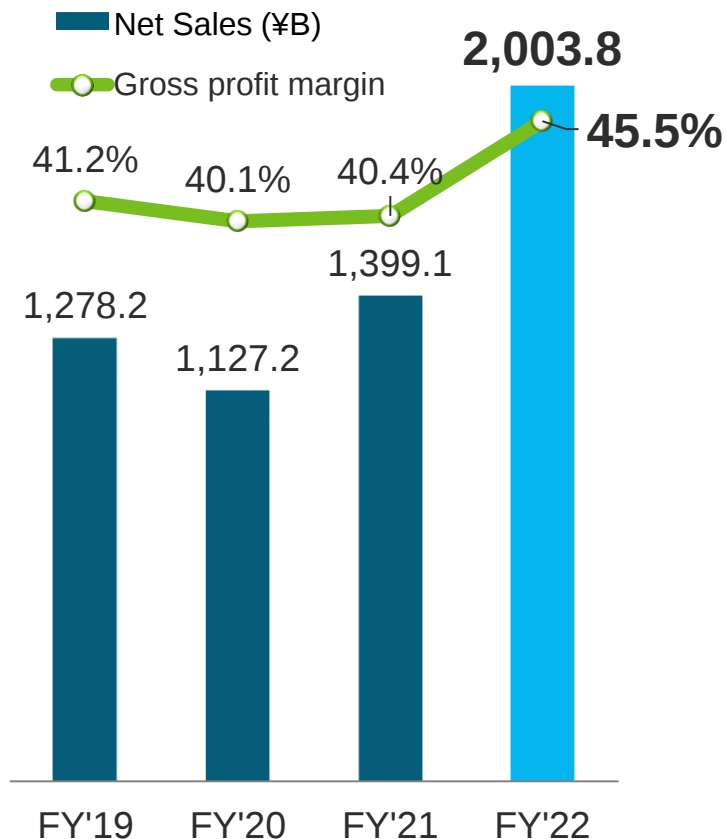


Agenda

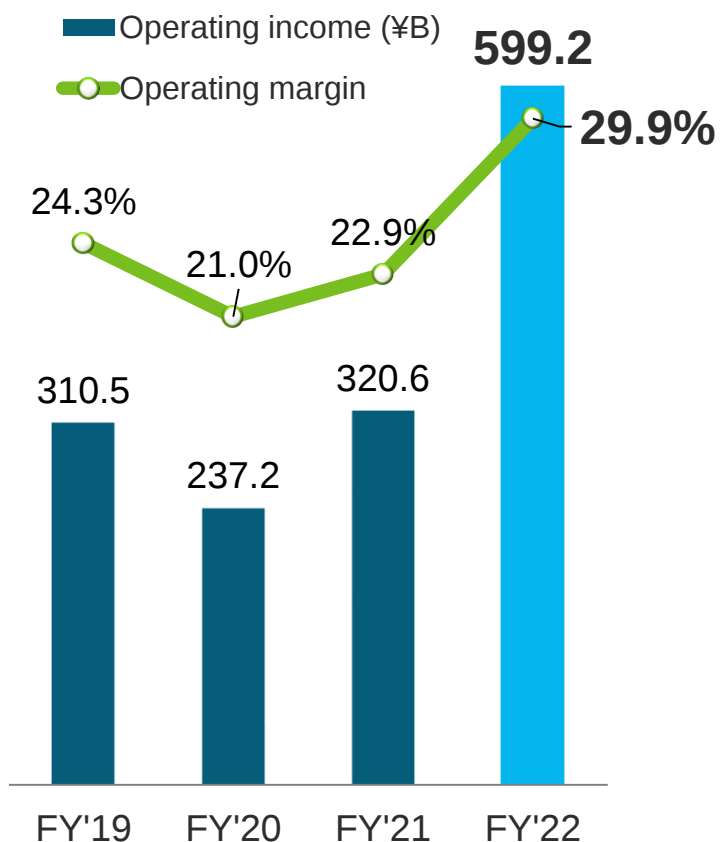
- **Business Highlights**
 - Progress on the Medium-term Management Plan
 - Main Achievements
- **New Medium-term Management Plan**
 - Business Environment
 - Overview of the New Medium-term Management Plan

FY'22 Financial Highlights

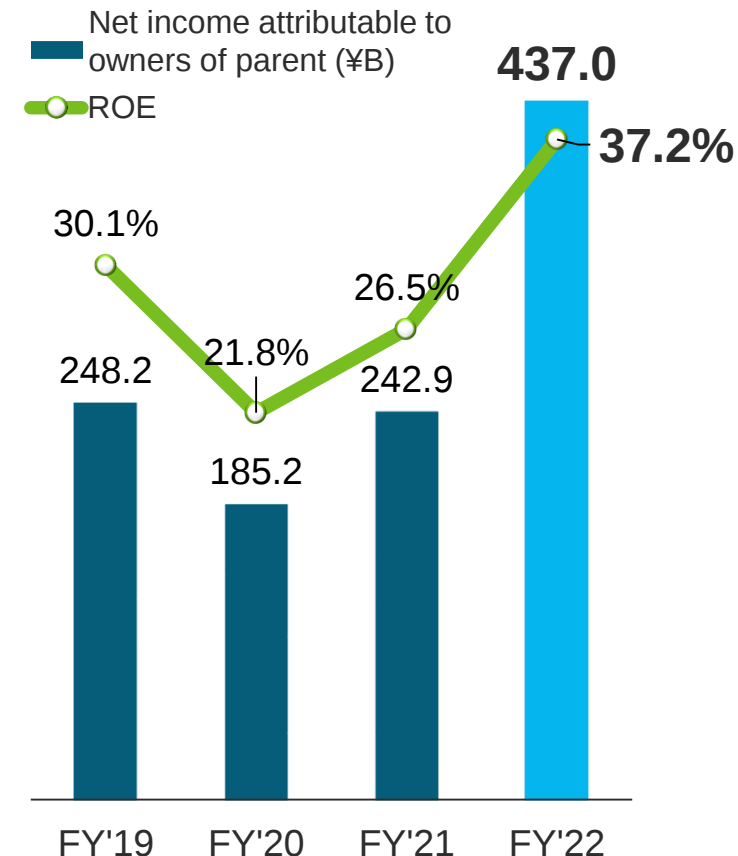
Net Sales and Gross Profit Margin



Operating Income and Operating Margin



Net Income Attributable to Owners of Parent and ROE



Net sales, gross profit margin, operating margin and ROE reached record high

Progress on the Medium-term Management Plan

Announced on May 2019

	Financial Model (by FY'24)		
Net sales	¥1.5T	¥1.7T	¥2T
OP margin	26.5%	28%	>30%
ROE	>30%		



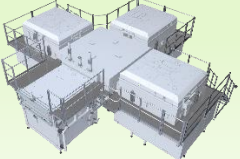
FY'22 Actual
¥2T 3.8B
29.9%
37.2%

Reached our financial model 2 years ahead of schedule

Major Achievements and Initiatives on the Medium-term Management Plan

- **Outperformed the market.** Increased WFE* market share
- Significant progress was made in **acquiring PORs and introducing new products and functions** through high value-added products that only we can make

【Our latest main products】

Deposition	Coater/ developer	Etch	Cleaning	Wafer prober	Wafer bonder	FPD Etch
						
NT333™	LITHIUS Pro™ Z	Episode™ UL	CELLESTA™ Pro	Prexa™	Synapse™ Si	PICP™ Pro

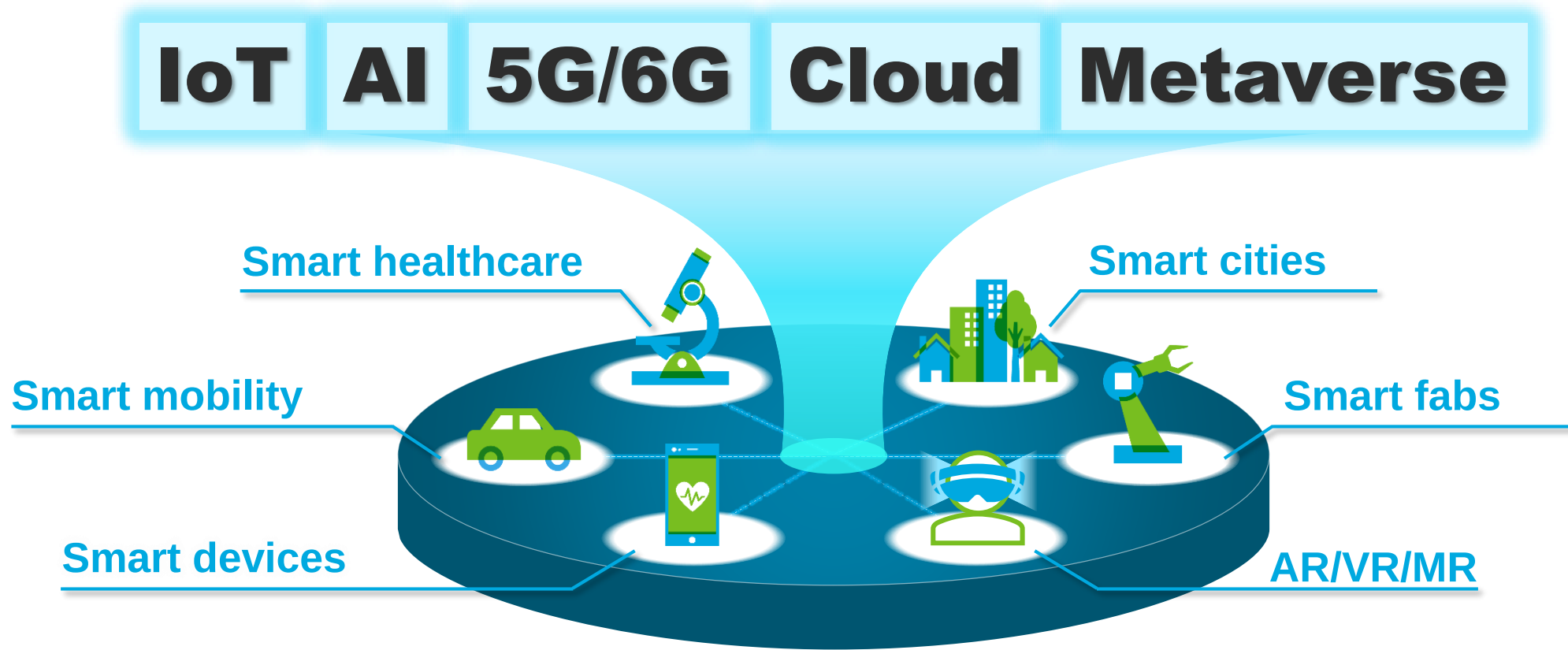
- As planned, invested **over 400 billion yen on R&D expenses** over the past three years. Continue investing for future growth

* WFE : WFE (Wafer fab equipment): Wafer fab equipment refers to the production equipment used in front-end production and in wafer-level packaging production.

Agenda

- **Business Highlights**
 - Progress on the Medium-term Management Plan
 - Main Achievements
- **New Medium-term Management Plan**
 - Business Environment
 - Overview of the New Medium-term Management Plan

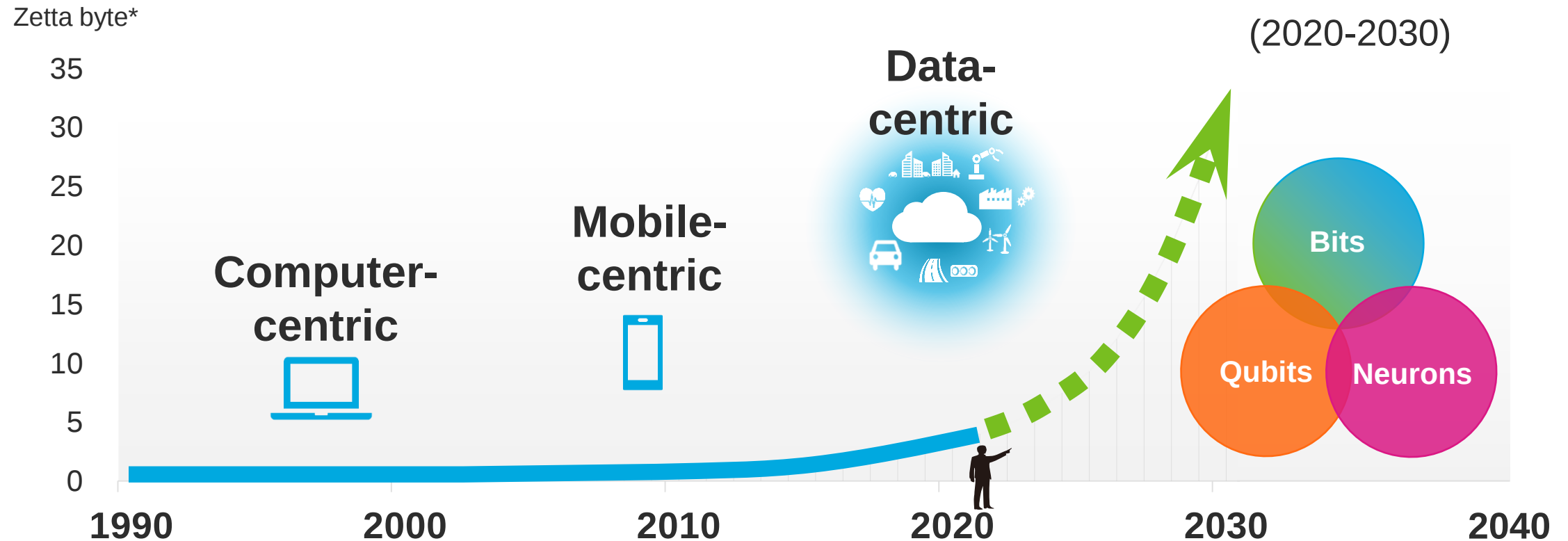
Spread of IoT · AI · 5G and Accelerating the Digital Shift



The world is currently pushing firmly ahead with implementing ICT and DX as well as taking action to realize a carbon-free society in order to build a strong and resilient society in which economic activities do not stop under any circumstances

World Data Traffic

CAGR 26%
(2020-2030)



Source: Omdia

*Zettabyte: 1 Zettabyte = 10^{21} byte, 1 Zettabyte is said to be "the number of sand grains on sandy beaches around the world"

Explosive increase in data traffic

Outlook for the Semiconductor Market

US\$ trillion

1.2

1.0

0.8

0.6

0.4

0.2

0.0

1990

2000

2010

2020

2030



PC



Smartphones



Data centers



Services for consumers



Services for industry

Products
(electronic devices)

Products × **Value**
(services)

\$555.9 billion
(2021)

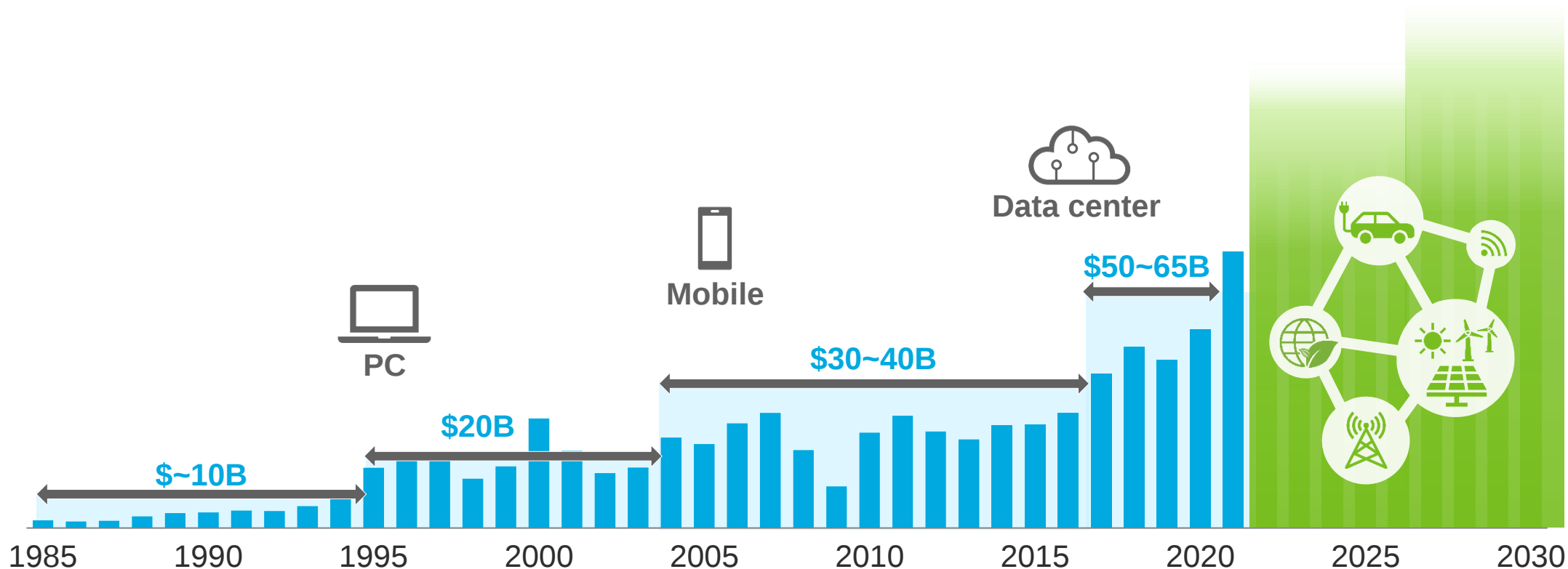
>\$1.35 trillion

Growing to more than double by 2030

Source: 1990-2021 (WSTS)
2022-2030 (IBS, May 2022)

WFE Market

ICT • DX • decarbonization,
electric vehicles, autonomous
driving, post-5G



Source : TechInsights Manufacturing Analysis Inc. (VLSI) (1985-2021)

WFE Market will grow further with progress of digitalization and evolution of semiconductors

The New Medium-term Management Plan : Financial Targets

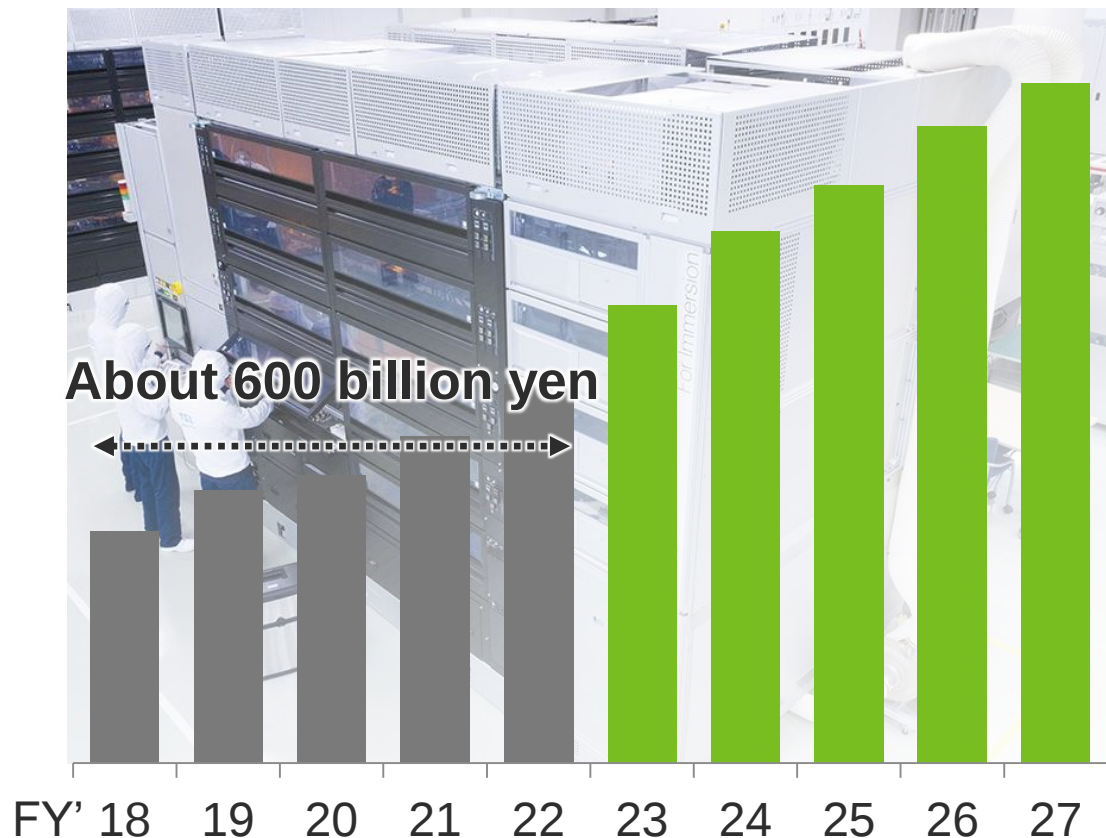
Financial Targets (by FY'27)	
Net sales	≥ 3 trillion yen
OP margin	≥ 35%
ROE	≥ 30%

Material Issues



Toward short- , medium- and long-term profit and continuous corporate value enhancement

Continue to Invest Aggressively on R&D



**More than 1 trillion
yen planned for
5 years from FY'23**

**Continue active investment in growth to
create high value-added next-generation products**

Further Increasing Corporate Value



Won the Grand Prize Company in the Corporate Governance of the Year[®] 2021

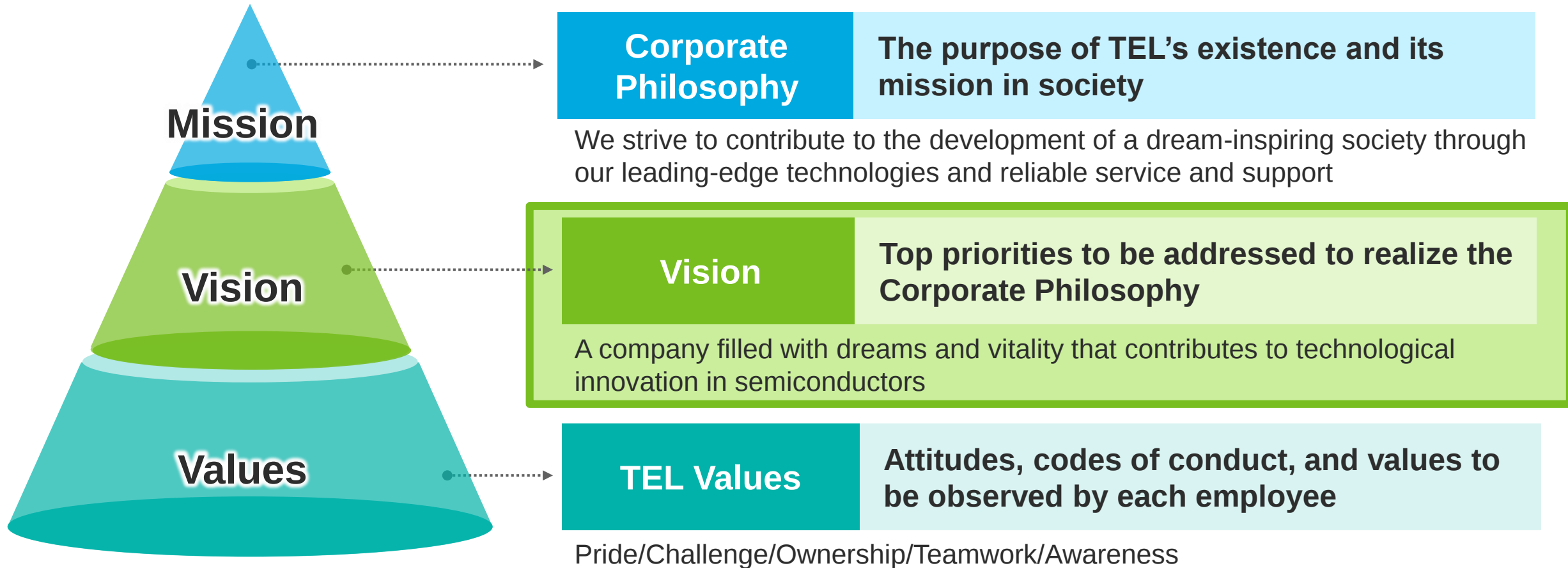
Sponsored by the Japan Association of Corporate Directors / Released on Jan. 12, 2022



Feedback (Evaluation points for TEL)

- Approach to increase earning power and aggressive style to pursue profits
- Aggressive ESG (efforts to enhance corporate value through both Offence and ESG)
- Actions to increase employee engagement
- System to evaluate representative directors
- Operating rhythm to make governance more solid
- Communication with outside directors through the Board of Directors and offsite meetings

TEL's Corporate Principles



New Vision

A company filled with dreams and vitality that contributes to technological innovation in semiconductors

Tokyo Electron pursues technological innovation in semiconductors that supports the sustainable development of the world.

We aim for medium- to long-term profit expansion and continuous corporate value enhancement by utilizing our expertise to continuously create high value-added leading-edge equipment and technical services.

Our corporate growth is enabled by people, and our employees both create and fulfill company values. We work to realize this vision through engagement with our stakeholders.



Corporate Message

Technology Enabling Life

TSV : TEL's Shared Value (TEL's CSV)

CSV (Creating Shared Value)

The concept is to create social and economic value by leveraging corporate expertise to solve social issues, thereby enhancing corporate value and achieving sustainable growth.

New Vision : A company filled with dreams and vitality that contributes to technological innovation in semiconductors



- Pursue technological innovation in semiconductors that supports the sustainable development of the world
- Continuously create high value-added leading-edge equipment and technical services
- Medium- to long-term profit expansion and continuous corporate value enhancement
- Engagement with our stakeholders

Realization of Vision = Creating Shared Value in TEL

Our Approaches to Social Issues

Sustainable development of the world / Diversification of values and happiness

Solutions

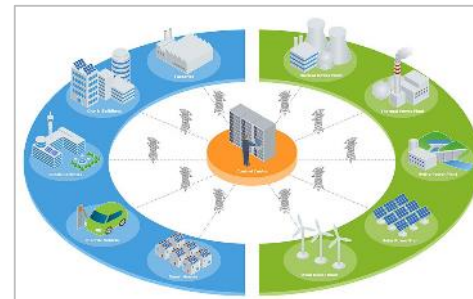
Online/Metaverse



AI diagnosis/Prevention/Robots



Smartification



EV/Autonomous driving/MaaS



Technologies

Higher speed
communication
(5G/6G)

Cloud/Edge
Computing

AI

IoT

AR/VR/MR

Semiconductors

Logic

Memory

Power

Analog

Sensors

Displays

TEL

**Pursue technological innovation in semiconductors :
Larger capacity/Higher speed/Higher reliability/Lower power consumption**

Higher definition/Flexible
/Lower power consumption

Vision & New Medium-term Management Plan

FY'23

FY'27

FY'31 (CY'30)

■ Goals for 2030

- Supporting sustainable development in the world
 - ① Driving the semiconductor market through technological innovation
 - ② Contributing to a sustainable global environment
- Medium- to long-term profit expansion and continuous corporate value enhancement
- Engaging with our stakeholders

■ New Medium-term Management Plan (FY'23-27)

- Achievement of Financial Model
(Five-year goal toward 2030)

Realization of Vision

A company filled with dreams and vitality
that contributes to technological
innovation in semiconductors



**Aiming to achieve the Medium-term Management Plan
by FY'27 with a view to realizing Vision in 2030**

Approaches to Sustainability

E-COMPASS



Environmental Co-Creation by Material, Process and Subcomponent Solutions

Semiconductors	Products	Business activities
Contribute to technological innovation for higher performance and lower power consumption of semiconductors	Offer the Best Products and Best Technical Services	Improve green performance
• Leading-edge technology contributes to a lower power consumption society • Accelerating environmental technology innovation	• Improve environmental performance of semiconductor production equipment (Productivity per unit area and hour, equipment utilization, quality, material consumption, recycling, etc.) • Environmentally Hazardous Substance-Free	• Reduction of CO₂ emissions at plants and offices • Reduce and recycle packaging materials • Reduce environmental impact during procurement and logistics

Promoting technological innovation of semiconductors and reducing environmental impact of semiconductor manufacturing throughout the supply chain as an industry leader

Laser Edge Trimming: Ulucus™ L (Released on June 8)

Edge trimming equipment for semiconductor's 3D Packaging

*ウェーハ外周の切断

E-COMPASS

Achieve high precision, high quality cutting and high productivity by laser control processing

Reduces the amount of DIW* consumption by 70% or more compared to conventional method**



Ulucus™ L

The equipment platform is based on LITHIUS Pro™ Z, which is highly reliable and productive.

* DIW: Deionized water, ** TEL estimates

Released a new model equipment with environmental and process performance that only TEL can manufacture for the backend process where further technological evolution and market expansion are expected

Medium-term Environmental Targets for 2030

CO₂ Emission Reduction Goal

Products



30% Reduction

Per wafer (compared to 2018)

Plants and Offices



70% Reduction
of total emissions (compared to 2018)

Reduce energy consumption by 1% YoY at each plant and office (per-unit basis)

Ratio of renewable energy 100%

Long-term Goal (2050)

As a leading corporation in environmental management, Tokyo Electron works actively to conserve the global environment. **We will realize net zero** by proactively promoting the reduction of environmental burden of both our facilities and products. We strive to contribute to the development of a dream-inspiring society by providing evolutionary manufacturing technologies that effectively reduce the power consumption of electronic products.

Net Zero

Scope 1 & 2

To be achieved by 2040

Scope 3

To be achieved by 2050

Safety First



Safety Goals (by FY'27)

TCIR ≤ 0.1

TCIR: Total Case Incident Rate.
The number of workplace incidents per 200,000 working hours

TEL Values as codes of conduct



Engagement



Career



Corporate growth is enabled by **people**, and
our employees both create and fulfill company values

Retention



Work-life balance



Diversity and Inclusion



3G

Global • Generation • Gender

Key Indicators for Continuous Corporate Value Enhancement



- **Net sales/Operating margin/ROE**
- **Initiatives for Net Zero**
 - ✓ Products/Plants and offices/
Reduction of CO₂ emissions from logistics, etc.
- **Stakeholder Engagement**
- **Safety**
- **Risk Management**
- **Governance**

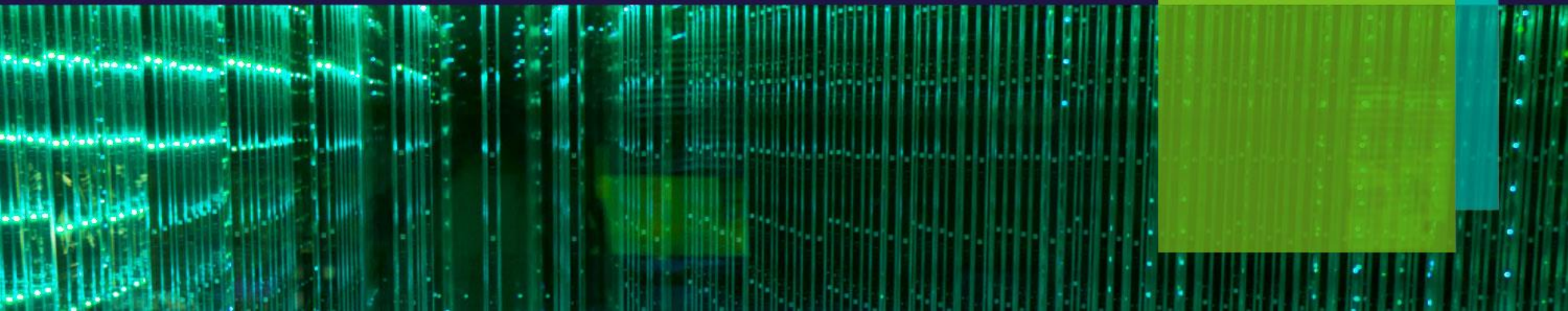


Technology Enabling Life

Review of the Previous Medium-term Management Plan and Financial Strategy for the New Medium-term Management Plan

June 8, 2022

Hiroshi Kawamoto
VP & GM, BS Division
Tokyo Electron Miyagi Limited



Overview

- Review of the previous Medium-term Management Plan and results
 - Execution of growth investments made over the past five years
 - Trends in net sales and operating income
 - Trends in TEL's market capitalization and total net assets (start of 2010 onward)
- Financial strategy to achieve the new Medium-term Management Plan
- Shareholder return policy

Review of the Previous Medium-term Management Plan

(Billion yen)

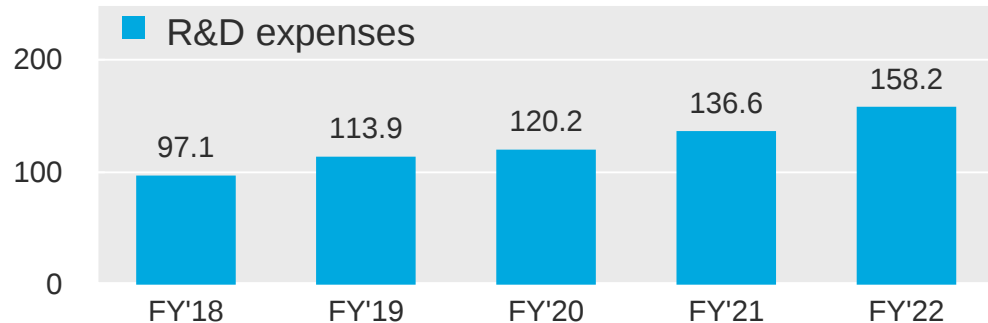
	FY2022 (Actual)	By FY2024 (Plan)		
Net sales	2,003.8	1,500.0	1,700.0	2,000.0
Gross profit	911.8	650.0	740.0	890.0
Gross profit margin	45.5%	43.3%	43.5%	44.5%
SG&A expenses	312.5	252.0	264.0	290.0
SG&A expenses to sales ratio	15.6%	16.8%	15.5%	14.5%
Operating income	599.2	398.0	476.0	>600.0
Operating margin	29.9%	26.5%	28.0%	>30.0%
ROE	37.2%	>30%		

Achieved the financial model of 2 trillion yen in net sales two years ahead of schedule

- Factors behind achieving the model two years ahead of schedule
 - Dynamically executed business strategy to address changing circumstances
 - Continued growth investments even during periods where the market is undergoing adjustment
 - Close communications and collaborations with partner companies

Performance of Growth Investments Made Over the Past Five Years

(Billion Yen)



Miyagi logistics building
(Began operation in Feb. 2018)



Production capacity doubled
*Began operation of the automated warehouse in Jun. 2018

Iwate production building
(Began operation in Jul. 2020)



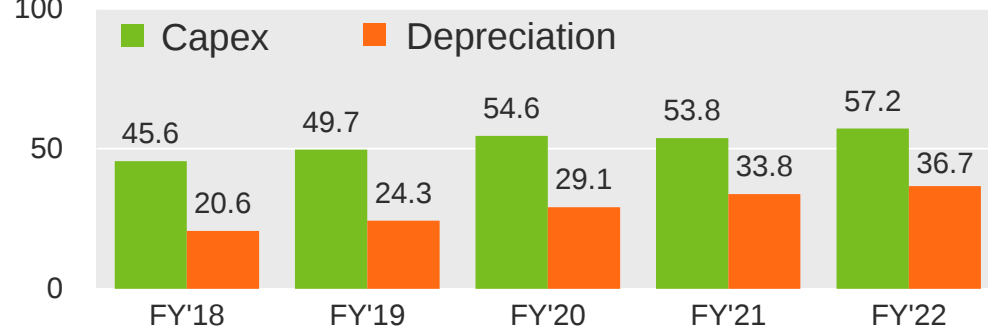
Production capacity doubled

Yamanashi production building
(Began operation in Aug. 2020)



Production capacity 1.5 times

(Billion Yen)



Miyagi No.2 development bldg.
(Began operation in Nov. 2018)



TEL Digital Design Square
(Began operation in Nov. 2020)

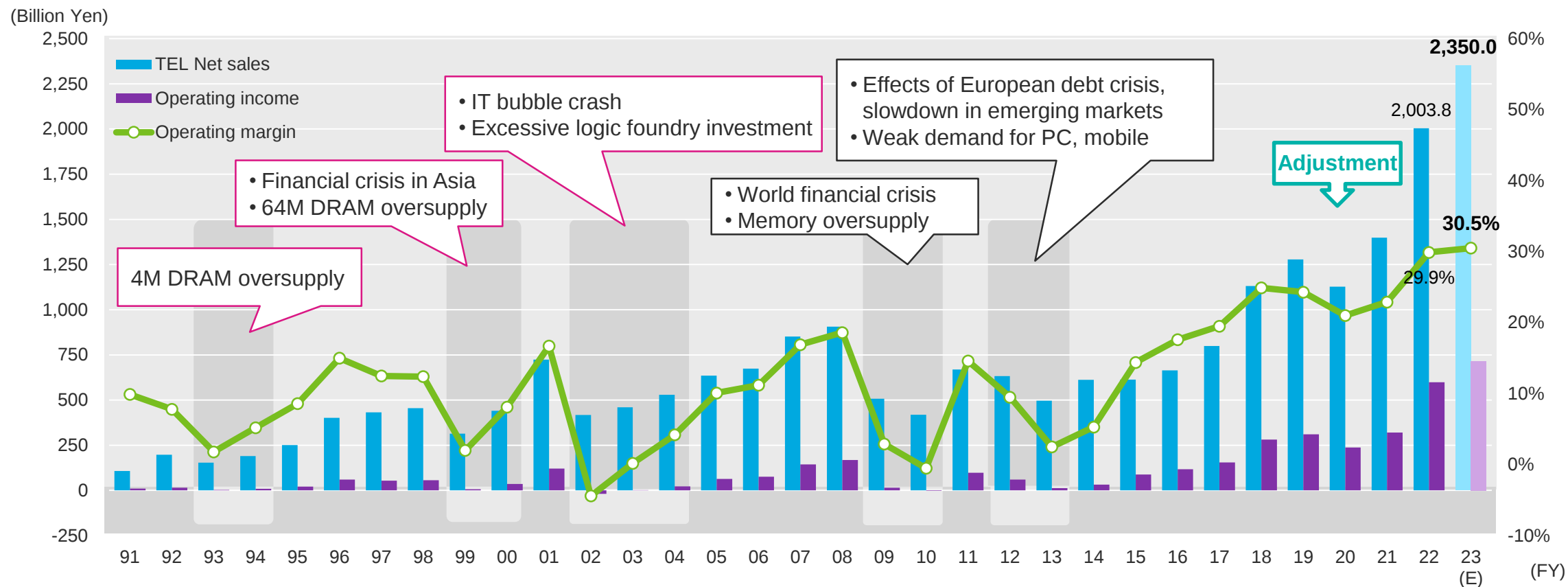


Miyagi Technology Innovation Center
(Began operation in Oct. 2021)



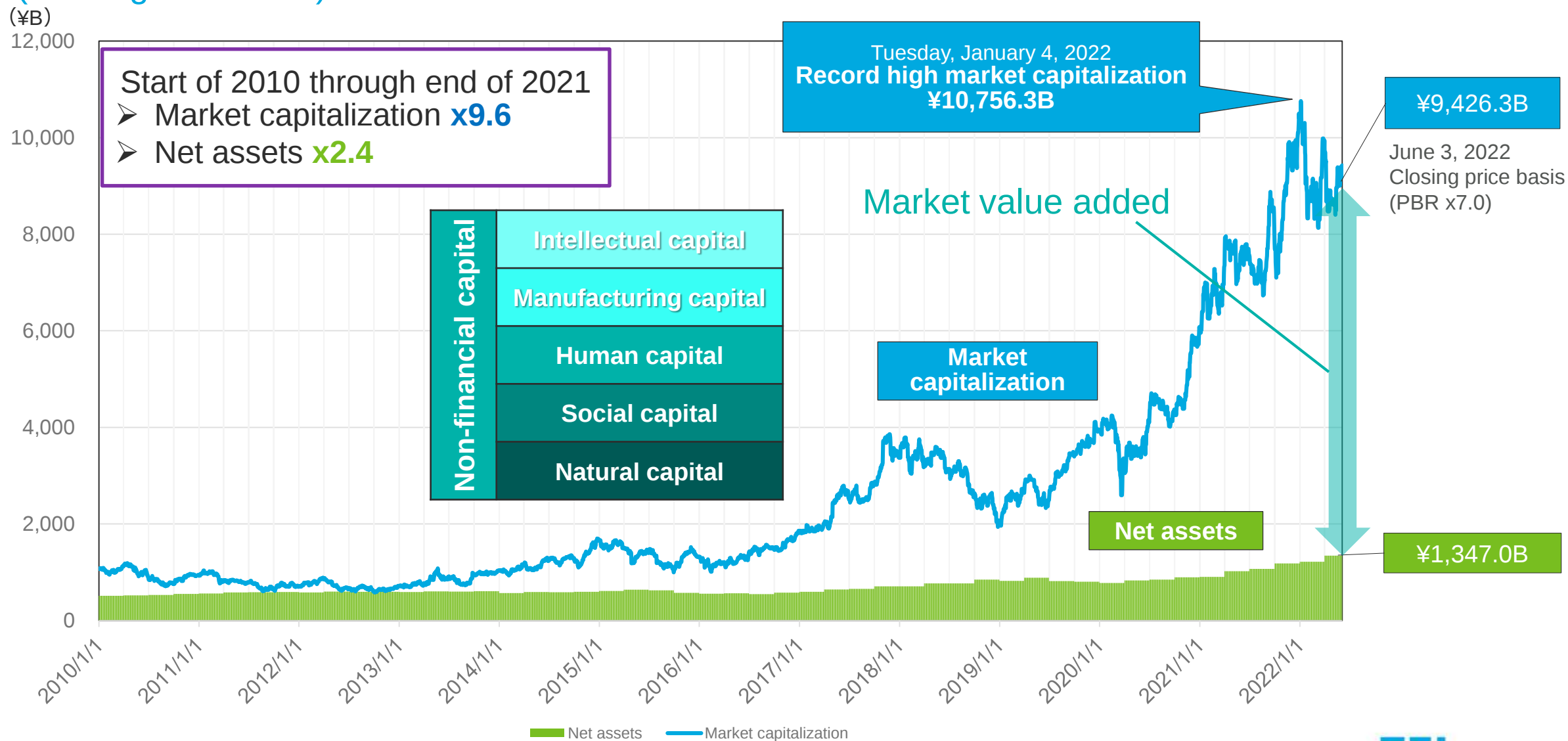
Invested on increases in production capacity, enhancement of development capabilities, advancement of DX, and partnerships with suppliers

Trends in Net Sales and Operating Income

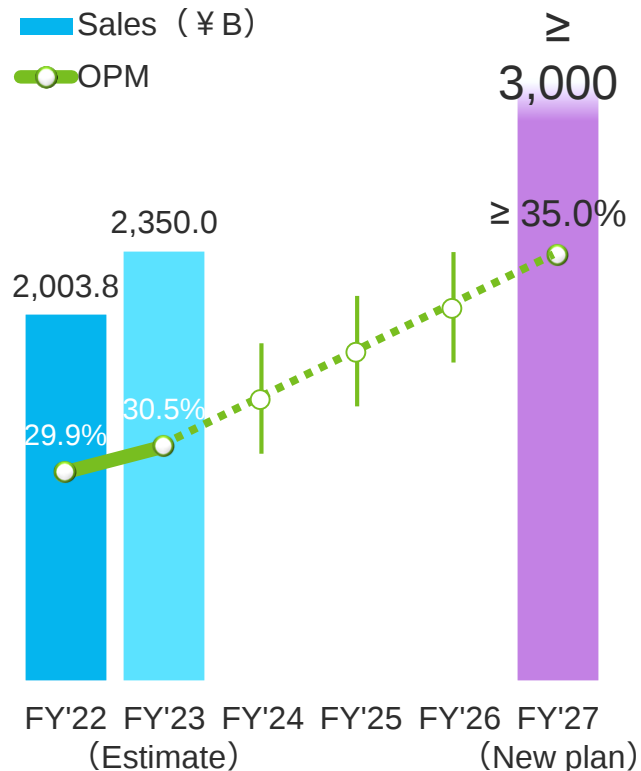


As cycles have reduced, aggressively continue growth investments even during periods of adjustment

Trends in TEL's Market Capitalization and Total Net Assets (Starting from 2010)

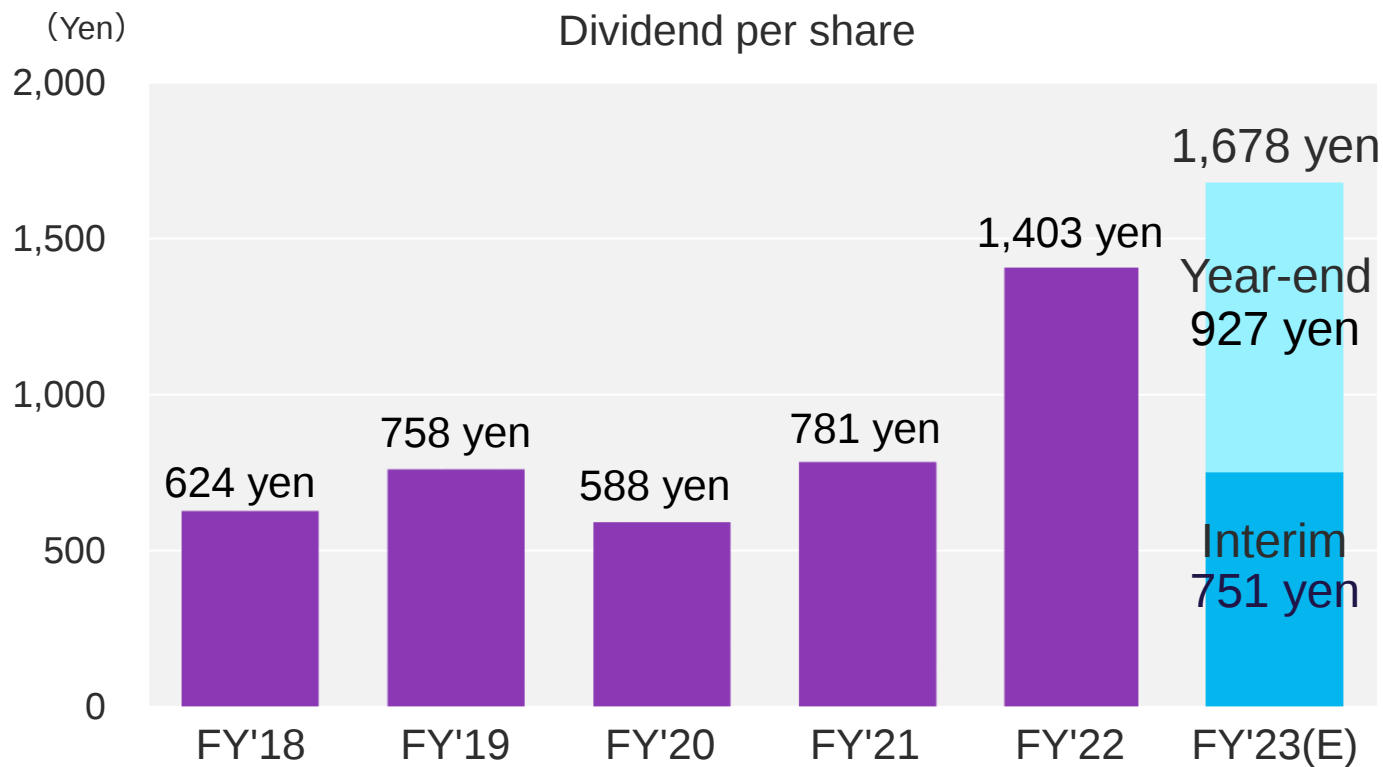


Financial Strategy to Achieve the New Medium-term Management Plan



- Increase investment into production capacity in anticipation of market growth
- Allocate more than 1 trillion yen in R&D expenses over the next five years (development portfolio management)
 - Development of new products in the leading-edge generation
 - Integration that enhances added value of products
 - Component research, expansion of fundamental technologies, and exploration of new areas
- Consider DX advancement investment ratios in light of economic effects
 - Increases to added value of equipment and profitability of advanced field solutions
 - Optimization of R&D activities
 - Optimization of sales activities and admin work
- Optimize fixed costs based on scope of business and business activities

Shareholder Return Policy



TEL shareholder return policy

Dividend payout ratio: 50%

Annual DPS of not less than 150 yen

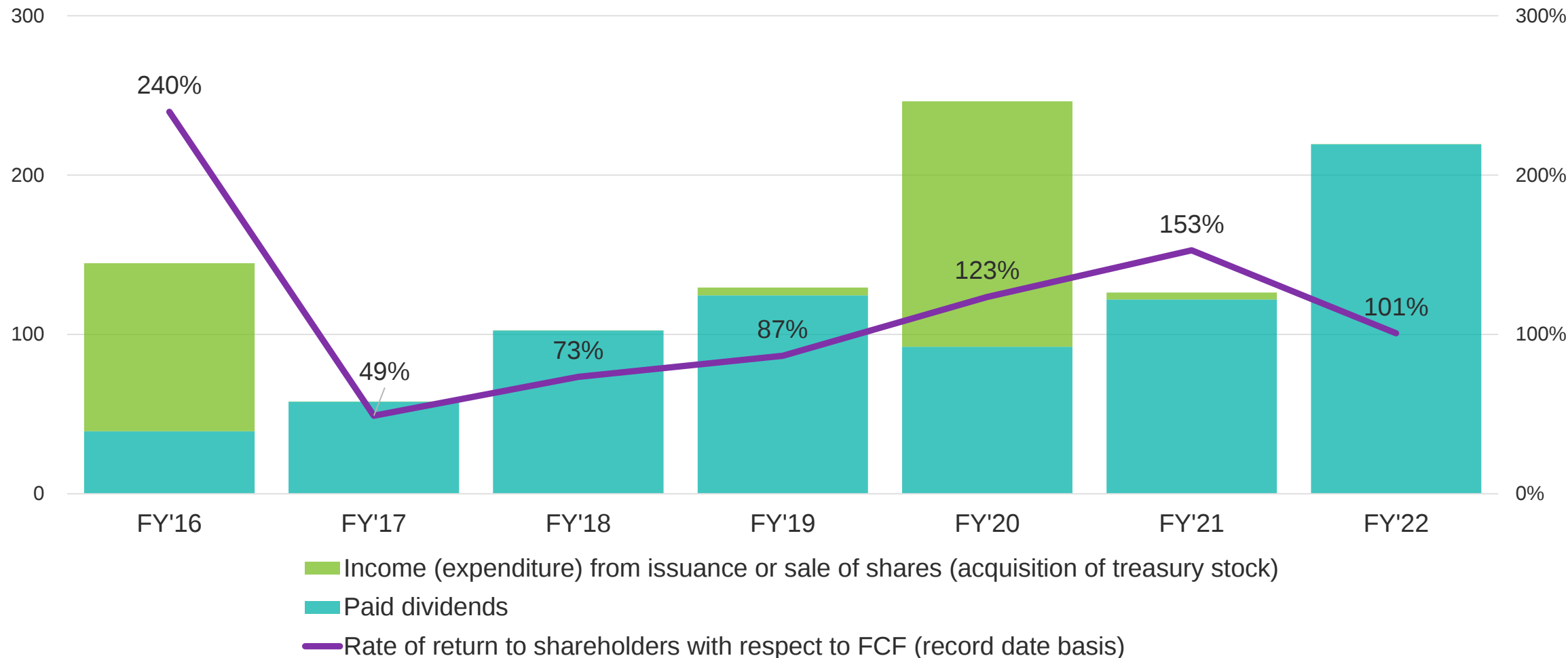
We will review our dividend policy if the company does not generate net income for two consecutive fiscal years

We will flexibly consider share buybacks

No change to shareholder return policy

Total Returns with Respect to FCF

(Billion yen)



Summary

- Achieved financial model from the previous Medium-term Plan (scenario of 2 trillion yen in net sales) two years ahead of schedule
 - Dynamically executed business strategy to address changing circumstances
 - Continued growth investments even during periods where the market was undergoing adjustment
 - Had close communications and collaborations with partner companies
 - As cycles have reduced, aggressive growth investments even during periods of adjustment were well-received by the stock market, resulting in significant growth to market capitalization compared to net assets
- Key financial strategies to achieve the new Medium-term Management Plan
 - Increase investment into production capacity in anticipation of market growth
 - Allocate more than 1 trillion yen in R&D expenses over the next five years properly (development portfolio management)
 - Consider DX advancement investment ratios in light of economic effects
 - Optimize fixed costs based on scope of business and business activities
- No change to shareholder return policy, return profits to shareholders through growth

Procurement and Manufacturing Strategy E-COMPASS

June 8, 2022

Sadao Sasaki
Representative Director, EVP & GM,
Development & Production, Corporate Production Division



We would like to sincerely thank all of our stakeholders for their kind support

- **Need for Production Innovation (Procurement/Manufacturing)**
 - Build production operation with high productivity
 - Build a sustainable supply chain
- **Efforts toward reducing environmental impacts**
 - Activities toward Scopes 1, 2 and 3
 - Activities toward total net zero CO₂ emissions



E-COMPASS



Major Domestic Production Sites (As of April 1, 2022)

Yamanashi: Near full-utilization



Kumamoto: Full-utilization (increasing production)



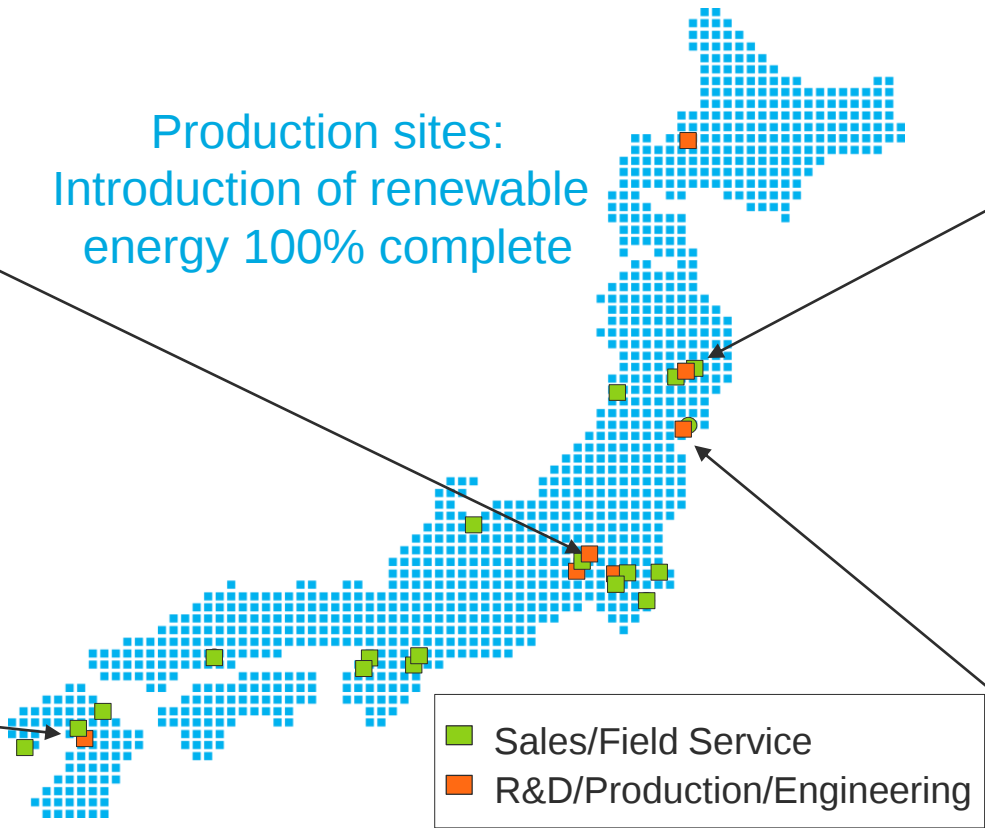
Iwate: Full-utilization (increasing production)



Miyagi: Full-utilization (increasing production)



Production sites:
Introduction of renewable
energy 100% complete



Continue to provide high-quality semiconductor production equipment to semiconductor manufacturers all over the world according to required deadlines

Need for Production Innovation (Procurement/Manufacturing)

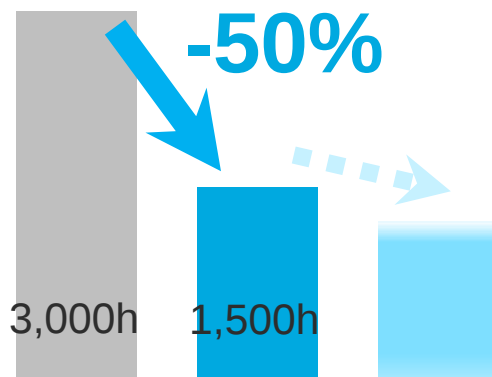
- Build production operation with high productivity
- Build a sustainable supply chain
 1. Production capacity increases
 2. Insufficient start-up personnel
 3. Parts shortages

Continuous Production Innovation in Pursuit of Safety, High Quality and High Reliability

- Build a production system able to quickly respond to market changes
- Shorten time from new product development to mass production
- Shorten production lead times: Achieve 100% module shipment
- Utilize DX and automation in manufacturing, and expand automated warehouse
- **Significantly reduce equipment start-up time (One-touch start-up)**
 - Reduce start-up time up to 75% (primary target), One-touch (final target)



Shorten start-up time

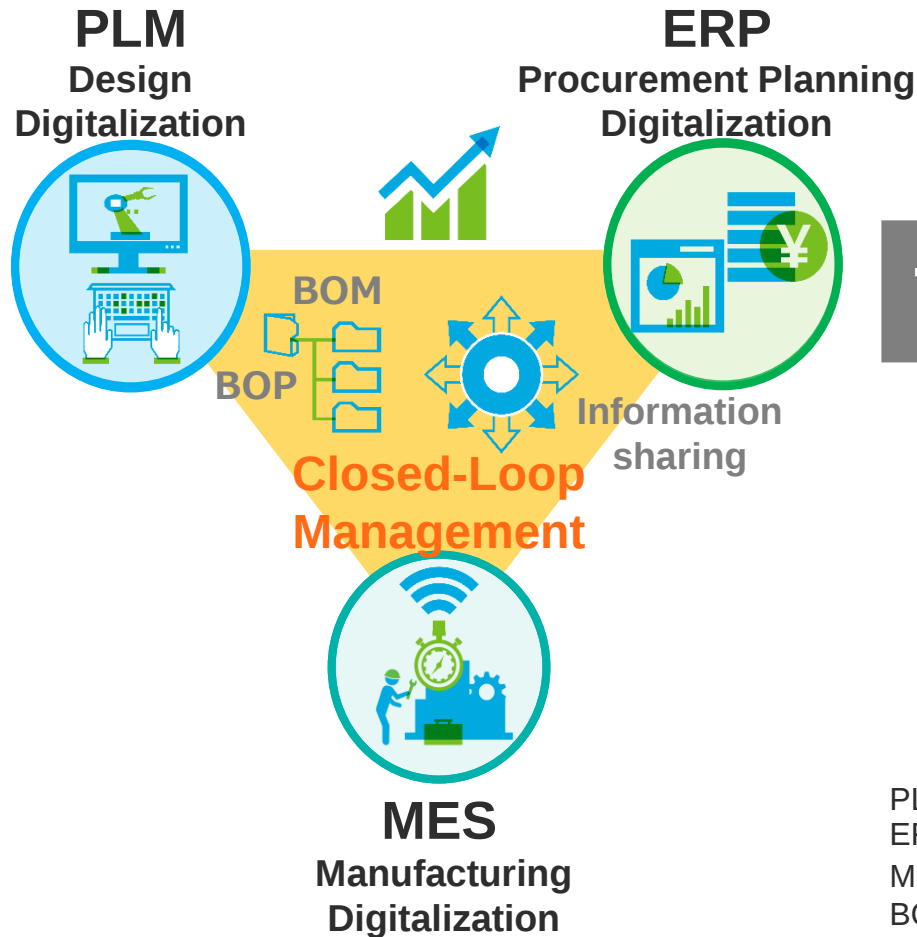


Conventional → after production innovation

Expected outcome from shorten start-up time

- Enhance productivity and start-up quality
- Reduce accident risks
- Optimize resources and the work-life balance

Efforts to Utilize TEL PLM-DX and Improve Productivity and Efficiency



TEL PLM-DX



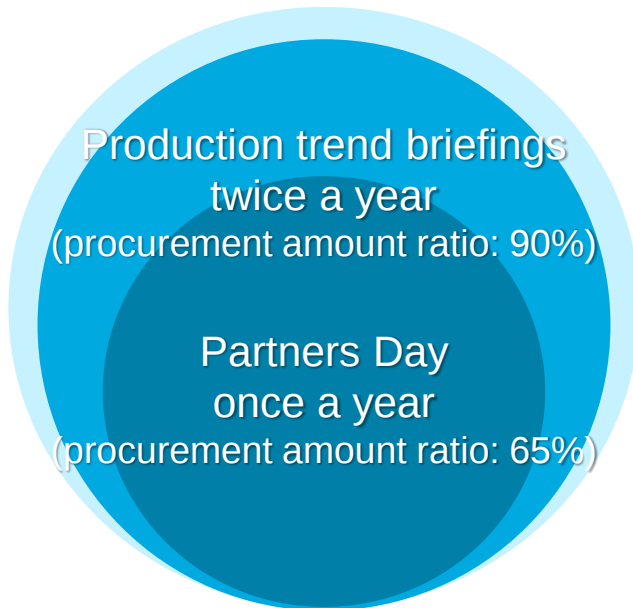
PLM: Product Lifecycle Management
ERP: Enterprise Resource Planning
MES: Manufacturing Execution System
BOM: Bill of Material
BOP: Bill of Process

- Improve core system
 - Production leveling < 12 months
 - MRP processing capability for procurement increased 10-fold
- Introduce PLM-DX and BOM concept
 - Enhance production capability up to 2 times within 3 years
 - Minimize manufacturing lead time
 - 3-fold increase in design efficiency
 - Reduce new product development period by half

“Shift Left” production plan toward the business scale of 1 trillion-yen procurement

Build a Sustainable Supply Chain

- Fair and transparent relationships and reliable trust relationship with our business partners
 - Implement CSR/BCP assessments based on industry codes of conduct
 - Share knowledge in such areas as safety, quality, the environment and compliance



E-COMPASS

Applaud environmental impact reduction activities,
adding environmentally related items
to assessment studies

- ✓ Reduce CO₂ emissions and the amount of energy usage
- ✓ Introduce renewable energy
- ✓ Promote resource conservation
- ✓ Promote waste reduction and recycling
- ✓ Promote activities for reducing the environmental impact of logistics



Procurement BCP and Proactive Procurement Activities

Mid- and long-term forecast
Promote “Shift Left” procurement strategy
Build BCP system resilient to procurement difficulty

Oversee whole supply chain from upstream to downstream
Visualize and grasp risks

Supply chain responsive to any kind of risks
(Raw materials, parts, processing and assembly)
Strong and reliable supply chain

**Safety stock
Inventory liquidity**

**Visualize
supply chain**

**Risk management on
business partners
Strengthen partnership**

Measures for procurement BCP

Early procurement of parts

- Early procurement for long term
- Ensure inventory exchange flexibility among factories
- Inventory reductions in total

Secure semiconductor devices

- Secure semiconductor devices for our equipment
 - Visualize and streamline distribution channel
 - Collaborate with semiconductor makers
- = TEL can be a customer of our customers

Parts and Suppliers

- Identify and analyze risk parts
- Multi sourcing of producing countries
- Standardization, centralization and decentralization of parts
- Measures to secure capacity for us

Efforts toward Reducing Environmental Impacts

Responsibilities as an Industry-Leading Company

Digital (ICT/DX)

×

Green (Decarbonization)

ICT: Information and Communication Technology

DX: Digital Transformation of societies and business models, etc.

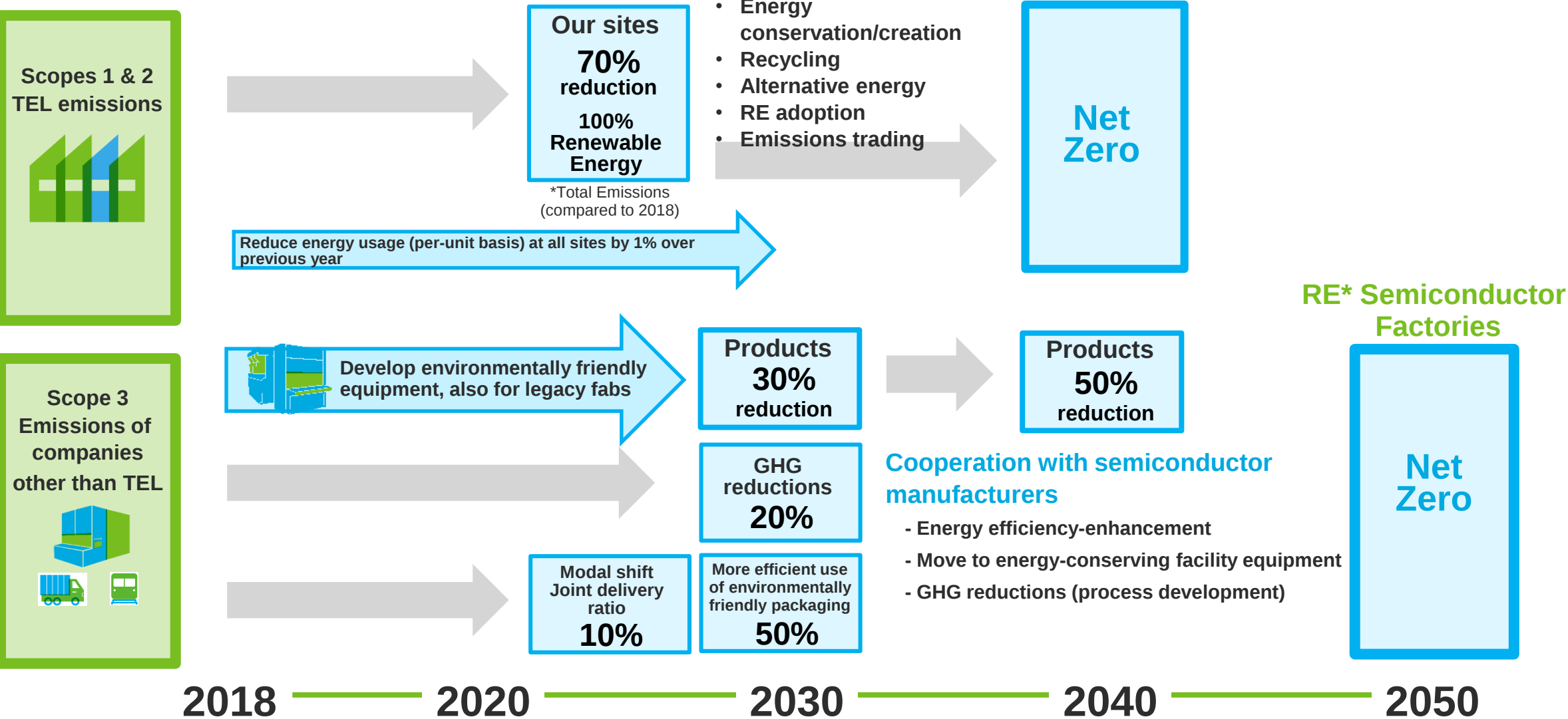


E-COMPASS

Environmental Co-Creation by Material, Process and Subcomponent Solutions

TEL will forcefully lead the entire industry toward the realization of a decarbonized society

Milestones for CO₂ Emission Reductions toward Net Zero Emissions



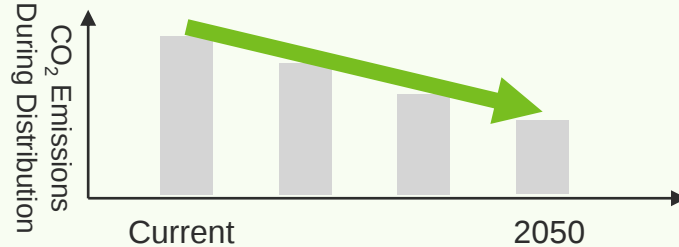
E-COMPASS Activities Toward Scopes 1, 2 and 3

Strengthen partnerships: Pursue industry-wide sustainability

What We Aim For

1 Reduce the environmental impact of procurement logistics

Realize logistics with minimized environmental impacts

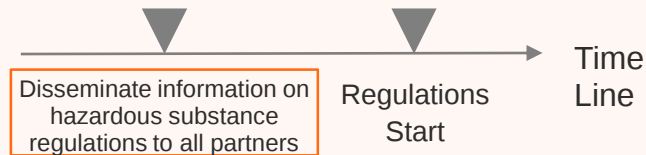


Common Goals

- Promote modal shift
- Reduce the environmental impact of packaging materials
- Adoption of electric/H₂ trucks (requested)

2 Equipment free of environmentally harmful substances

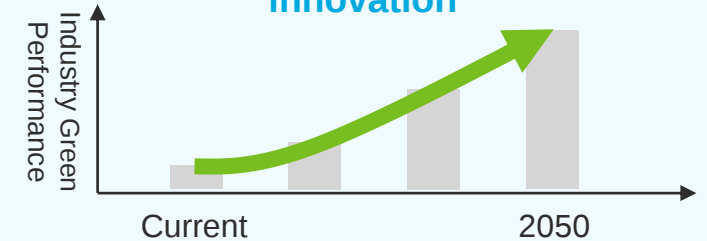
Abolish TEL-designated prohibited substances before they begin to be regulated



- Abolish prohibited substances before they begin to be regulated
- Create a system for sharing information on part that contain prohibited substances (as defined in parts specifications)
- Reduce the number of sheet metal product and cable assembly product studies by half

3 Proactive develop of environmental technologies for equipment

Use environmental technologies to accelerate manufacturing technology innovation



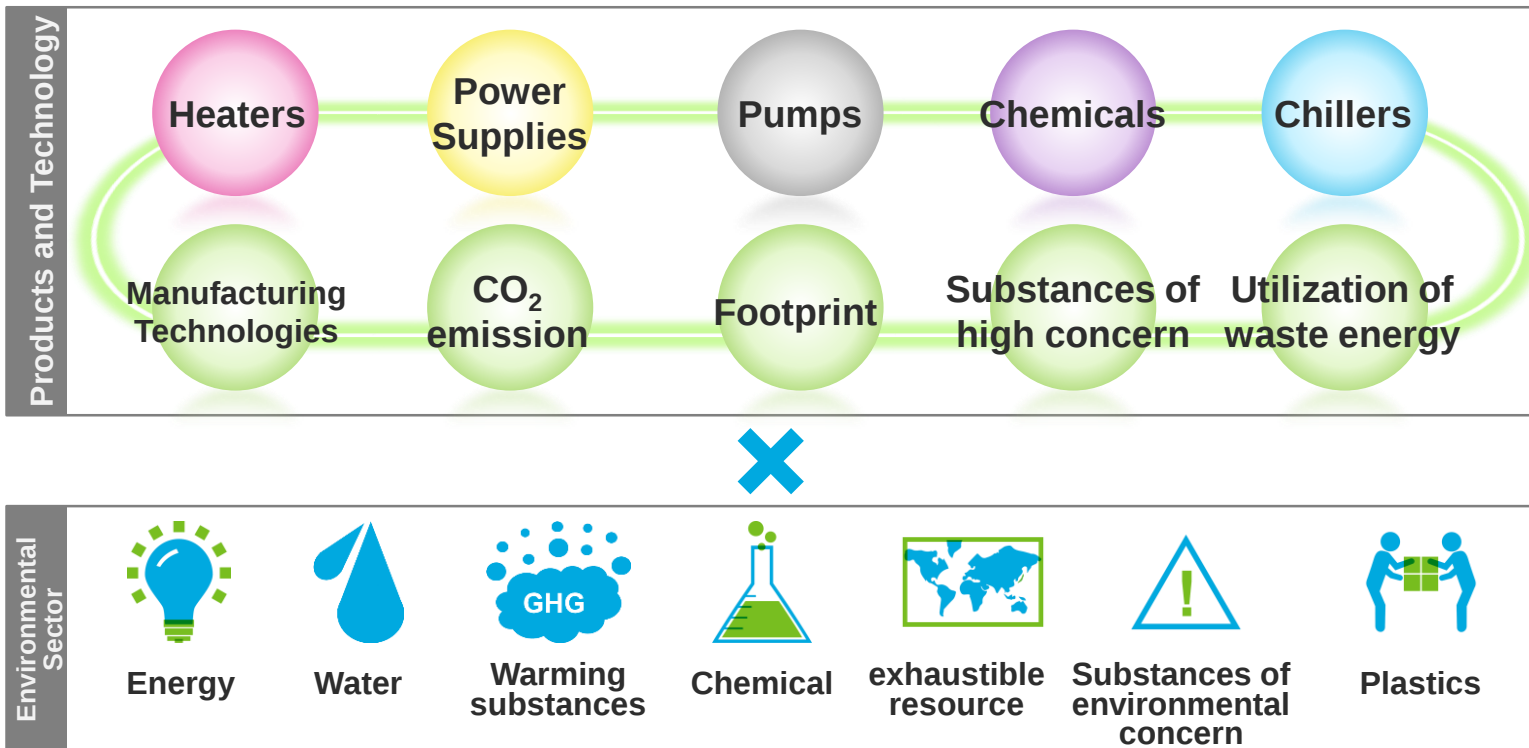
- ❑ Efforts with joint development partners
 - Share 10-year environmental technology roadmap
 - Set environmental performance standards for reducing environmental impacts in product specifications
 - Degree of achievement with respect to, or number of product types achieving, environmental specifications on a product-by-product basis

Prepare system (awards, etc.) for publishing business partner achievements after this fiscal year's TEL Partners Day
Accelerate technological innovation to create new, more-competitive equipment environmental technology

E-COMPASS Activities Toward Scope 3

We are targeting "net zero" to reduce environmental impact, and aim to solve environmental technology issues through industry-wide collaboration and to contribute to society as a member of among environmentally advanced companies

10 technical sector themes and 7 environmentally important sectors



Together with all of You

- Share environmental information about products
- Share goals for enhancing environmental performance
- Share 10-year roadmap for environmental technology

Support from TEL

- Accelerate joint development with supporting companies
- Joint development investments in supporting companies*

*We will invest when we deem it necessary

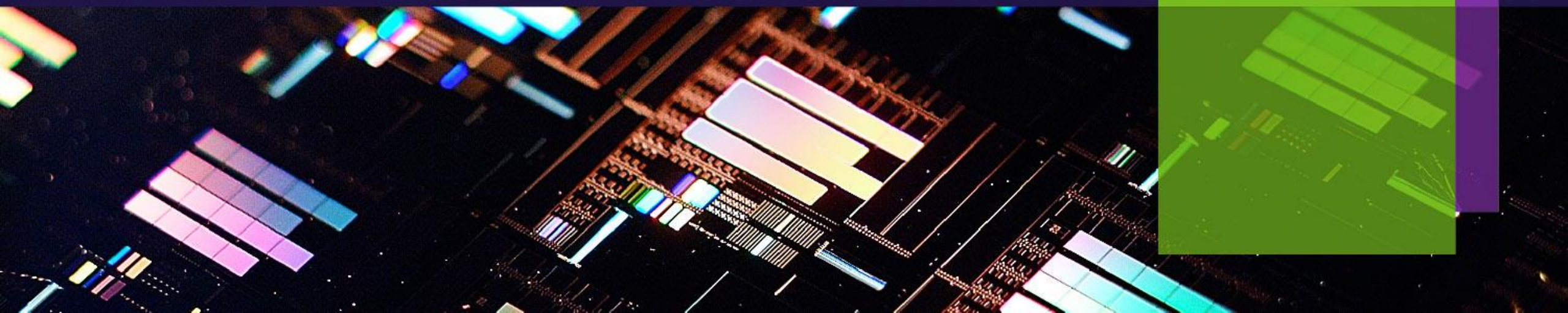
Summary

- Pursuit of production innovation (Procurement/Manufacturing)
 - Reduce burden on site by One-touch equipment start-up
 - Utilize TEL PLM-DX to double production capabilities
 - Achieve production leveling and stabilization through proactive procurement
- Efforts toward reducing environmental impacts
 - Scope 1/2: Utilize renewable energy across the board
 - Total net zero CO₂ emissions: Through the collaboration with semiconductor manufacturers and supply chain, we will realize RE semiconductor factories, environmentally friendly equipment and GHG reductions

SPE Business Strategy

June 8, 2022

Yoshinobu Mitano
Corporate Director, Senior Vice President and General Manager
SPE Business Division

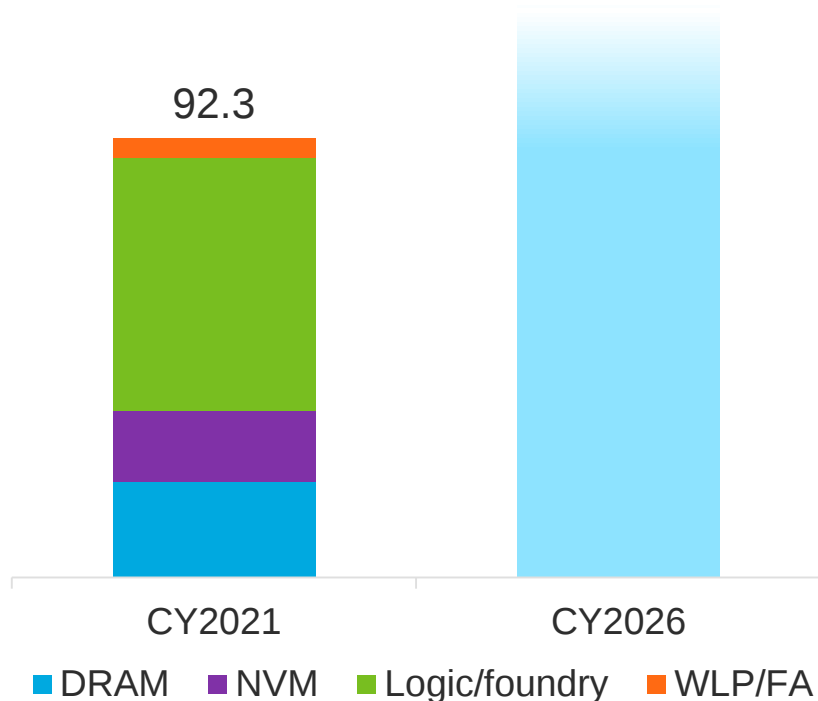


Overview

- WFE Market and Technological Requirements by Application
- Technology Roadmap
- SPE Segment Sales Target and Business Opportunities
- Development Efforts
 - Strengthen R&D Capabilities
 - Increase in New Product Sales Composition Ratio
 - Increase Environmental Performance
 - Increase Efficiency of Equipment Start-up
- Summary

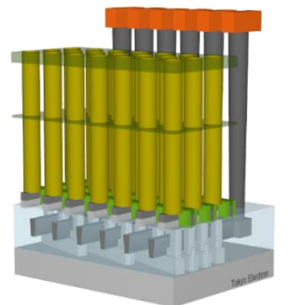
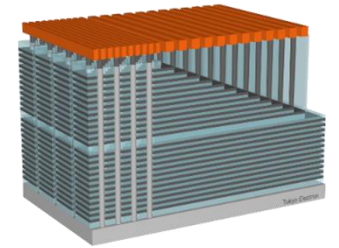
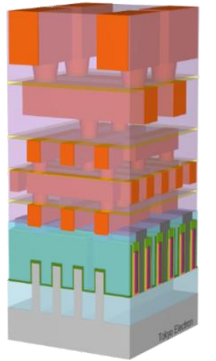
WFE Market and Technological Requirements by Application

WFE Market Growth (USB\$)



Technological Requirements

- Logic/foundry :
 - Scaling along with structural changes
 - Reduction in manufacturing cost per transistor
 - Lowering power consumption
 - Higher performance
- NAND
 - Increasing the layer counts
 - Reduction in manufacturing cost per bit
- DRAM
 - Scaling to realize
 - Reduction in manufacturing cost per bit
 - Lowering power consumption
 - Higher performance

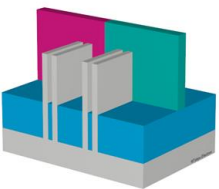
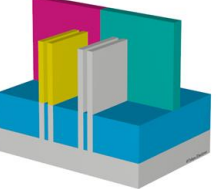
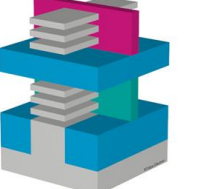
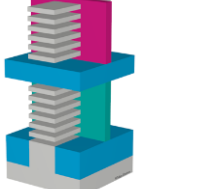


Logic Technology Roadmap

Assume new knob will be created in each node

* DTCO: Design technology co-optimization

** Single Diffusion Break, *** Self Align Gate Contact

Year of HVM (20k/month)	2018	2020	2022	2024	2026	2028	2030
Node	N7	N5	N3	N2	N1.4	N1	N0.7
Device	3~2 Fin 	2 Fin 	2~1 Fin 	GAA NS 	Forksheet 	CFET 	2 nd Gen. CFET 
Poly pitch (PP)	56	48	45	42	39	36	33
Min. MP [nm]	40	28	22	20	18	16	12
Cell height (CH)	240 (2Fin)	210 (2Fin)	176 (2Fin)	120 (NS)	90 (NS)	64 (CFET)	48 (CFET)
Density (a.u.) PP x CH x DTCO*	1	1.73 (vs. N7)	1.53 (vs. N5)	1.81 (vs. N3)	1.65 (vs. N2)	1.75 (vs. N1.4)	1.67 (vs. N1.0)
Scaling booster	SDB**	EUV High μ channel	SAGC*** Dipole eWF	Backside PDN		Heterogeneous channel	2D material

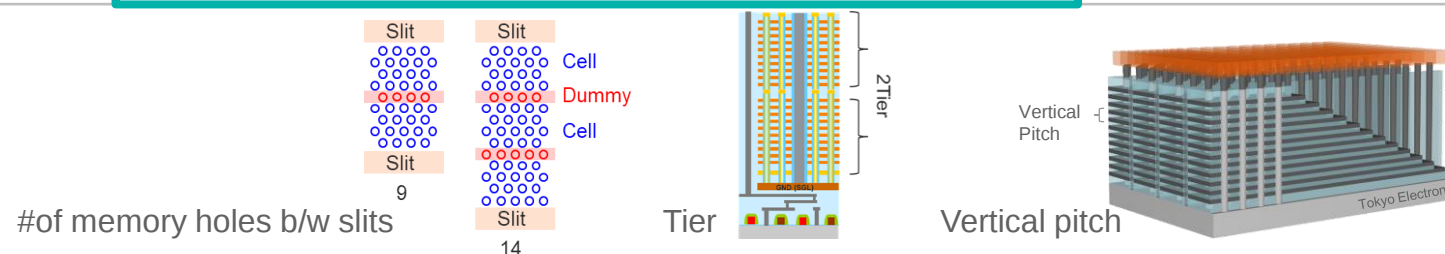
Source: iedm 2020^[1], IRDS2020 with TEL's update ^[1] imec, S. B. Samavedam et al.

Aiming for 1.6-1.8x increase in logic density along with pitch scaling, DTC and scaling booster

NAND Technology Roadmap

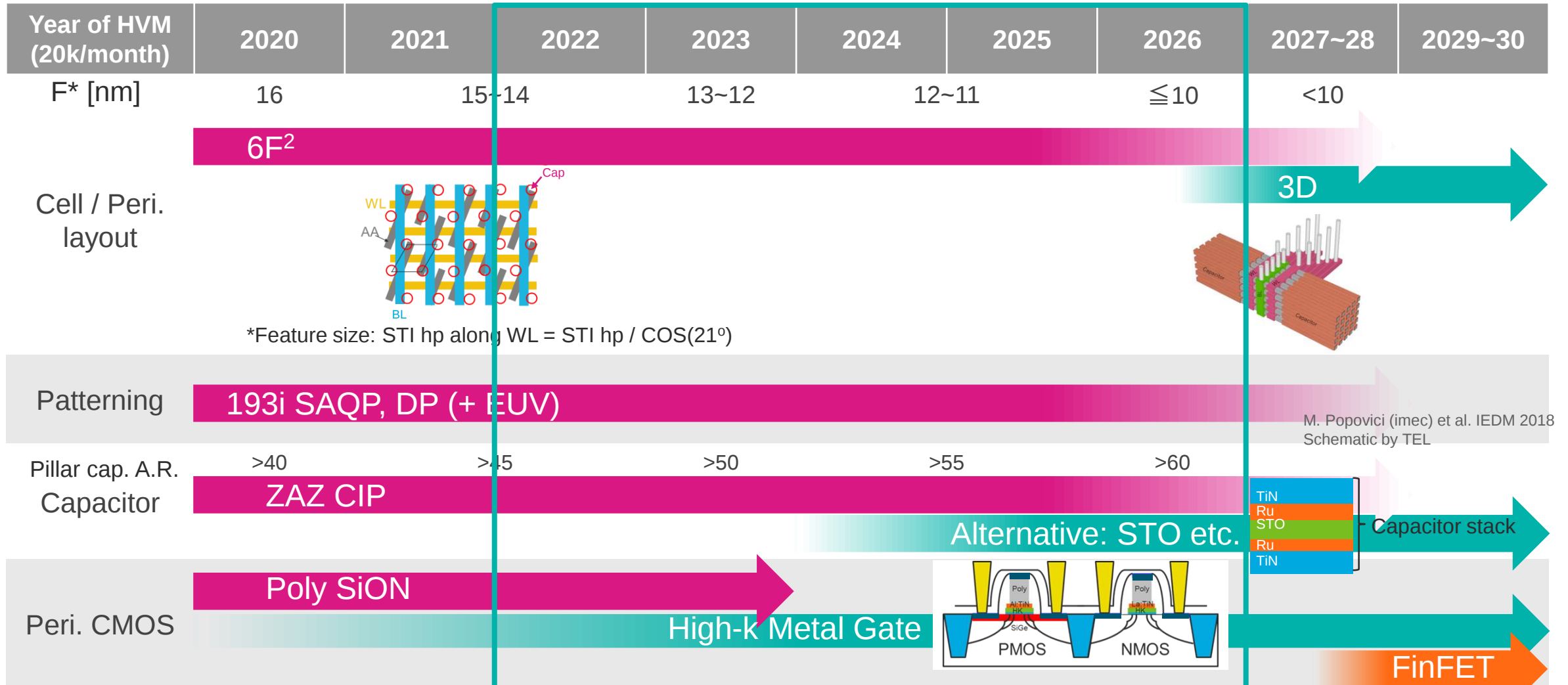
Source: TEL estimates

Year of HVM (20k/month)	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Stack (~1.6x/3years)	128L	16x~19xL (176)	22x~25xL (240)	28x~32xL (304)	35x~4xxL (368)	41x~45xL (440)	5xxL (512)				
Tier	1 or 2	2	2	2	2 or 3	3	3 or 4				
Vertical pitch	50~55nm	45~55nm	40~50nm	35~45nm	35~45nm	35~45nm	35~40nm				
Memory height	7~8μm	8.5~10.5μm	10~12.5μm	11~14μm	13.5~17μm	16~20.5μm	18.5~21μm				
Channel	Poly Si grain CIP			incl. MILC Si*							
WL metal	W	W	W	Mo	Mo	Mo	Mo				
#of memory holes b/w slits	9	9	9~24	14~24	19 or 24	19 or 24	19 or 24				
Peri. CMOS (In general)	Under array or Next array	Under array	Under array or Bonding	Under array or Bonding	Under array or Bonding	Under array or Bonding	Under array or Bonding				



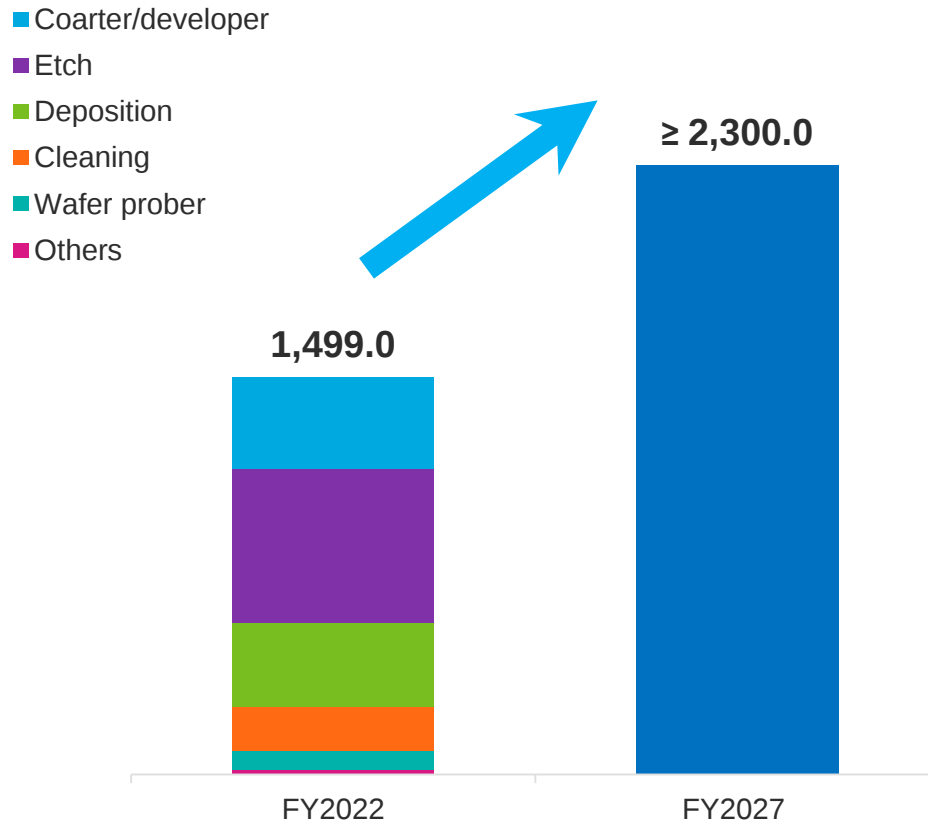
DRAM Technology Roadmap

Source: TEL estimates



SPE Segment Sales Target and Business Opportunities

SPE New Equipment Sales Target (\$B)

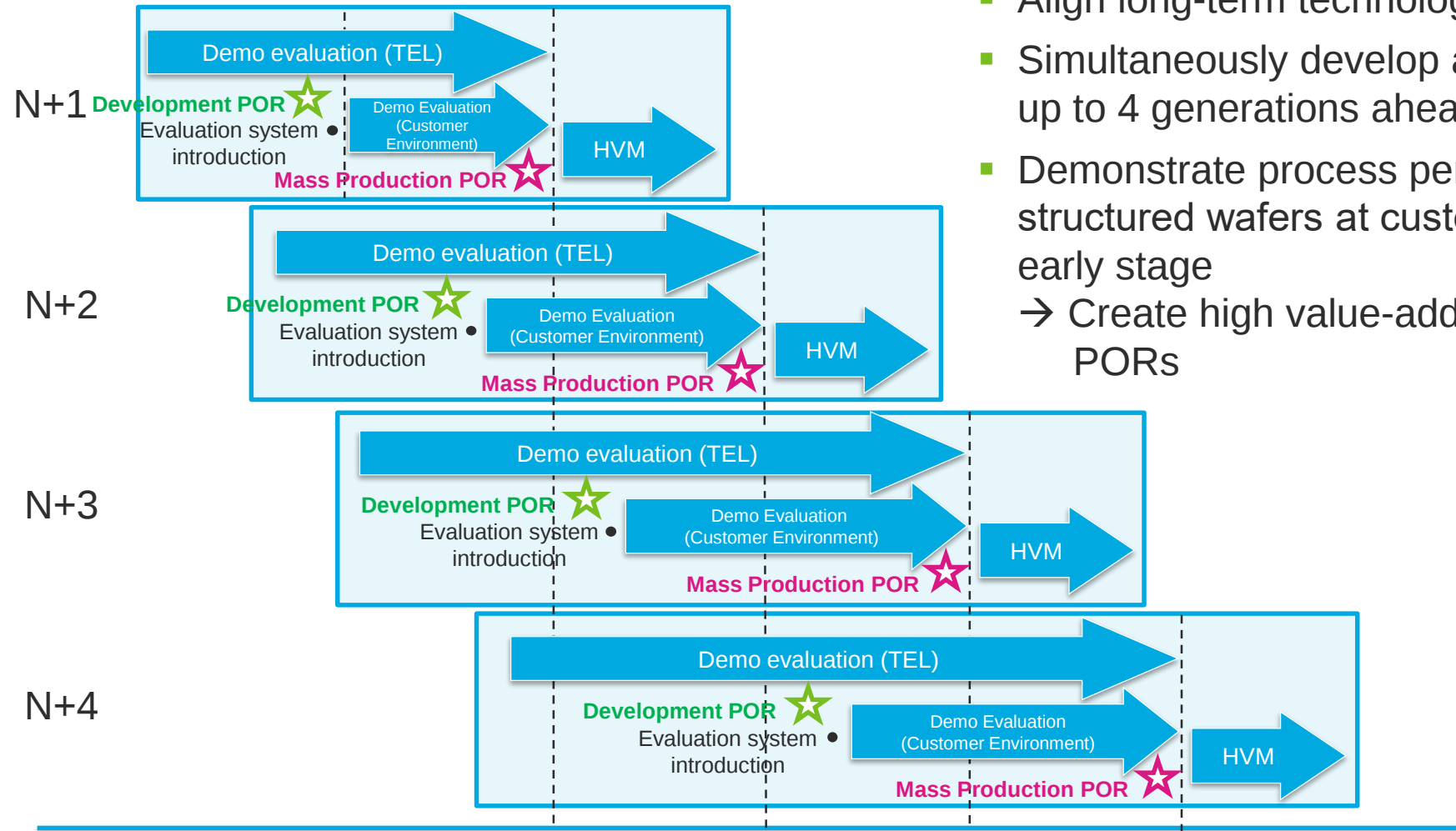


Business Opportunities

- Logic/foundry
 - Increase patterning complexity requires co-optimization between unit processes
 - Adoption of High-NA EUV lithography
 - Adoption of GAA and backside PDN
- NAND
 - 3D NAND layer counts reach more than 300 layers
 - High aspect ratio etch, high productivity sacrificial film removal and atomic-level deposition on 3D structure
- DRAM
 - Technology to suppress RC delay in wiring
 - Capacitor formation technology for further scaling

Development Efforts

Simultaneous 4-Generation Developments



- Align long-term technology roadmap with customers
- Simultaneously develop and evaluate technologies up to 4 generations ahead
- Demonstrate process performance on customer structured wafers at customer's environments at early stage
→ Create high value-added products and acquire PORs

Strengthen R&D Capabilities

Yamanashi R&D building

Deposition system, gas chemical etch system,
corporate R&D
(Completion scheduled for spring 2023)



Kumamoto R&D building

Coater/Developers, surface preparation system
(Completion scheduled for fall 2024)



Miyagi R&D building

Etch system
(Completion scheduled for spring 2025)



Miyagi Technology Innovation Center

Etch system
(Began operation in Oct. 2021)

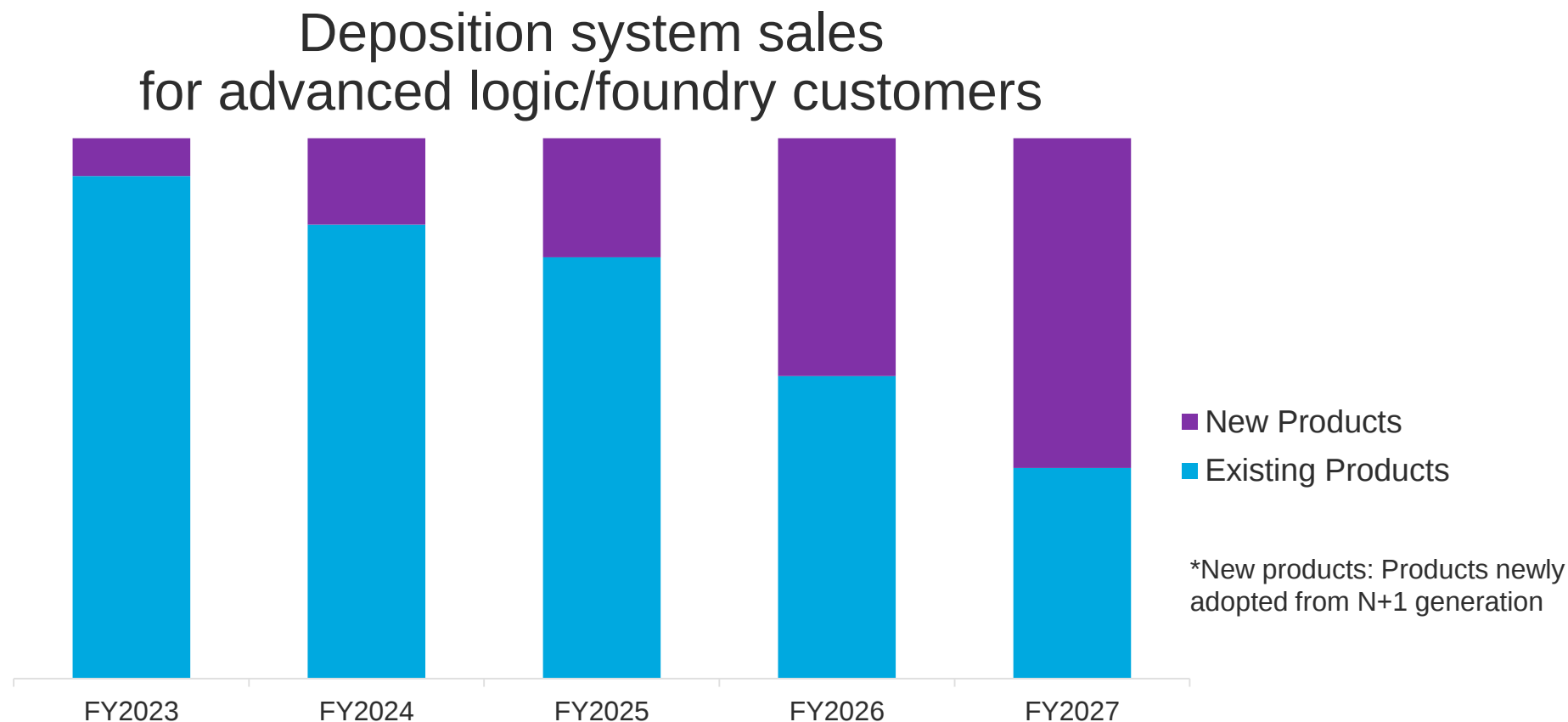


TEL Digital Design Square

DX, Software
(Began operation in Nov. 2020)



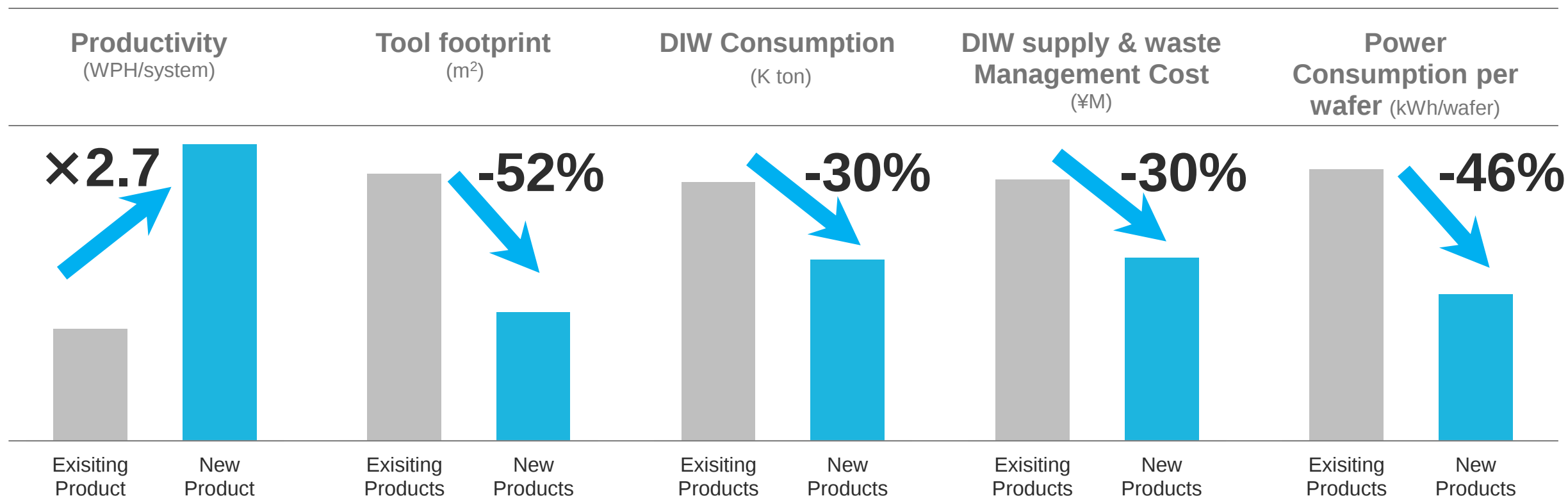
Increase in New Product Sales Composition Ratio



The proportion of high value-added products will increase.
Contribute to enhancing sales, profits and market share

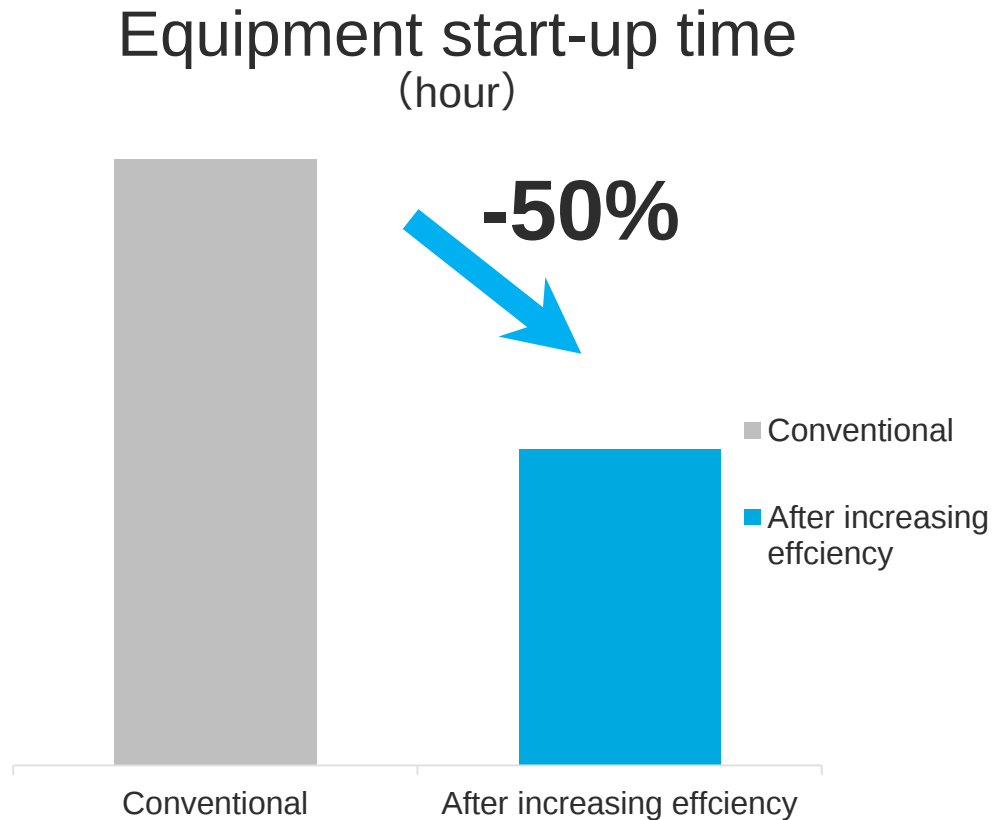
Increase Environmental Performance

Cleaning system



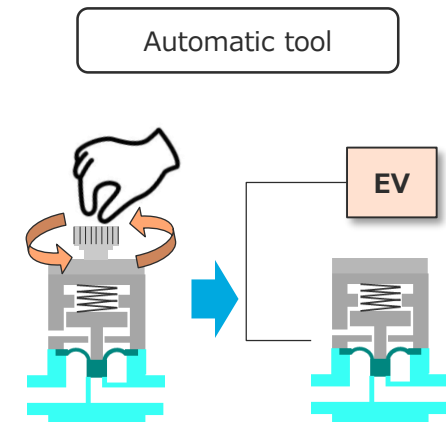
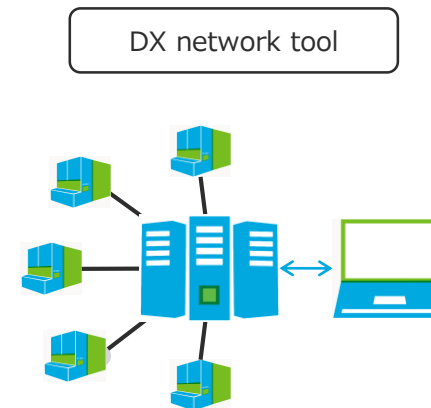
Environmental performance = equipment performance
Further enhance environmental performance

Increase Efficiency of Equipment Start-up



■ Measures :

- Optimize inspection items and automate inspection
- Expand online support
- DX network tool
- Automatic tool



Further enhance customer satisfaction and productivity

Summary

- Business opportunities are expanding along with the technological innovation in both logic and memory
- Provide added value through co-optimization of our wide range of products
- Create high value-added equipment and acquire PORs through 4-generation simultaneous developments and evaluations with our customers
- Enhance and strengthen development capabilities
- Enhance customer satisfaction and productivity by shortening equipment start-up times using DX and AI

Backend Business Strategy :

Activities for the Development of Wafer Bonding Process

June 8, 2022

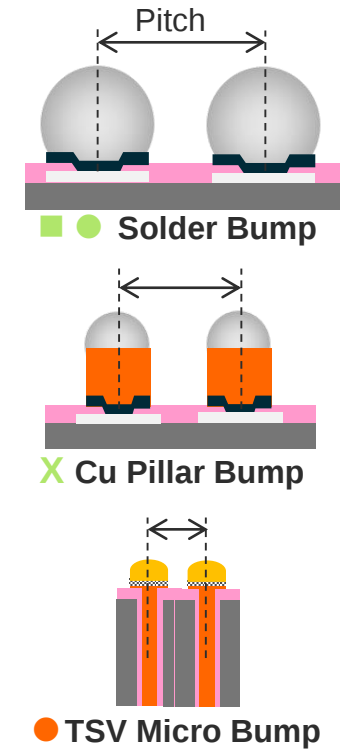
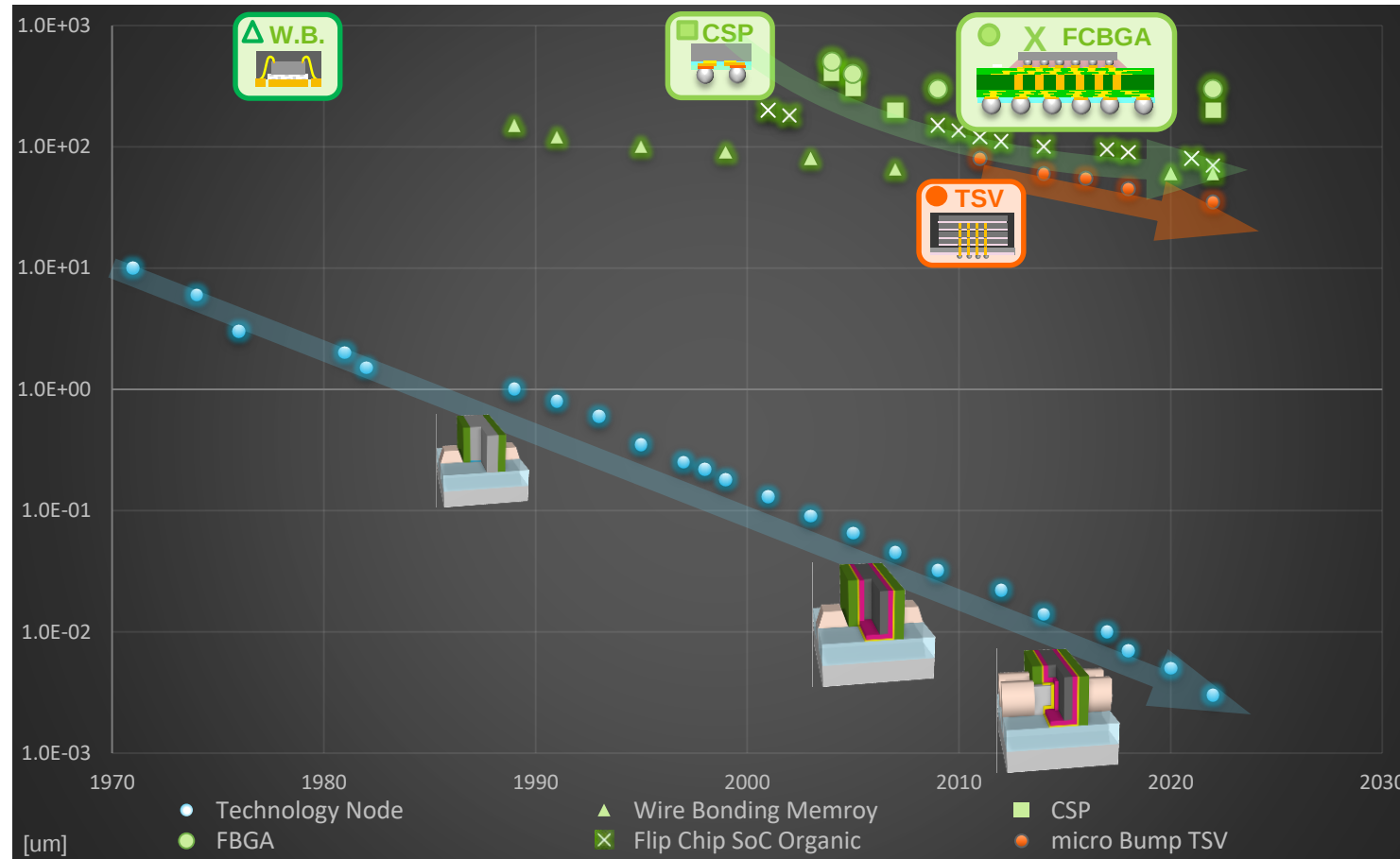
Yohei Sato

BUGM

ATS BU

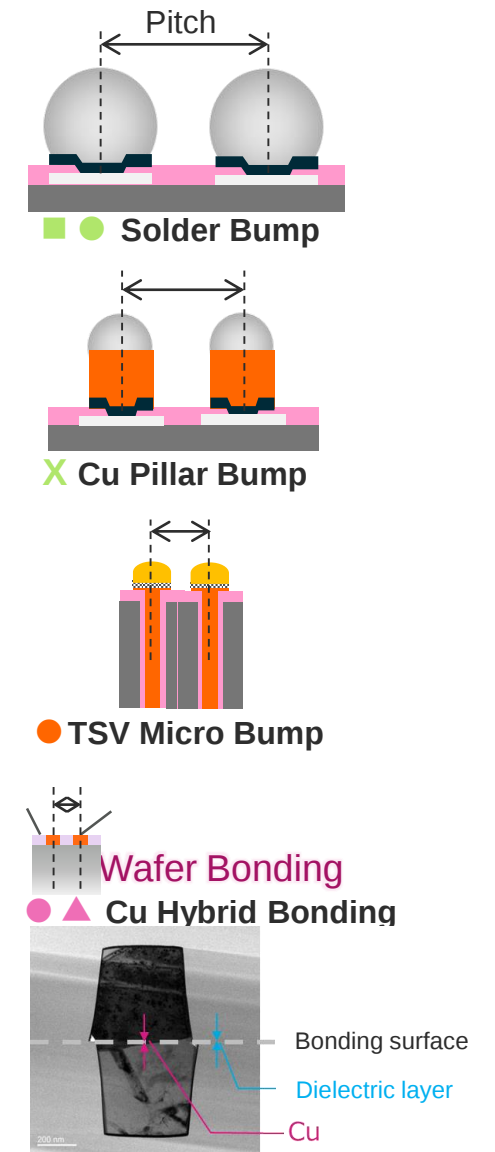
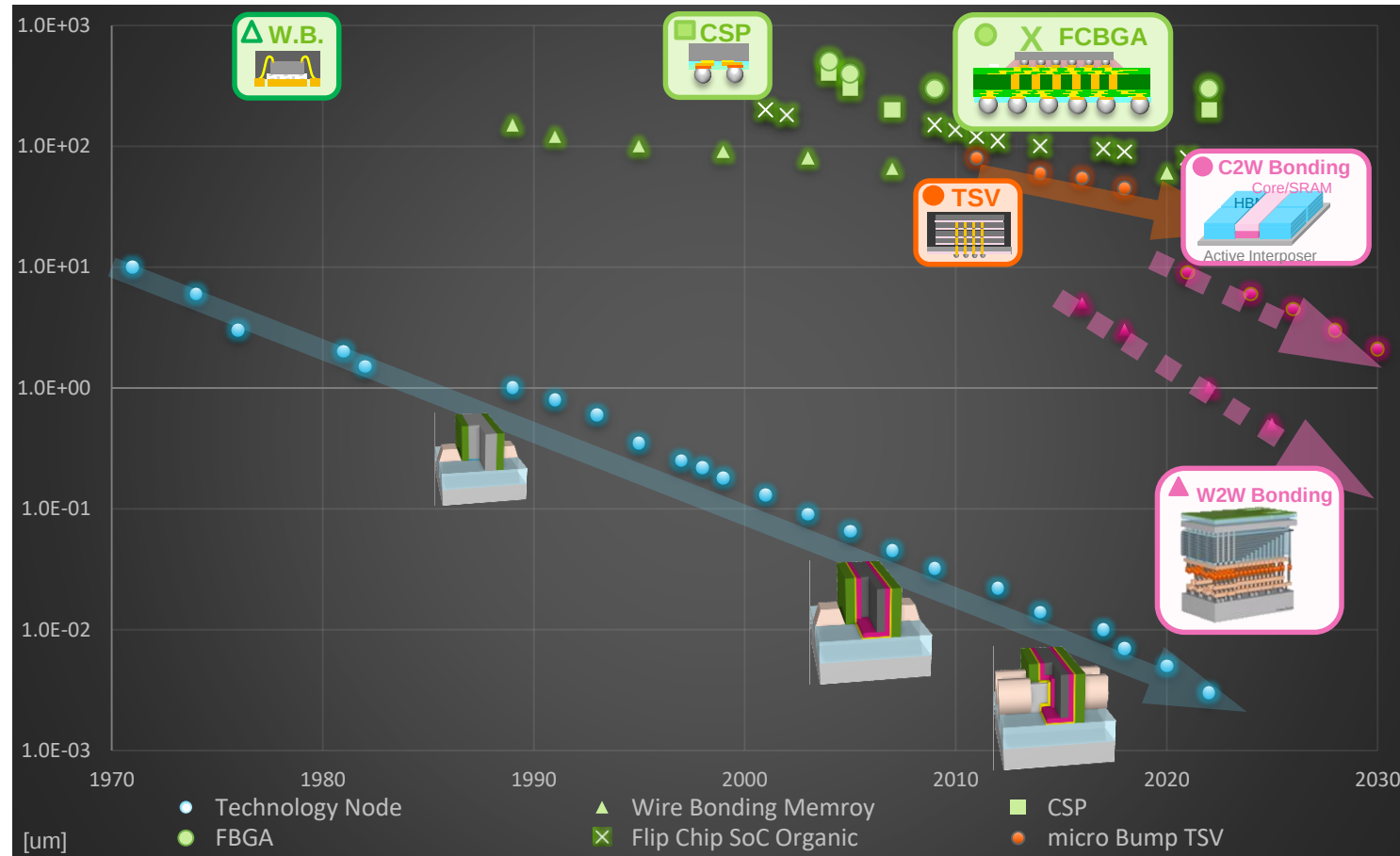


Semiconductor Technology Node and Bump Pitch



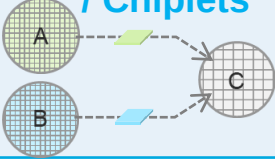
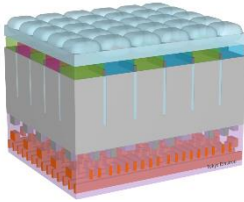
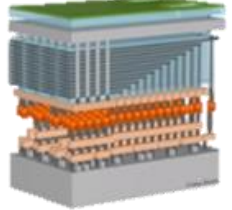
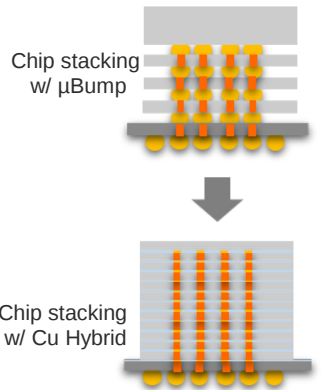
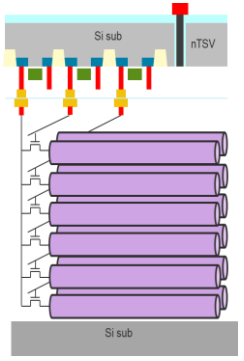
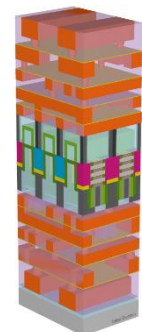
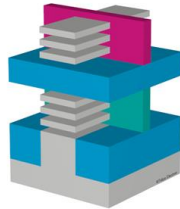
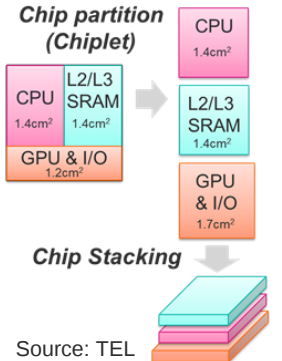
Introduction of wafer bonding technology accelerates further reduction of pitch

Semiconductor Technology Node and Bump Pitch



Introduction of wafer bonding technology accelerates further reduction of pitch

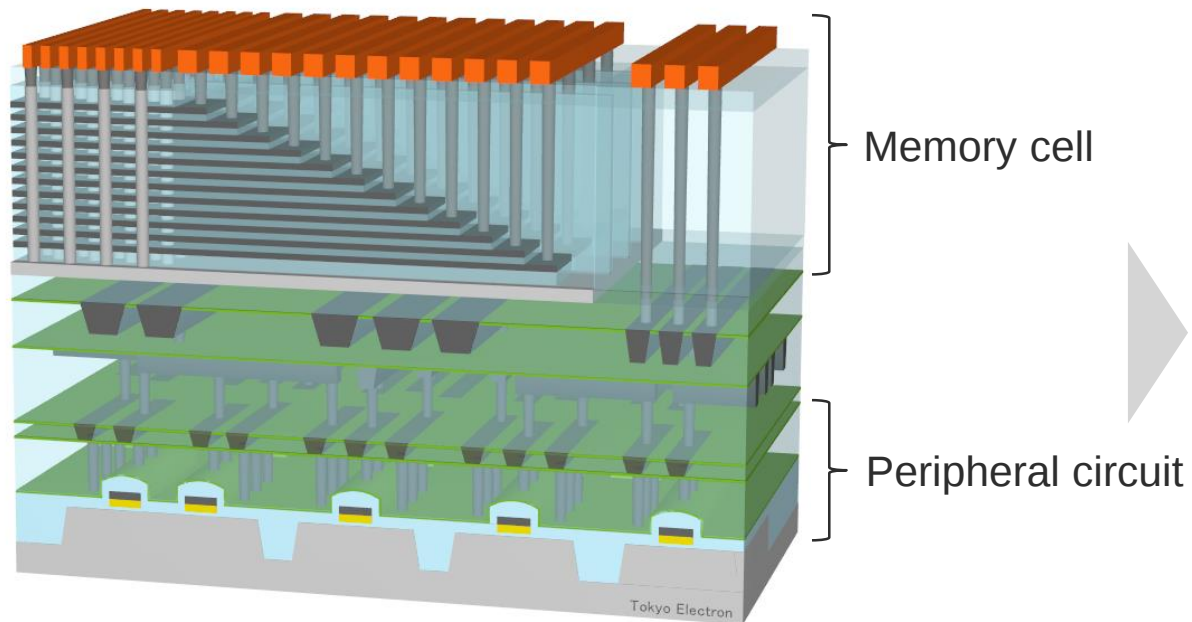
Application of Wafer Bonding

Device	CIS	NAND	DRAM			Logic	
	BSI	3D NAND	HBM	3D DRAM	Backside PDN	Sequential CFET	Disaggregation / Chiplets
Stacking Device	Sensor + Memory + Logic	Cell + Peripheral	DRAM ⋮ DRAM + Logic	Cell + Peripheral	Logic + Bare Si	Logic + Logic	
Bonding	W-W Cu Hybrid	W-W Cu Hybrid	D-W Cu Hybrid	W-W Cu Hybrid	W-W Ox Fusion	W-W Ox Fusion	D-W / D-D Cu Hybrid
3D I/O Pitch	3 μm → 1 μm	1 μm → 0.5 μm	40 μm → 25 μm	1 μm → 0.5 μm	Sub μm (nTSV)	Sub μm (nTSV)	10 μm → 1 μm
Structure			 Chip stacking w/ μBump Chip stacking w/ Cu Hybrid	 Source: TEL 3D DRAM structure			 Chip partition (Chiplet) CPU 1.4cm ² L2/L3 SRAM 1.4cm ² GPU & I/O 1.2cm ² Chip Stacking Source: TEL
Status	HVM	R&D~HVM	R&D	R&D	R&D	R&D	R&D

Expanding adoption of wafer bonding technology for next-generation devices

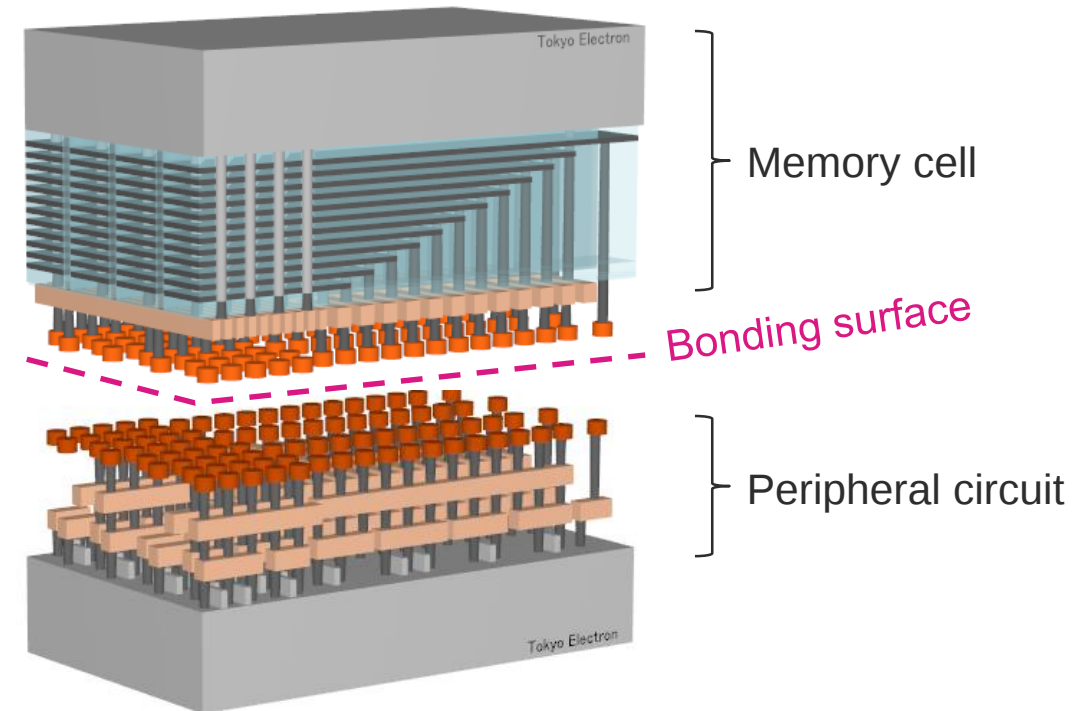
Wafer Bonding Application for 3D NAND

Current structure



- ✓ Peripheral circuit performance deteriorates due to exposure to high temperature during memory cell manufacturing
- ✓ Long interconnects wiring

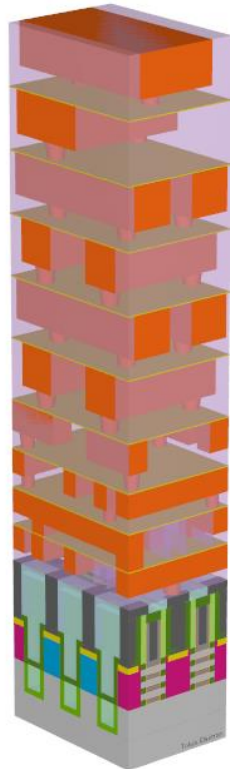
New structure



- ✓ Peripheral circuit is manufactured on the separate wafer and bond to the memory cell wafer
 - higher peripheral circuit performance
 - shorter TAT* process
- ✓ Shorter interconnects wiring

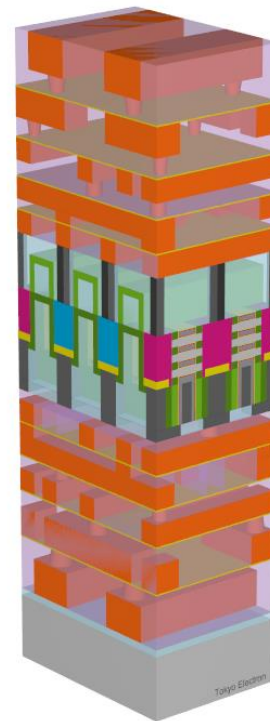
Wafer Bonding Application for Logic Backside PDN

Current structure



Signal & Power

Backside PDN : Power Delivery Network

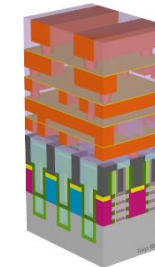


Power

Signal

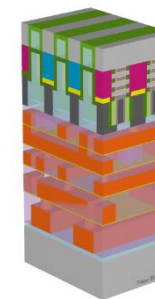
Pursue further scaling without the power wiring bottleneck

Signal BEOL (Front side)

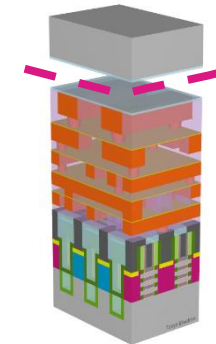


Power BEOL (Backside)

Backside thinning

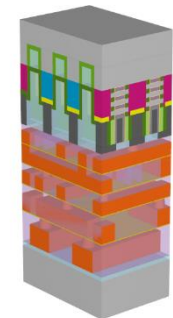


Bulk Si Wafer bonding



Bonding surface

Reverse



Our Proposal for Wafer Bonding Process

Pre-Bond

TEL Proposal for Wafer Bonding Process

Post-Bond

Coater Depo Etch Cleaning



Synapse™ Si



Ulucus™ L



Coater Depo Etch Cleaning



Wafer Process



CMP



Bonding



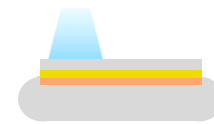
Trimming



Grinding



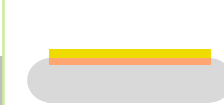
Cleaning



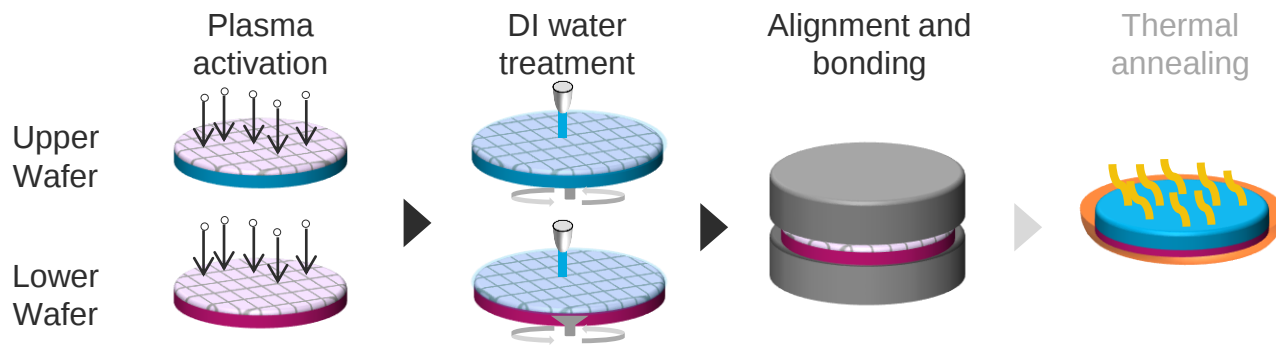
CMP



Wafer Process



Synapse™ Si

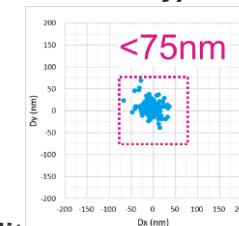
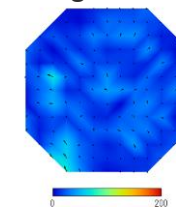


Ulucus™ L

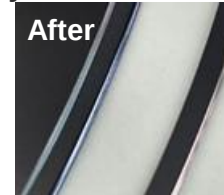
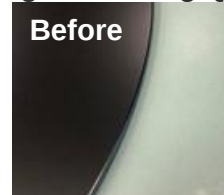
Laser Edge Trimming



Bonding Accuracy (Total Overlay)



Edge Trimming Quality



Wafer Bonding System



Synapse™ Si

- Integrate high high-productivity platform cultivated in the front-end process with plasma, cleaning and high-accuracy bonding modules
 - high productivity (uptime $\geq 90\%$)
 - alignment accuracy $3\sigma \leq 50\text{nm}$

High productivity and stable operation are realized at mass production fabs
Contribute to our customers to realize the future of "3D integration"

Laser Trimming System



Ulucus™ L (New release)

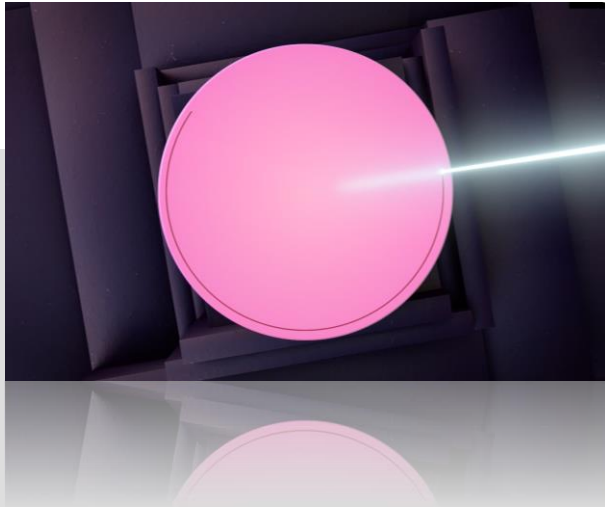
- Edge trimming on bonded wafer
- Latest platform utilizing super clean technology from the front-end process, with the integration of laser control technology

Laser technology realizes high accuracy and quality trimming processes, and environment-friendly capability through the reduction of DIW usage

Laser Trimming System

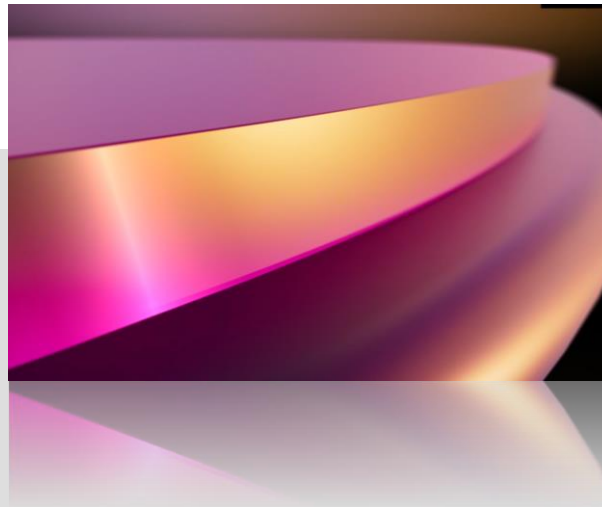
Revolutionize wafer bonding process with laser technology

Enhance yield and significantly reduce the use of DIW in the edge trimming process



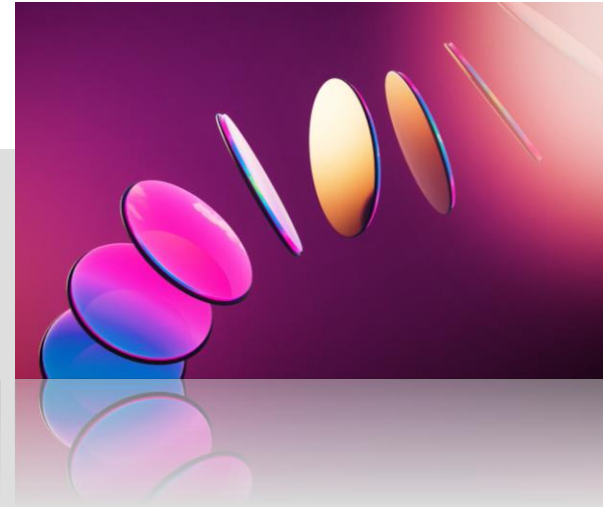
Higher Accuracy

Enabling narrower trimming width



Smooth Sidewall

Less damage, Better yield



Higher Throughput

High productivity, Reliability



Save Water

Reducing DIW to 70% or more

Summary - For the Development of Wafer Bonding Process

- Introduction of wafer bonding technology accelerates performance evolution at the leading-edge and system level
- Utilizing technology and experience gained in front-end process, we launch Ulucus™ L for wafer edge trimming, in addition to Synapse™ Si for wafer bonding
- By utilizing our comprehensive strengths, we promote research and development for the adoption of wafer bonding process for mass production



TEL Technology Center, America



Tokyo Electron Kyusyu Limited

Account Strategy

June 8, 2022

Seisu Ikeda
Senior Vice President and General Manager
Account Sales Division



Agenda

- Technological exchanges and joint roadmap development with customers
- Demand forecast for the next 24+ months
- Regarding the Customer Satisfaction Survey (CS Survey)

Framework for co-creation of technology roadmap from N to N+4

Customer

- Technology trends of semiconductor devices, outlook for device structure and design
- Required performance for each generation
- Sample wafers for high accuracy evaluation
- Expected timeline

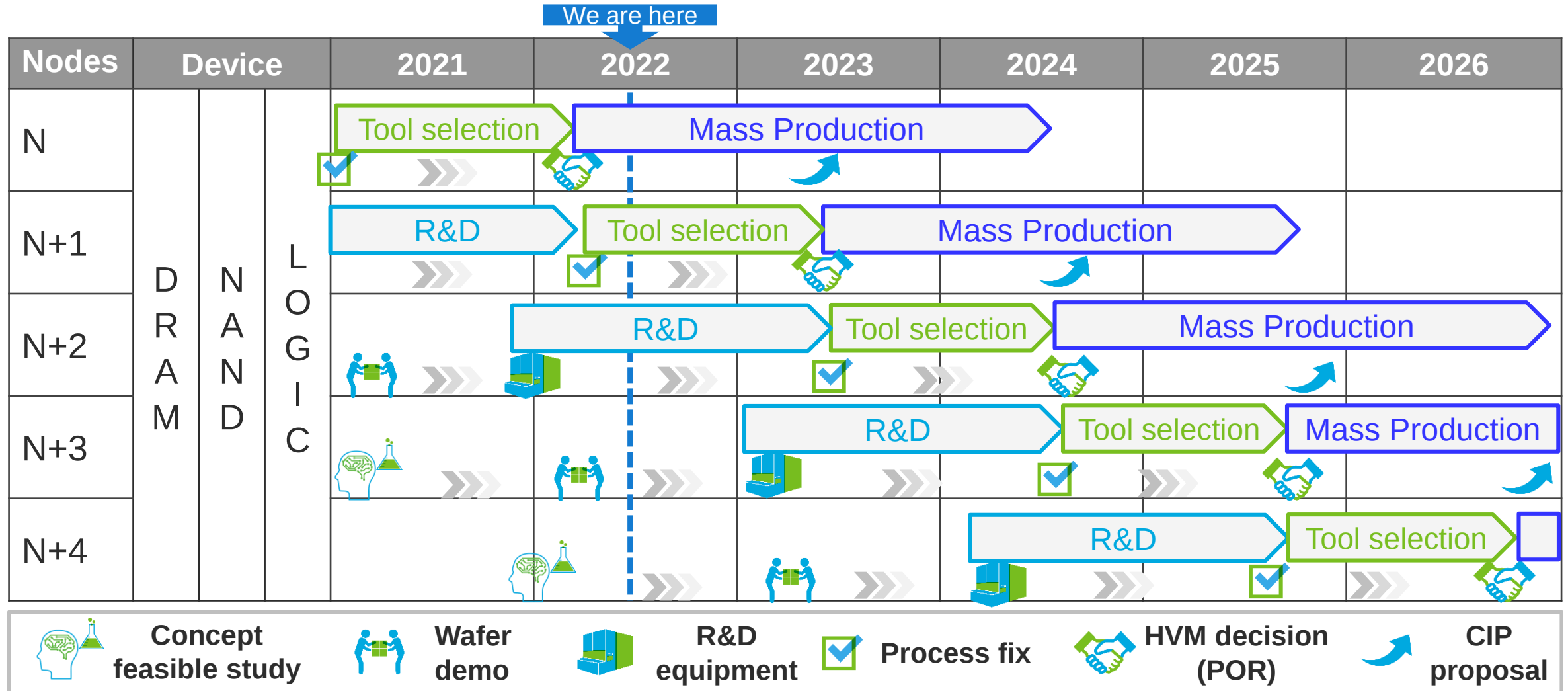


TEL

- Proposal on new function and materials through concept consideration and feasibility study with customers
- Equipment, process proposal, design and manufacturing to achieve required performance
- Build evaluation environment
- Output to meet customers' requirements

As the best partner for our customers,
continuously create high value-added next-generation products

Collaboration with Customers: Meet Tech Requirements for Several Generations

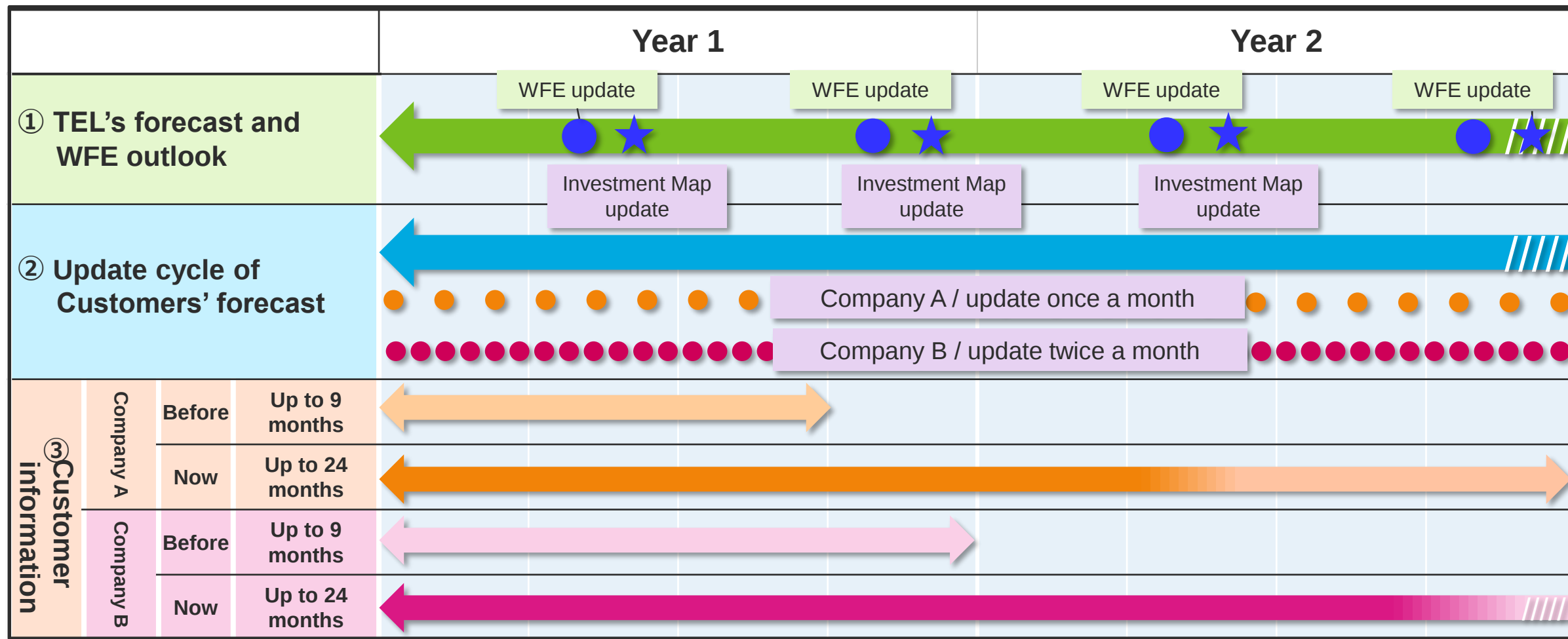


Simultaneous collaboration for the generations from N to N+4 with customers

Demand Forecast for the Next 24+ Months

- Objectives: Proactive procurement strategies and smooth delivery to customers
- Expected outcomes:
 - **By ensuring sufficient materials and realizing production leveling, meet customers' required delivery time**
 - Enhance safety, quality and productivity by eliminating additional load on our production and start-up engineers in case of delivery delays
- Difference from conventional approach
 - 【Conventional】 Compile multi-year investment roadmaps for major customers, and combine with our macro-market analysis. We independently forecast medium-term WFE, which is then reflected in the production plan at our plants
 - 【Current】 Since early 2021, in response to changes in the environment due to recent component shortages, our customers agreed to provide their plans for equipment procures on a more frequent and regular basis. By combining our WFE market forecast with the customers' plans, we can provide our supply chain and suppliers with latest and accurate forecast

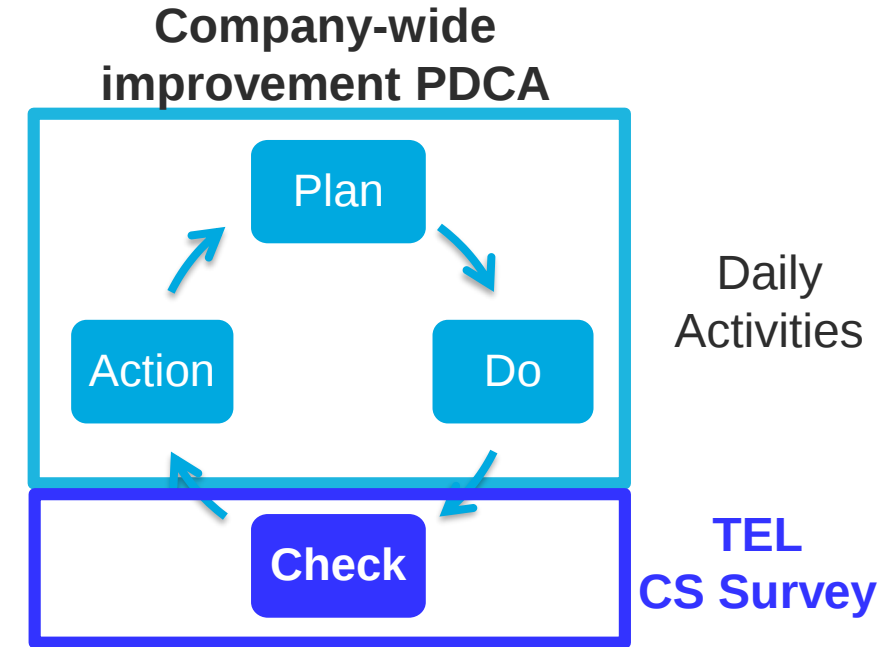
Demand Forecast for the Next 24+ Months – Operation Outline



By forecasting demand for the next 24+ months, we can secure sufficient components by planned procurement, and production leveling

Purpose, Positioning, and History of Customer Satisfaction Survey (CSSP: Customer Satisfaction Survey Program)

- Purpose: Observation of customer satisfaction
 - Conduct objective analyses to understand product and account strengths, weaknesses, problems and issues
- Position
 - Important reference for measuring direction of improvement activities
 - The "C" part of the company-wide improvement PDCA
 - Note: CS surveys are also required under ISO regulations



■ Activity history



*Customers who conduct their own supplier assessments are not included in this survey

CSSP (Customer Satisfaction Survey Program) Operation

- Target customers: 250 sites (number of locations/fabs as units)
- Questions/inquiries :
 - Sales: Ease of contact, how well sales comprehends requests and issues, and its ability to propose and execute resolutions, etc.
 - Equipment/plants: Equipment lead times, performance and functions; development and technical capabilities and speed, etc.
 - Service: Awareness of safety regulations, compliance with safety procedures, on-site support capabilities, etc
- Answer options: "Very satisfied: 4 points," "Satisfied: 3 points," "Dissatisfied: 2 points," and "Extremely dissatisfied: 1". Choose one out of the four
- Passing line: Achieve at least "Satisfied" as an average value for all items after calculating per-question scores for all customers who answered the question
- Actions with respect to items that require improvement: Immediate follow-up with customers who provided "Extremely dissatisfied (Red Flag)" responses. Improvement, etc. of items falling below the passing line described above

CS Survey KPI Results for All TEL Products (2021 vs 2022)

1. Customer response rate (Goal: At least 60%)

2021	2022	YoY
1,412 person (70.2%)	1,459 person (76.1%)	+47 person (+5.9%)

2. Customer Satisfaction Survey results (Goal: Achieve at least 3 points out of 4 points)

2021	2022	YoY
96.7% (29/30)	100% (30/30)	+3.3% (+1 questions)

3. Response rate to "Extremely dissatisfied (Red Flag)" (Goal: Resolve within a month)

	2021	2022	YoY
Ratio of resolution within a month	93.4%	94.8%	+1.4%
Response ratio as of Feb. 22 (day 42)	97.3%	100%	+2.7%

Exceeded the passing average of 3 on all questions
(for the first time since the start of this survey in 2014)

Response ratio to Red Flag has improved

To further improve customer engagement

Intel Outstanding Supplier Award



Evaluation points

- Safety
- Quality
- Capacity
- Affordability
- Technology
- Sustainability



Customer A
Best in Value Award



Customer B
Best Partner Award

TSMC Excellent Performance Award

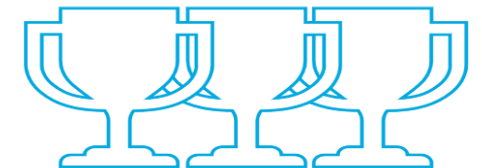


Evaluation points

Providing leading-edge technological solutions across multiple processes by leveraging our strength in having an extensive product lineup



Customer C
Best Partner Award



Other top prizes

Continue to enhance customer engagement and improve TEL's corporate value

Field Solutions Business Strategy

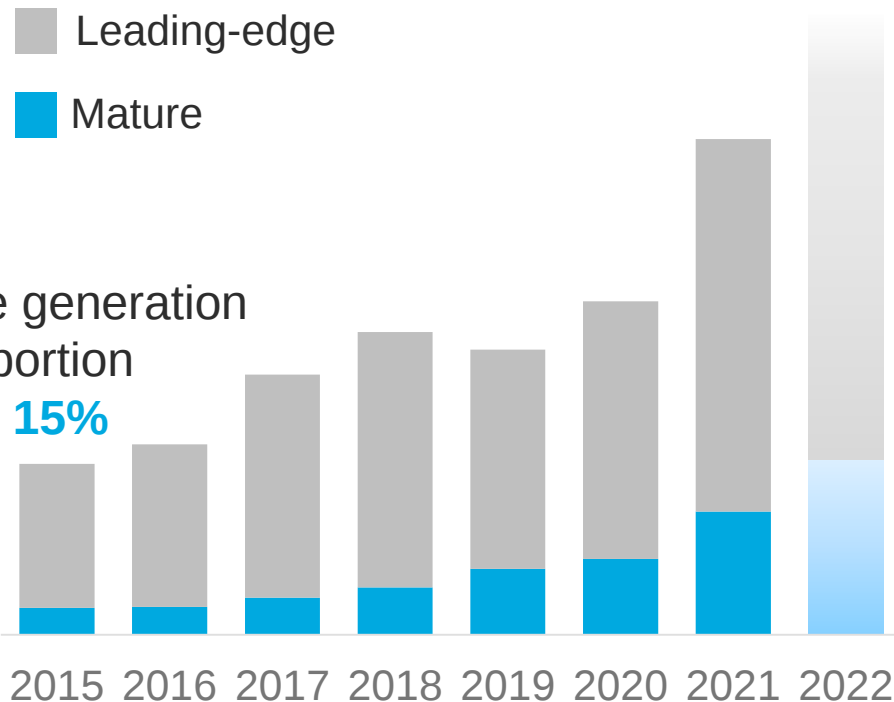
June 8, 2022

Takeshi Okubo
Senior Vice President and General Manager
Global Sales Division

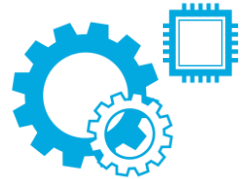


Rapidly Growing Investment in Mature Generation

WFE investment **~30%**



- Equipment
 - Reengineered equipment for 200mm wafer
 - New equipment for power devices
- Parts, repair and services
 - Parts replacement
 - Overhaul, cleaning, renewal
 - Repair, maintenance, relocation
- Modification
 - Performance enhancement
 - Process change, productivity enhancement
 - Modifications to software, hardware



With the expansion of investment in mature generations,
a wide range of business opportunities are growing

Equipment for Mature Generations

- Reengineered equipment for 200mm wafer
 - Thermal deposition systems, coater/developer, etch systems, etc.
 - Sales expansions not only for replacement demand of existing customers, but also for emerging customers
- Equipment for power devices
 - Equipment for SiC wafer, 300mm etch system
 - Respond to rapid growth in demand for power devices, such as for automotive



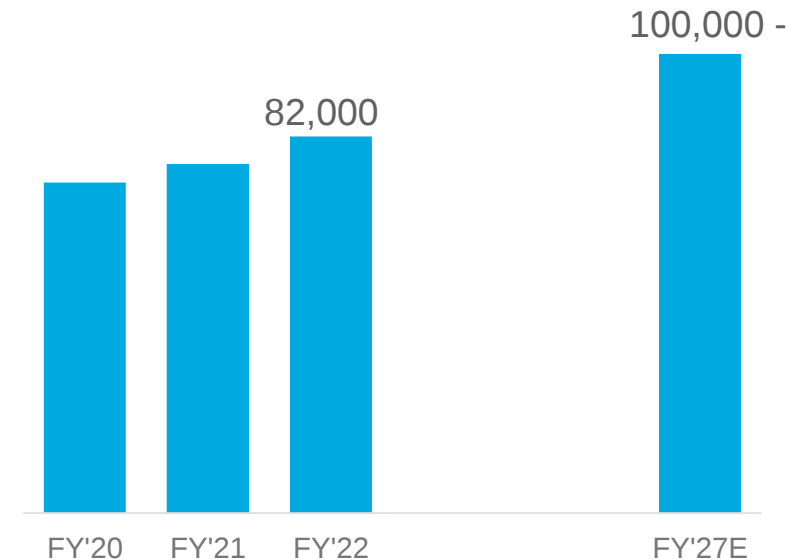
SiC epitaxial film deposition system

By integrating our technological assets with new technologies,
improve productivity and reduce impact on the environment

Field Solutions

- Parts and repair
 - Predictive maintenance for parts deterioration
 - Appropriate parts inventory management and prompt delivery
- Services
 - Providing “comprehensive contract type” services that encompass everything from equipment delivery to after-care maintenance
 - Proposing solutions that address customer demands and maximizing equipment utilization rates
- Modification
 - Productivity improvement
 - Yield improvement

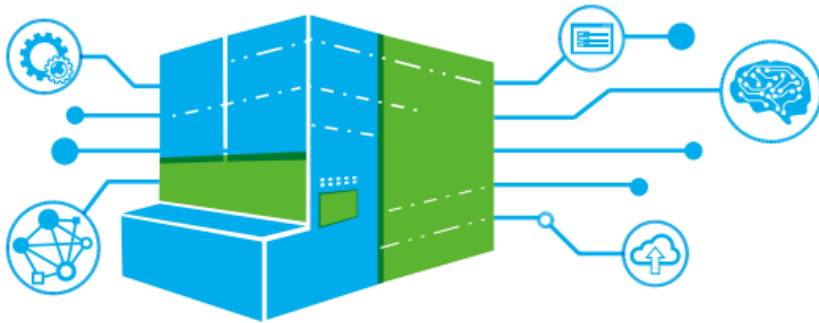
Number of installed base (Unit)



SAM* is expanding with 82,000 installed base currently and increasing by approx. 4,000 to 6,000 units each year

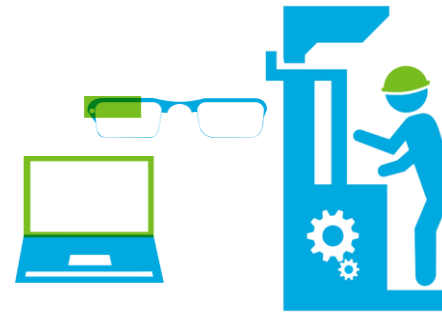
Advanced Field Solutions

TELeMetrics™



- Monitoring data on individual equipment
- Knowledge management and accumulation of problem case studies

Remote Support



- Minimization of downtime through predictive maintenance of equipment
- Remote support that enables prompt response even under travel restrictions

Strengthen Global System



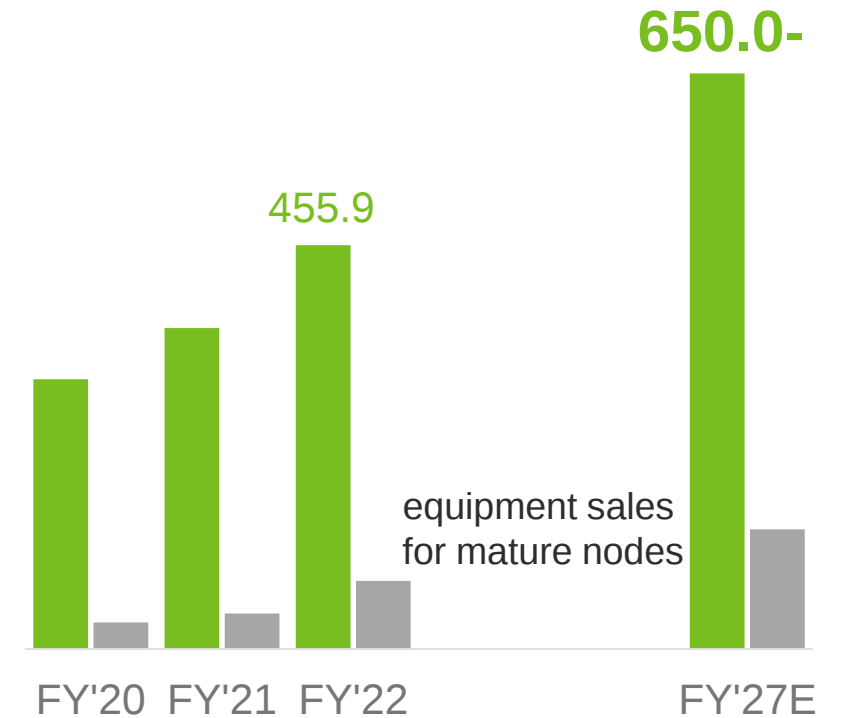
- Provision of support that takes advantage of time differences
- Parts management and delivery through advanced logistics
- Engineer training program

Proposing solutions with high added value
centered around “TELeMetrics™” that utilize DX

Summary

- Expand sales for equipment for mature (legacy) nodes
- Deploying solution business based on installed base
- Development and promotion of advanced Field Solutions
 - Providing leading-edge and sustainable support that utilizes the latest technology, such as DX
 - Development of remote maintenance support and training tools
- Enhancing the front-lines engineers and capabilities
 - Continuous skill improvement for field engineers

Field Solutions sales (¥B)



Support customers to maximize their business operations
through services with high added value

Introducing TEL's DX Activities and Our Ideal State

June 8, 2022

Noritaka Yokomori
Deputy General Manager, DX
Corporate Innovation Division



TEL DX Vision

- The tide of DX ripples throughout the industrial world as a whole, and the semiconductor industry is no exception. It is positioned as a part of the solution toward further demands for die miniaturization and layering



AI Chip



Autonomous



Cloud Service



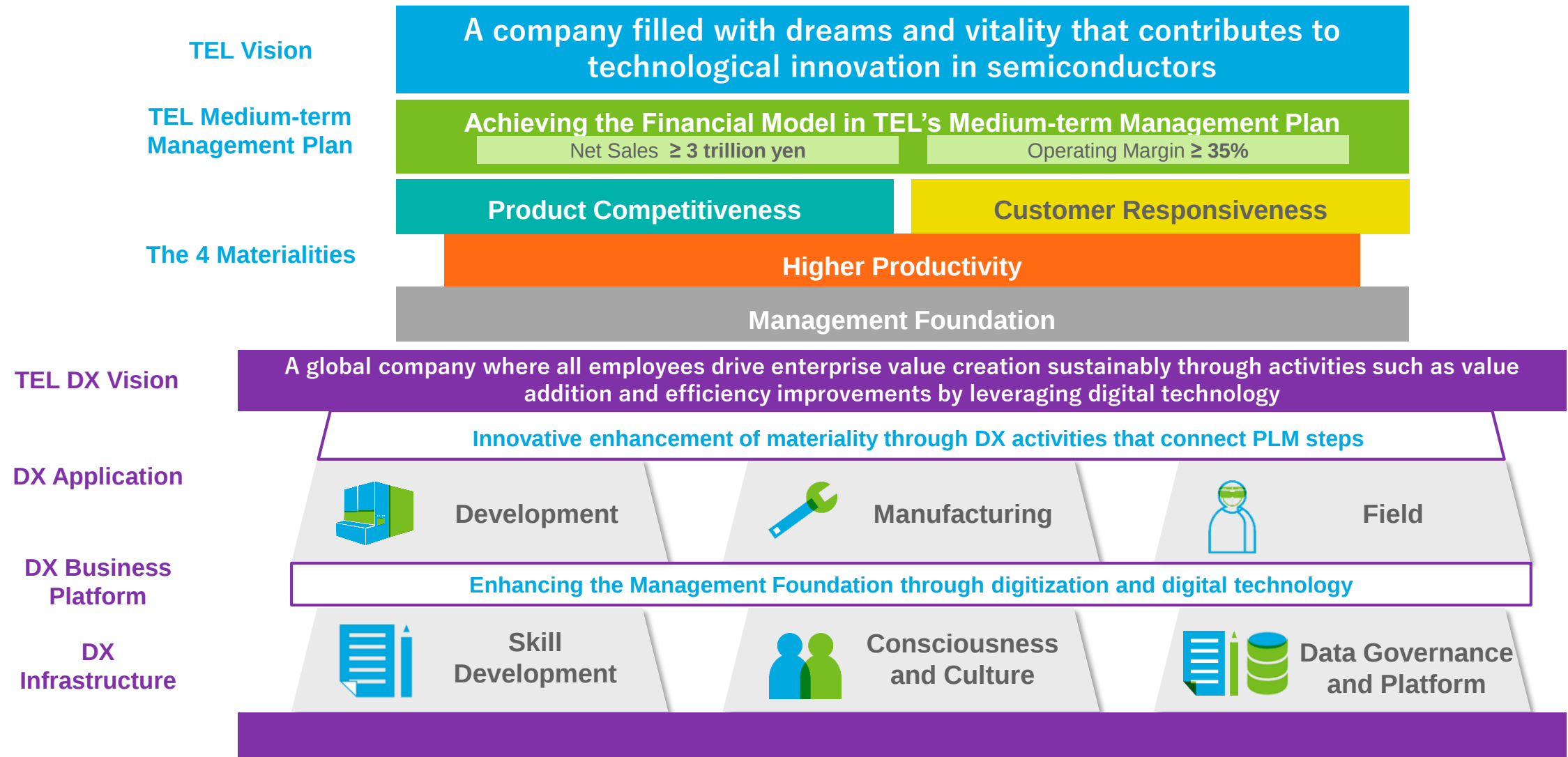
AR/VR

TEL DX Vision

A global company where all employees drive enterprise value creation sustainably through activities such as value addition and efficiency improvements by leveraging digital technology

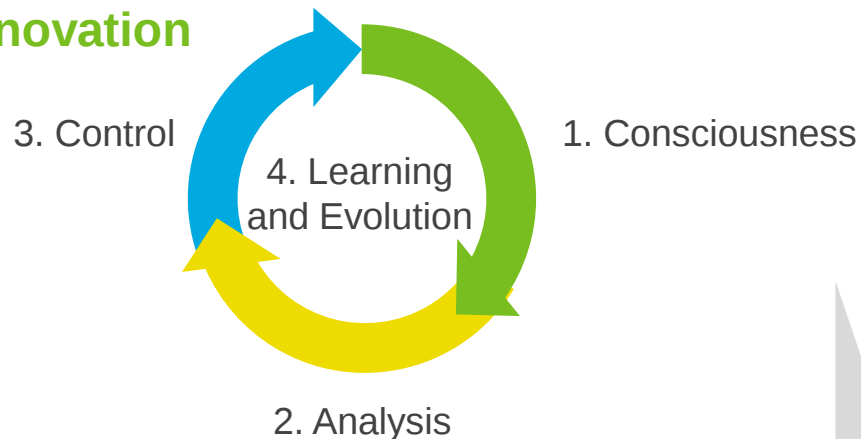
DX activities are ultimately a method and an opportunity to realize sustainable creation of corporate value. We have defined the image we must achieve (our “To-Be Image”) in order to realize transformation.

TEL DX Grand Design

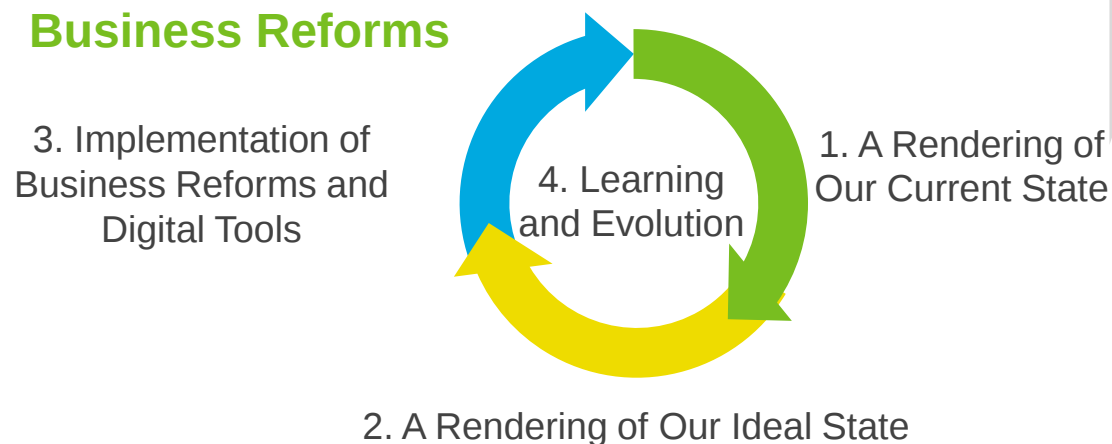


Steps of DX Activities

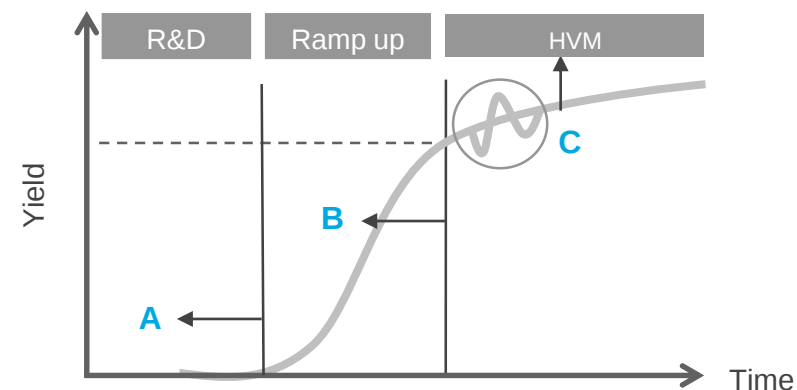
Product Innovation



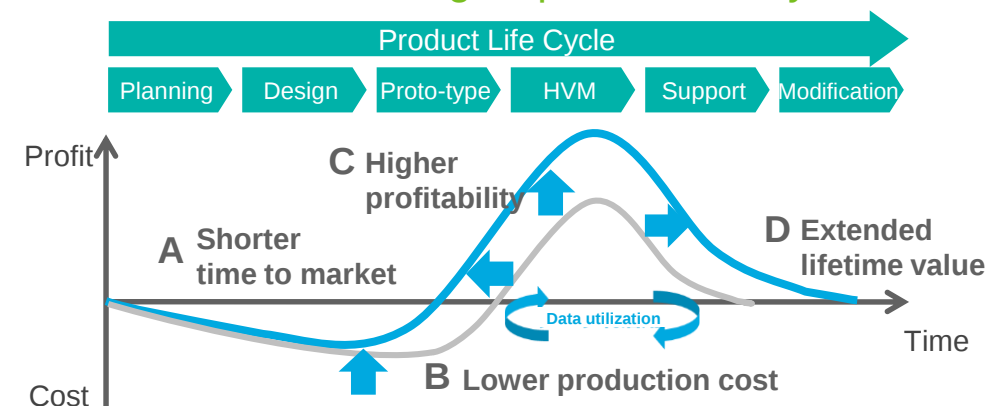
Business Reforms



DX in Contributing to Customers' Value Creation



DX in Raising Capital Efficiency



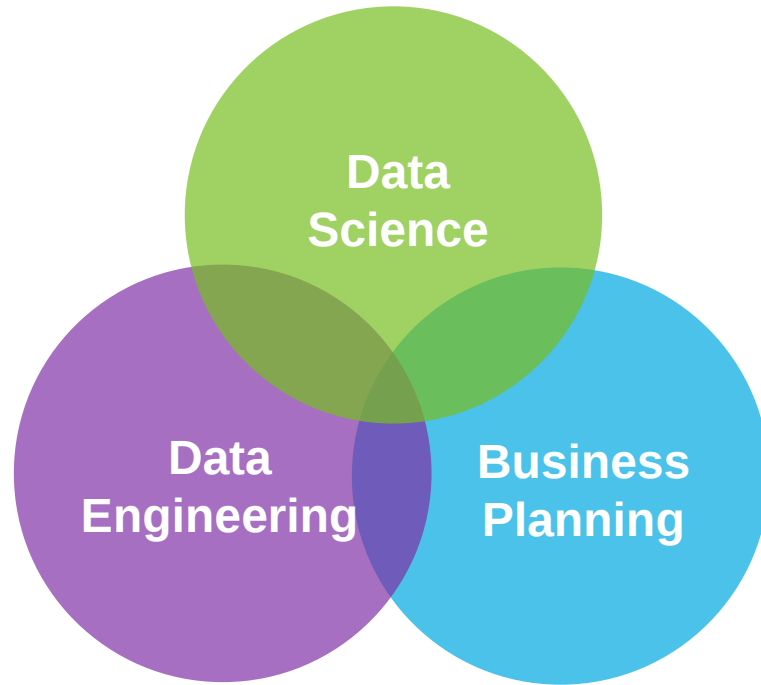
Solving issues of a higher dimension through digital transformation

Relationships between Projects in DX-related Developments



Through a DX foundation and DX that improves capital efficiency,
we will improve the quality and speed of our work,
and transition toward a use of time that creates even greater value

DX Engineer Training Plan



The ability to understand and utilize knowledge of information science, such as cutting-edge information processing, artificial intelligence and statistics

The ability to realize a form of data science that meaningfully contributes to TEL's creation of corporate value, and to practice and operate data science in a manner that fits our purposes

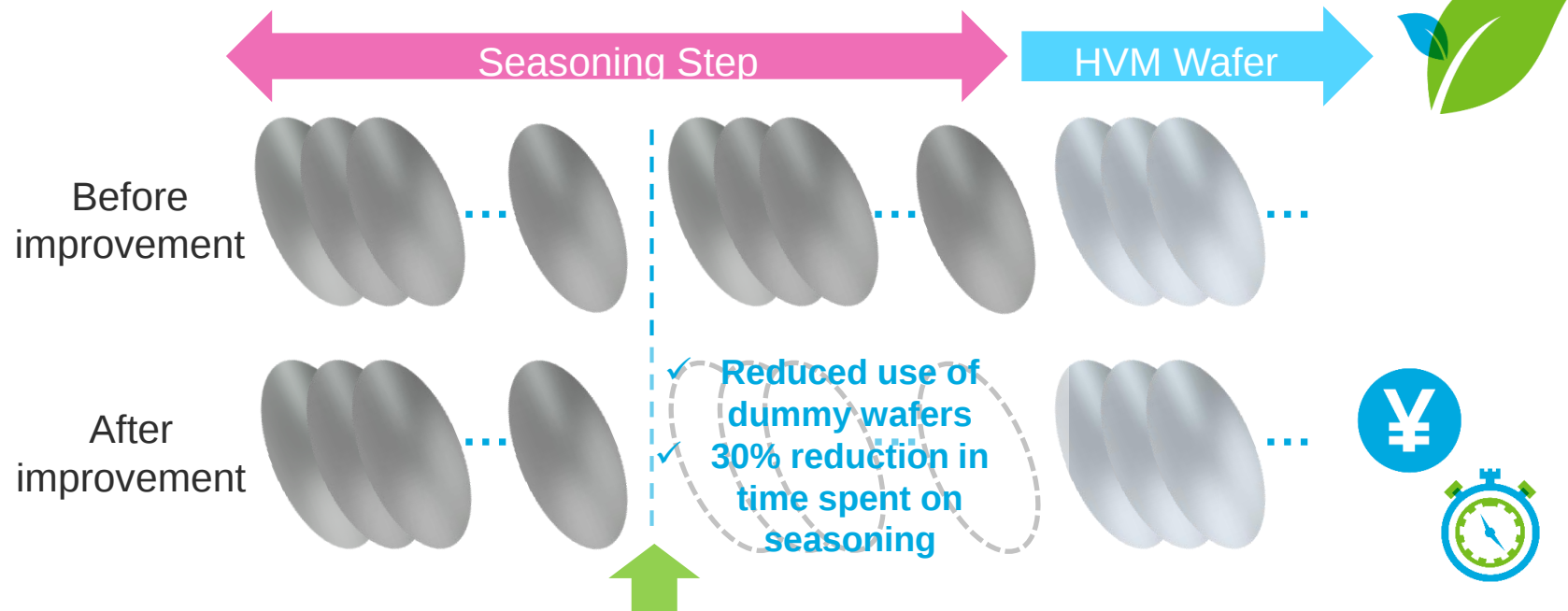
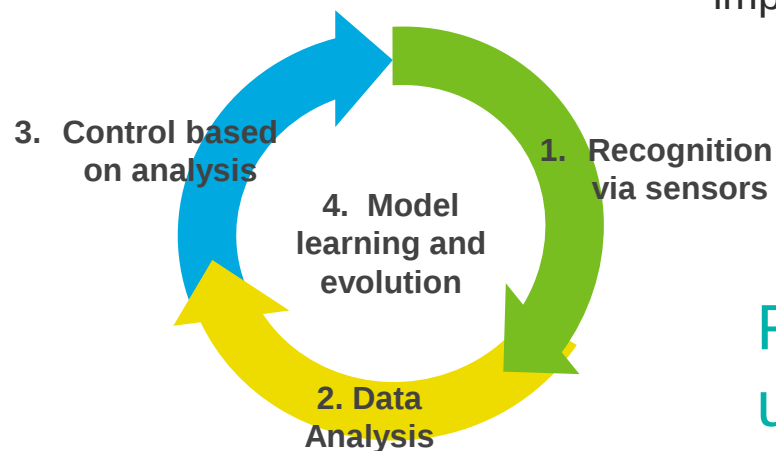
The ability to organize issues and their backgrounds, derive solutions, and connect them to our business

Utilizing data and digital technology in our day-to-day business operations in order to optimize our business operations and create added value

Engaging in planned training to foster personnel who can capitalize data science in TEL's business

Example Activity 1 – Increasing Productivity of Equipment:

Improving Utilization of Etch Equipment



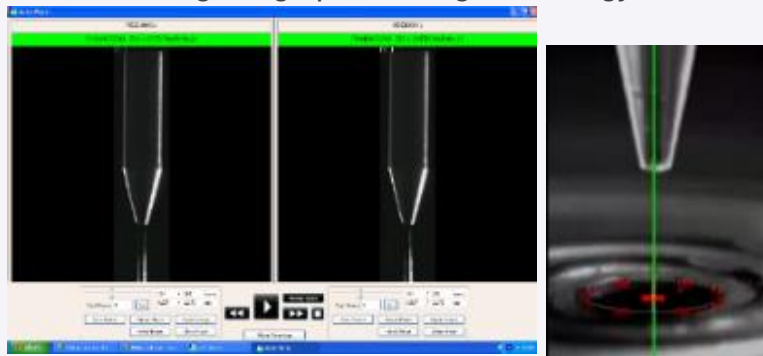
Seasoning at the right time with endpoint detection

*ISSM 2020, from “Seasoning Optimization by using Optical Emission Spectroscopy,” published by the Company

Feedback from the sensor provided an appropriate understanding of chamber conditions and improved utilization of equipment

Example Activity 2 – Increasing Operation Cost of Equipment: Reducing Chemicals of Coater/Developer

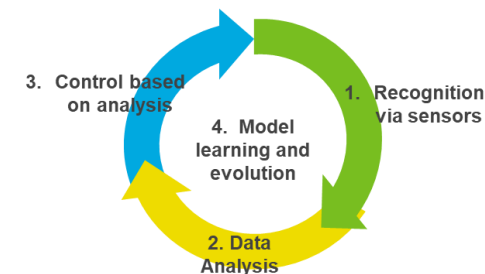
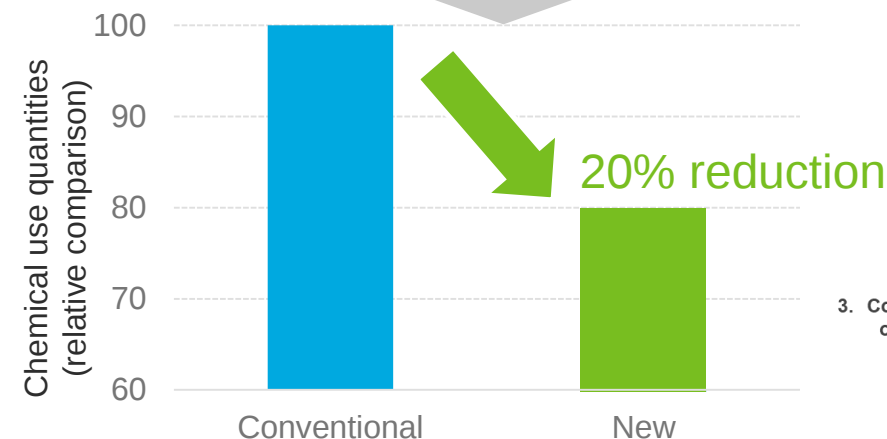
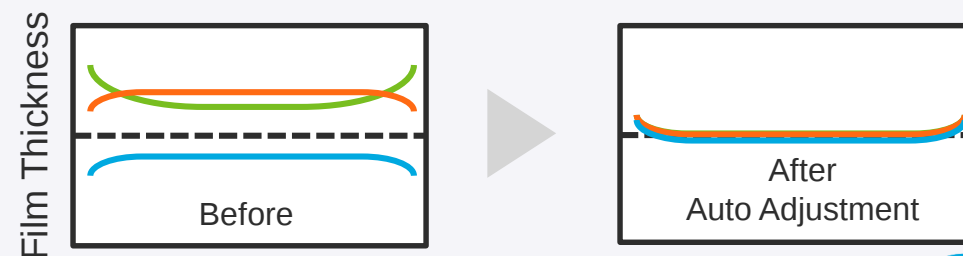
Monitoring of chemical discharge status
using image processing technology



Monitoring of chemical coverage of interior of surfaces
using image processing technology

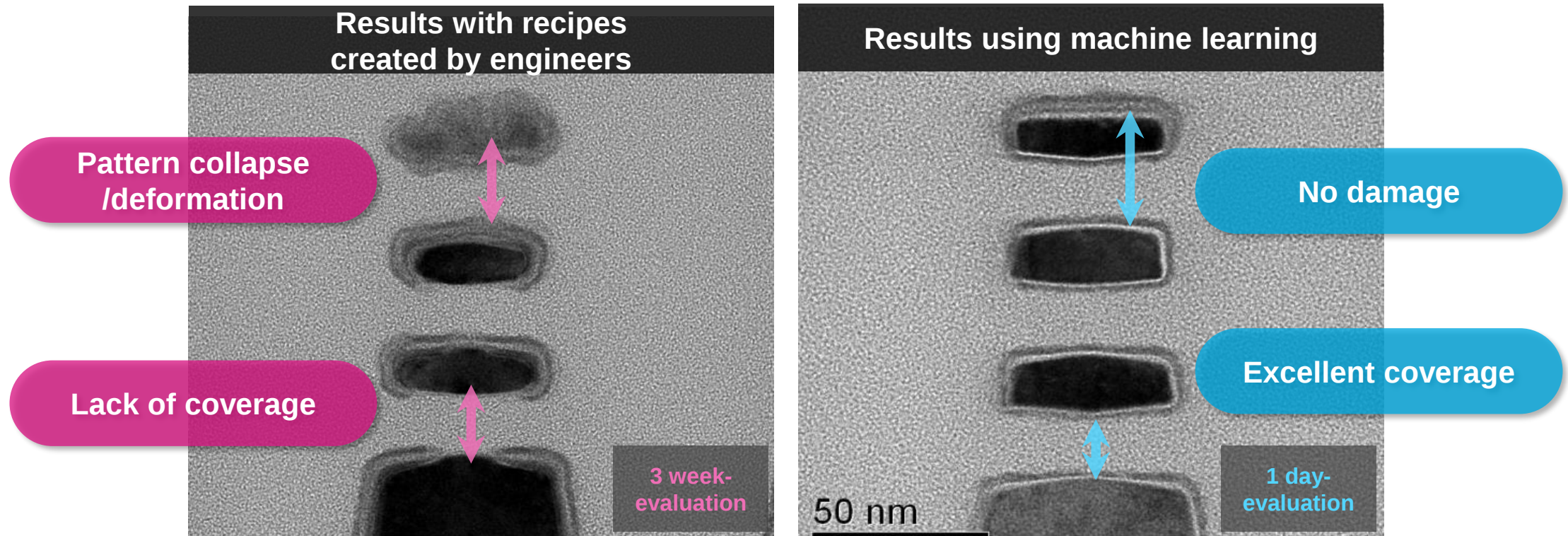
Dispense Volume	X ml	Y ml	Z ml	A ml
Judgement	Passed	Passed	Failed	Failed
Wafer image by WIS				

Automatic film thickness adjustment function



Contributed to customer operation costs
and the environment by using machine learning

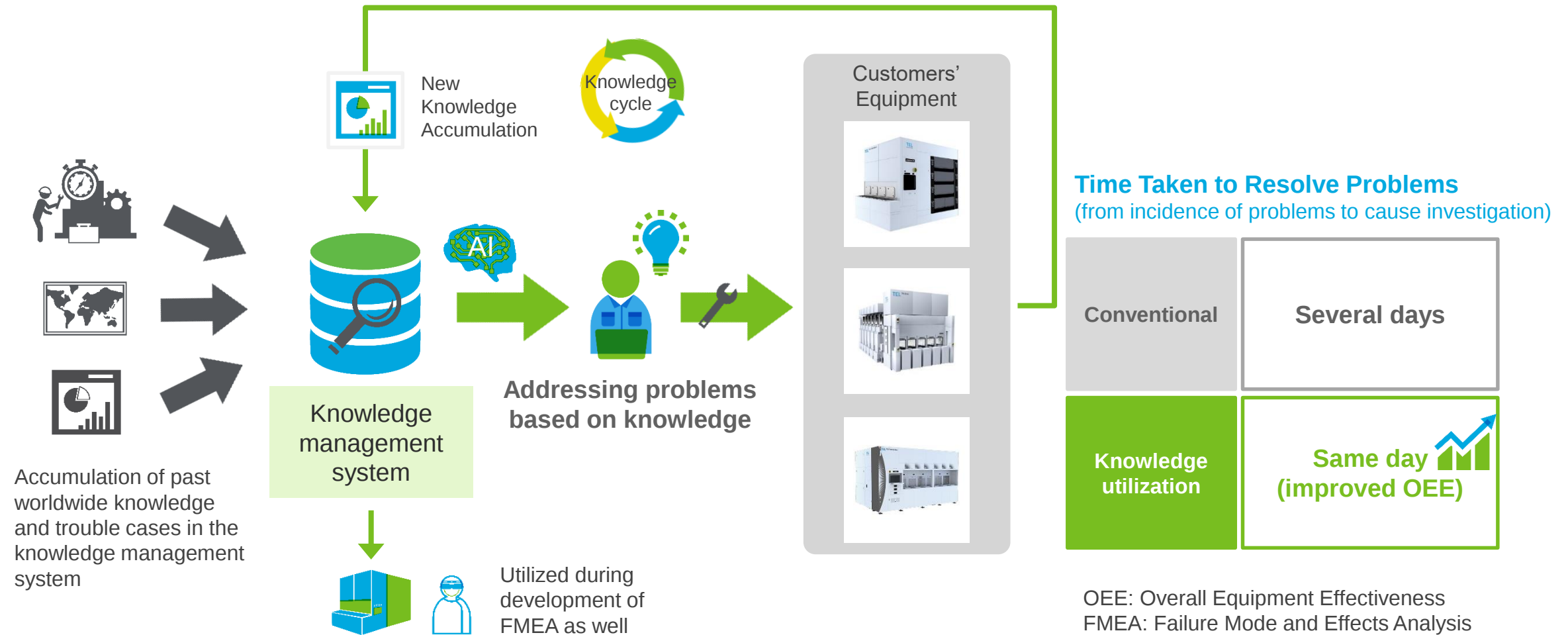
Example Activity 3 – Increasing Productivity of R&D: Process Informatics



Source: Tokyo Electron Technology Solutions Limited / Tokyo Electron Limited

Achieved good step coverage with no pattern deformation
in the ALD process by machine learning

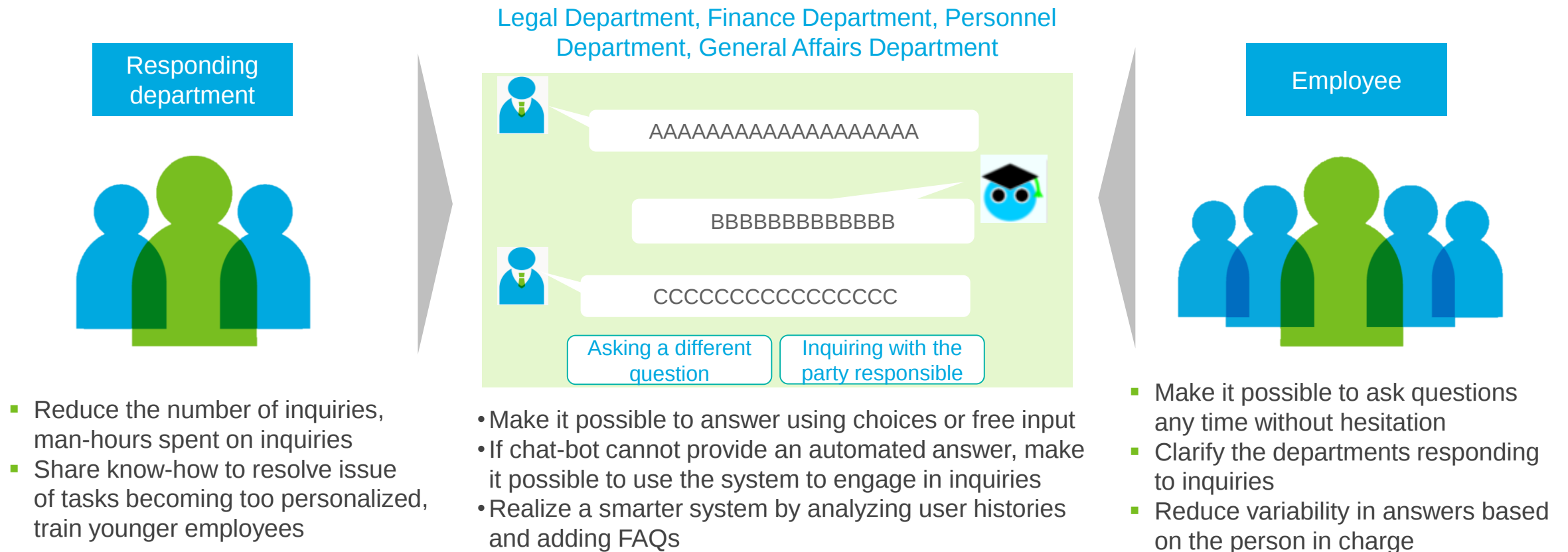
Example Activity 4 – Improving Overall Equipment Effectiveness



Using the Knowledge Management System to reduce the time taken to resolve problems and improve equipment operation rates

Example Activity 5 – Increasing Productivity of Operations:

Optimizing Business Operations by Implementing Chat-bots in Back-Office Work



Reduced the number of man-hours spent by employees answering questions with introducing chat-bots in multiple departments

New Board of Directors Structure and the Corporate Officer System

June 8, 2022

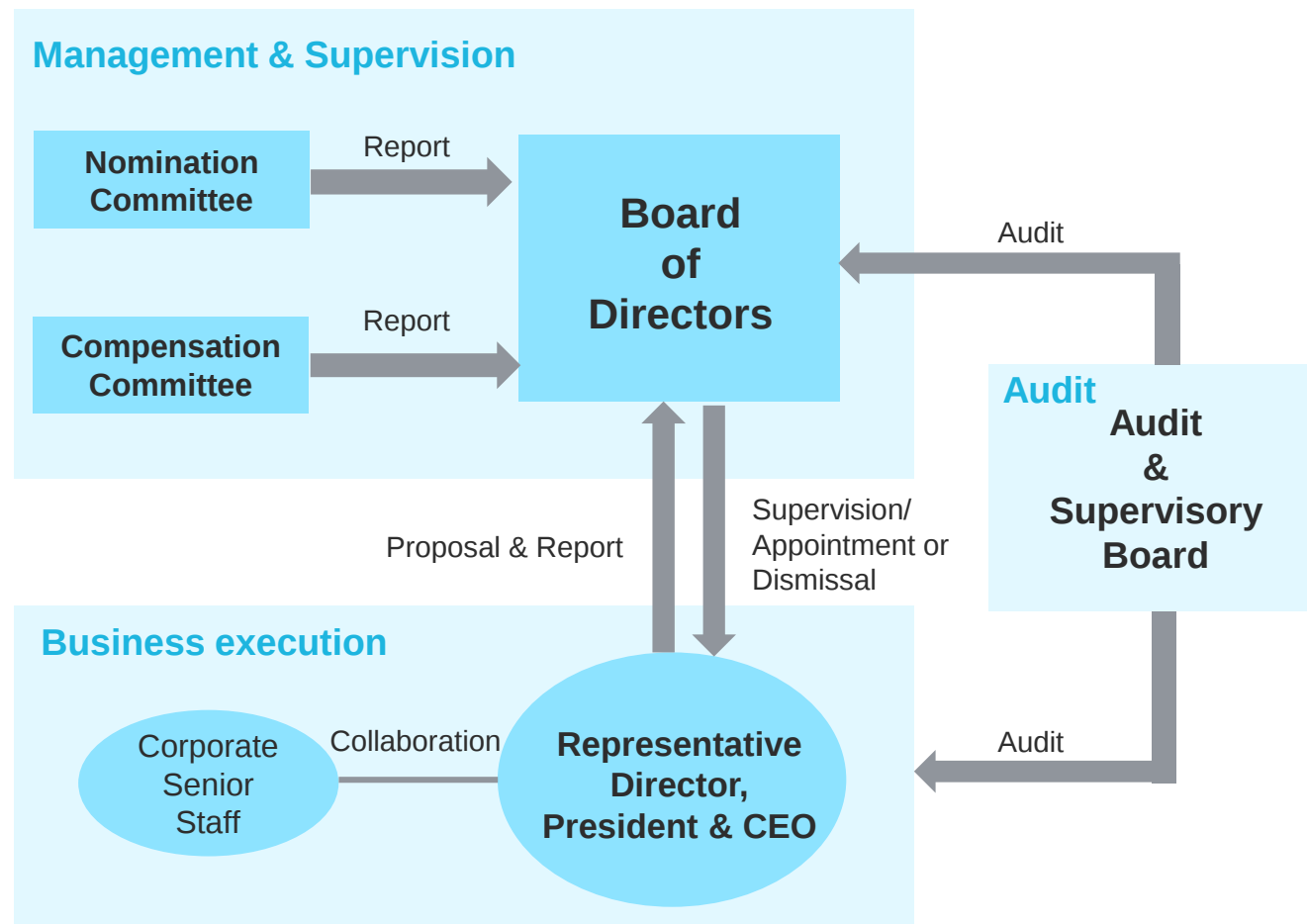
Tetsuo Tsuneishi
Corporate Director, Chairman of the Board



Corporate Governance Framework (Audit & Supervisory Board System)

As of June 8, 2022

<Framework (Excerpt)>



Outside Directors as of June 8, 2022



Corporate Director
(Outside Director)

Charles Ditmars Lake II
Chairman and Representative Director,
Aflac Life Insurance Japan Ltd.
President, Aflac International
Incorporated



Corporate Director
(Outside Director)

Michio Sasaki
Director and Vice President,
SHIFT Inc.



Corporate Director
(Outside Director)

Makiko Eda
Chief Representative Officer,
World Economic Forum
Japan



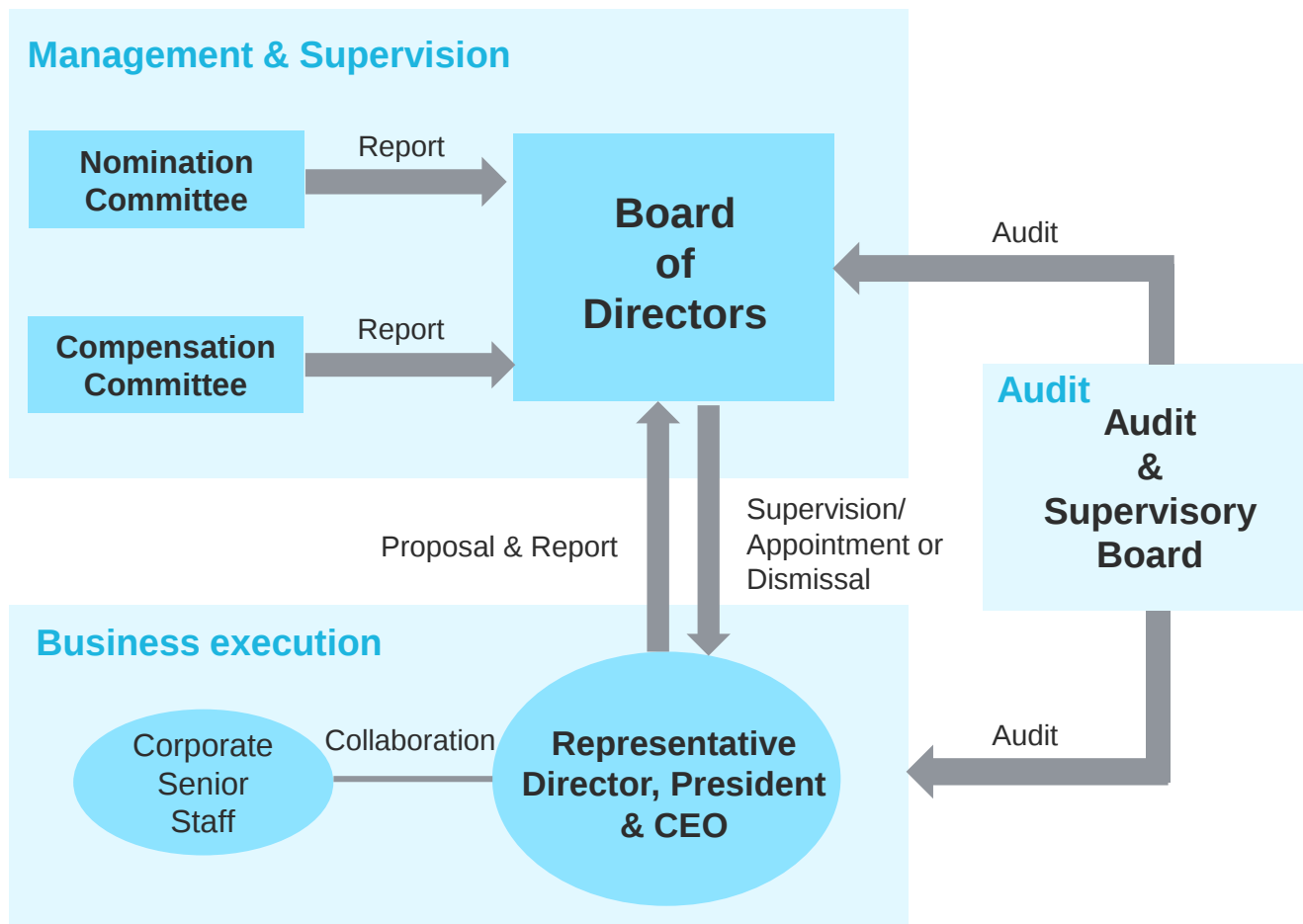
Corporate Director
(Outside Director)

Sachiko Ichikawa
Partner, Tanabe & Partners
Statutory Auditor,
The Board Director Training
Institute of Japan

Corporate Governance Framework (Audit & Supervisory Board System)

As of June 8, 2022

<Framework (Excerpt)>



The era of ultra VUCA

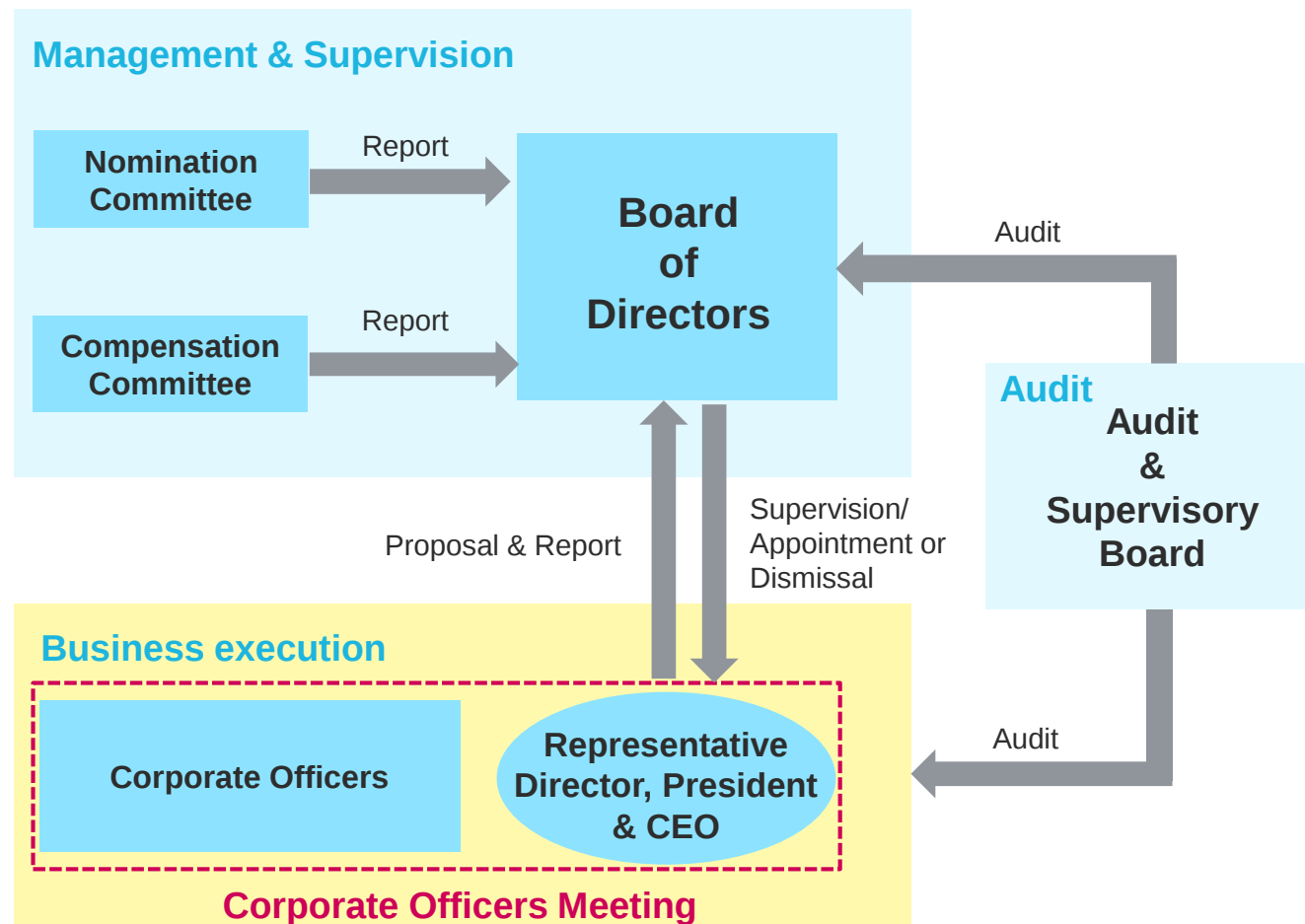
Sharp growth of the semiconductor market

Need to improve the **quality** and **speed** of decision making in both "Management & Supervision" and "Business execution"

Corporate Governance Framework (Audit & Supervisory Board System)

On and after June 21, 2022 (TBD)

<Framework (Excerpt)>



The era of ultra VUCA

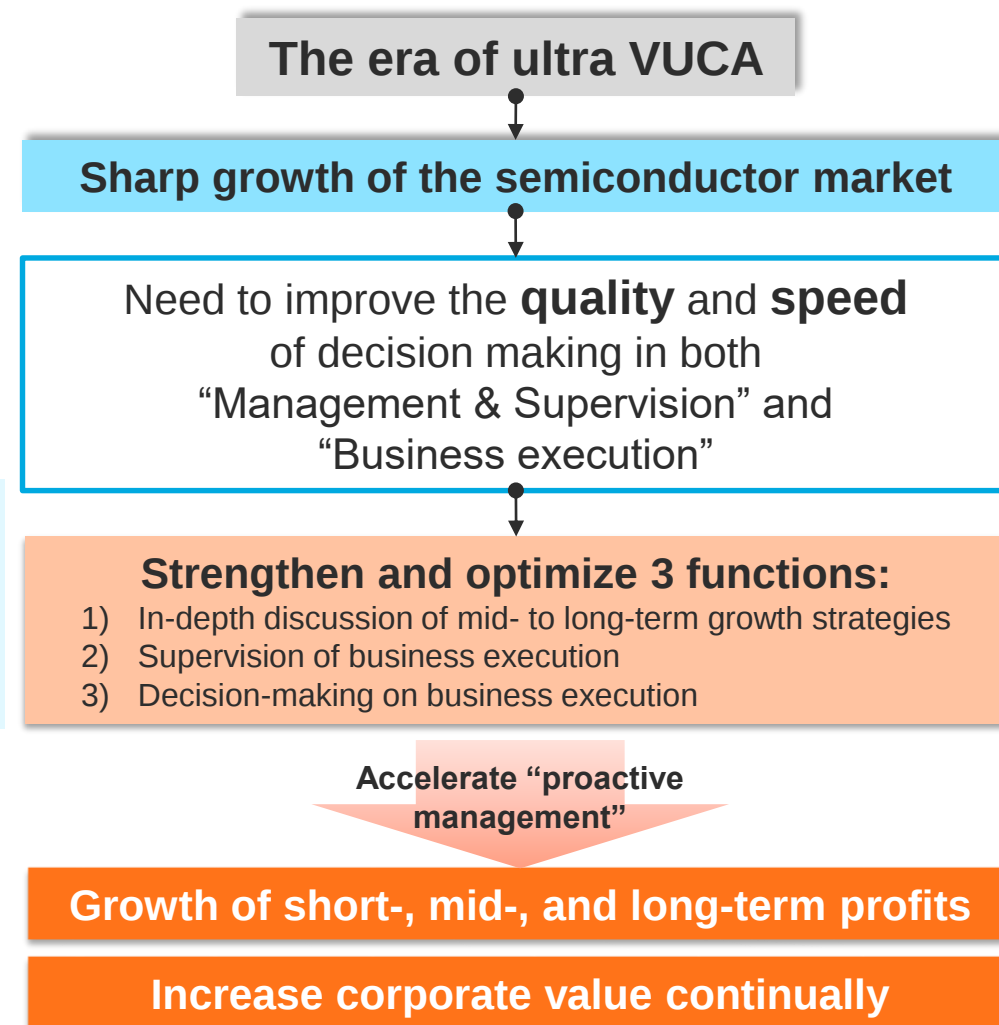
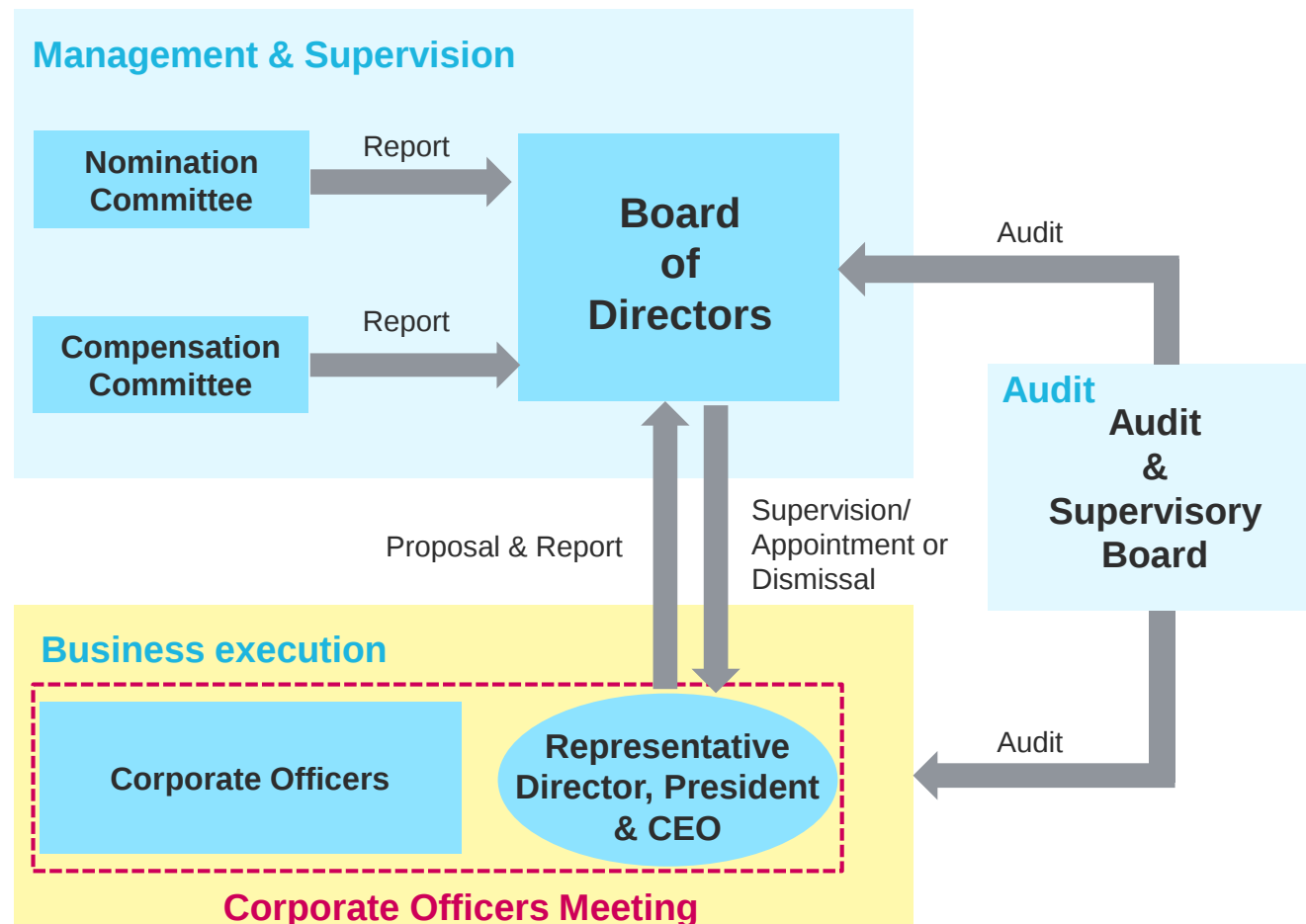
Sharp growth of the semiconductor market

Need to improve the **quality** and **speed** of decision making in both "Management & Supervision" and "Business execution"

Corporate Governance Framework (Audit & Supervisory Board System)

On and after June 21, 2022 (TBD)

<Framework (Excerpt)>





TOKYO ELECTRON