

TORAY IR Seminar

Toray Group's Initiatives for Digital Innovation (DI) Business

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Toray Industries, Inc.

- I. Outline of DI Business**
- II. Basic Strategy of DI Business**
- III. Main Products and Future Prospects**

I

Outline of DI Business

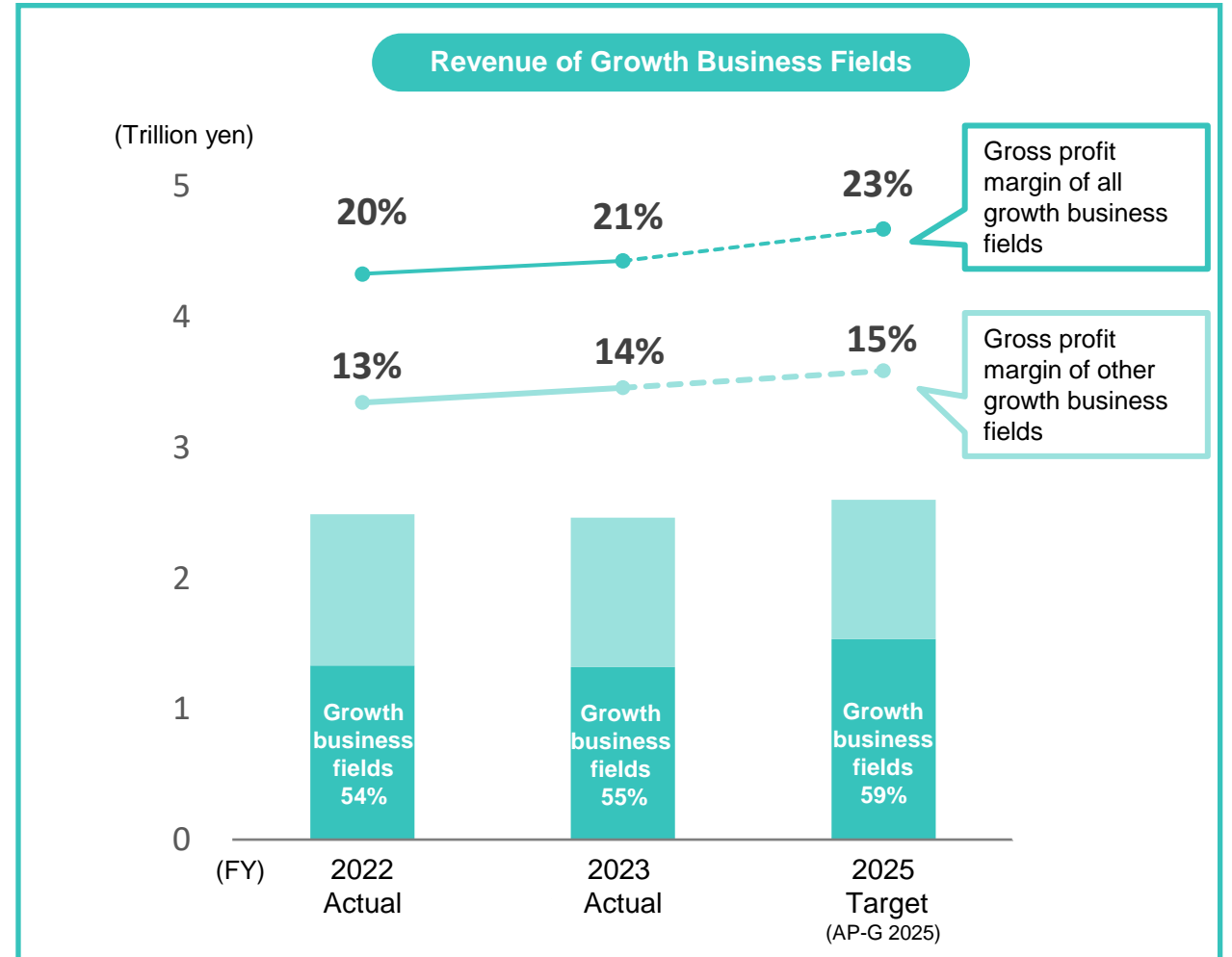
Toray Group's Growth Business Fields

Expanding revenues from businesses related to Sustainability Innovation Business^(*1) and Digital Innovation Business to about 60% of total

Prioritized business fields aimed at mid-term management program "Project AP-G 2025"

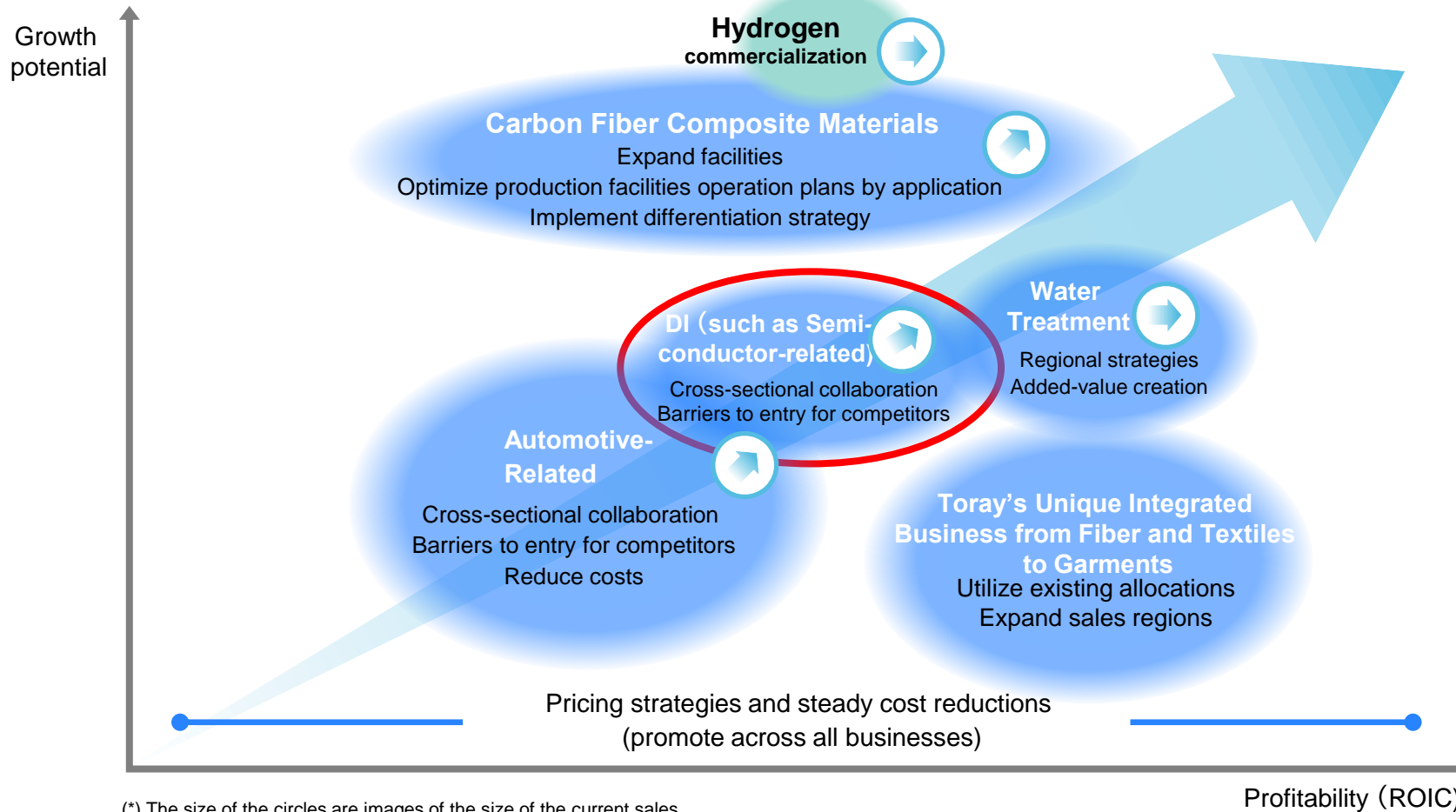
SI Business Sustainability Innovation Business (*1)	1 Products that accelerate measures to counter climate change
	2 Products that facilitate sustainable, recycling-based use of resources and production
	3 Products that help provide clean water and air and reduce environmental impact
	4 Products that help deliver better medical care and hygiene for people worldwide
DI Business Digital Innovation Business	Materials, equipment, technologies, and services that help improve convenience and productivity by supporting the widespread adoption of digital technology

*1: Group of businesses or products that can help realize the Toray Group Sustainability Vision



Positioning of DI (Digital Innovation) Business

Toray's High-Growth, High-Profitability Businesses (image*)

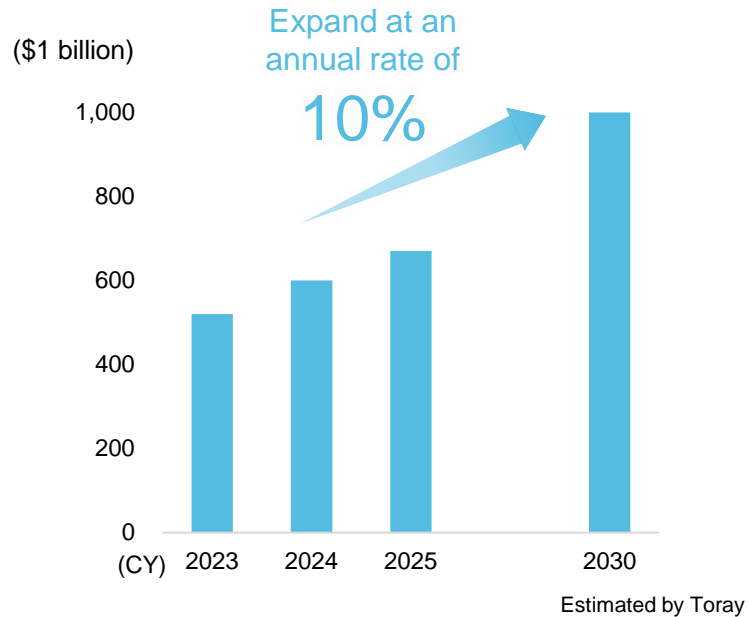


- Optimal strategies for businesses with high competitiveness (quality, share, technology, supply chain, etc.) in market
- Promote Toray-style ROIC improvements that increase profits and expand business while maintaining financial soundness
- Improve profitability by differentiation for businesses that are high growth, but require large initial investments (carbon fiber, etc.)
- Expand high-profitability businesses (ex. Toray's unique integrated business from fiber and textiles to garments) through asset-light strategy
- **Expand semiconductor and display-related businesses through cross-sectional cooperation within Toray Group and establishment of entry barriers**

(*) The size of the circles are images of the size of the current sales.

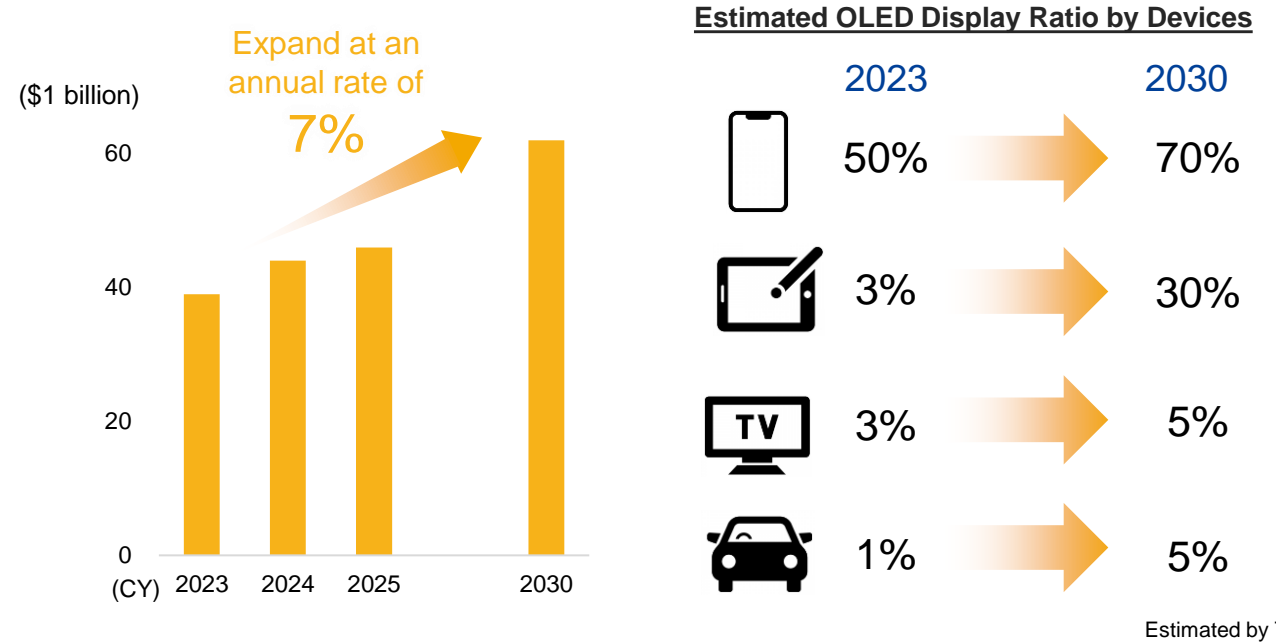
Growth of Semiconductor and Display Markets

Semiconductor Market



- Semiconductor market is expanding as ICT-related products grow.
- Increasing demand due to wide adaptation of various smart devices

OLED Display Market



- While growth in LCDs is slowing, OLED displays are expanding due to the accelerated adoption in tablets and notebook PC, in addition to smartphones.

Expansion of DI (Digital Innovation) Business

Target

Achieve 250 billion yen revenue in FY 2025 mainly for semiconductor and display applications

Digital Innovation (DI) Business



Electronic coating and mounting materials



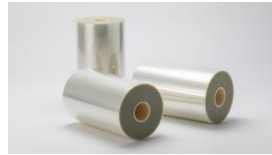
Semiconductor manufacturing and inspection equipment



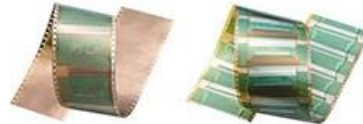
Cleaning and stripping solvents



RO membranes for ultrapure water production



Release film for semiconductor molds



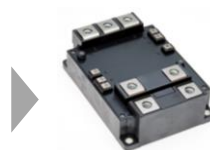
Flexible Printed Circuit Boards



Display materials

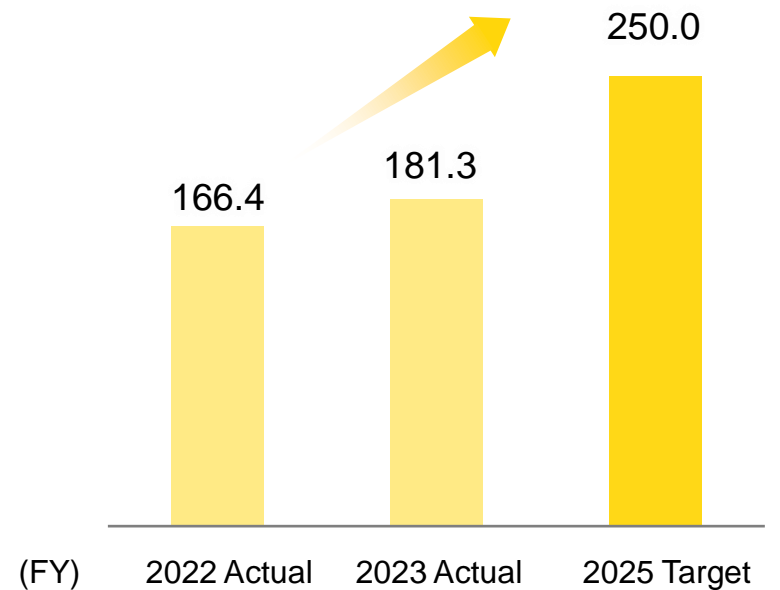


PPS resin for power modules



Courtesy of Mitsubishi Electric Corporation

Revenue from DI Business (Billion Yen)





Basic Strategy of DI Business

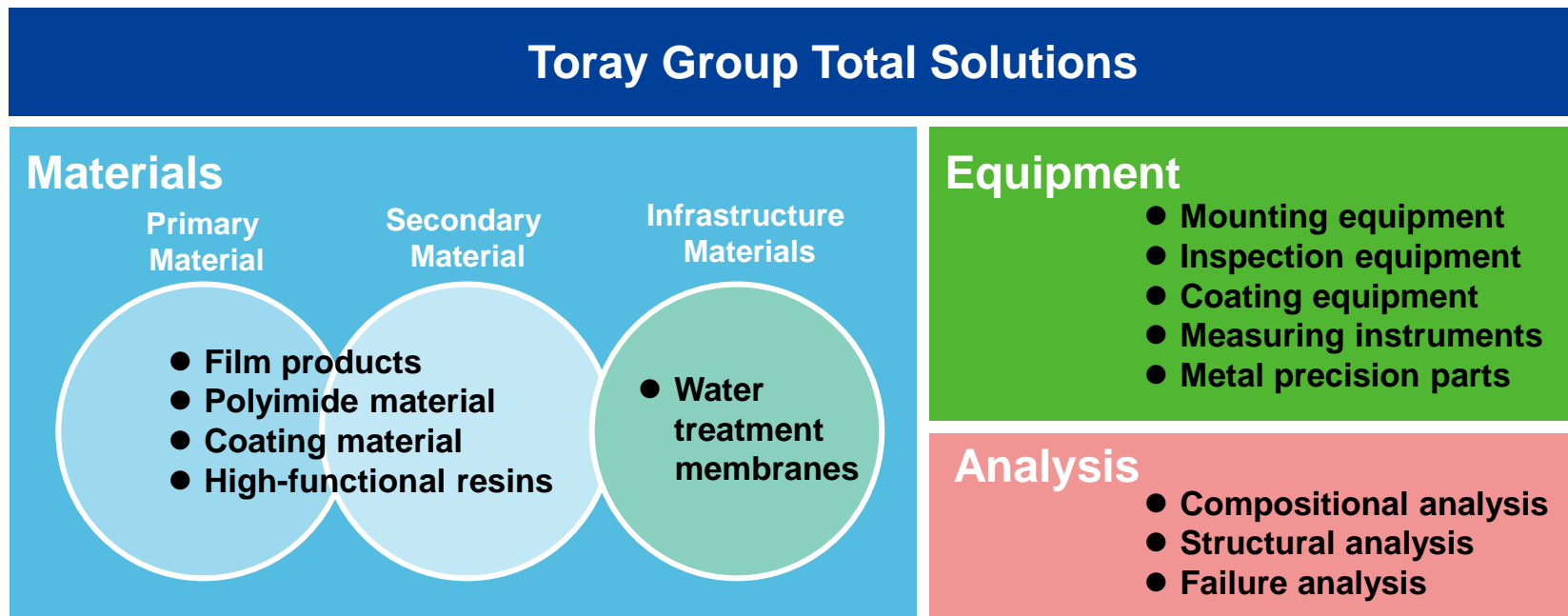
Technological Background for DI business

Utilizing our core-technologies such as material design (for materials), engineering capabilities (for equipment and processing technologies), and advanced analytical capabilities, we contribute to evolution of semiconductor, electronic parts and displays.



Group-wide Policies Leveraging Toray Group's Combined Strength

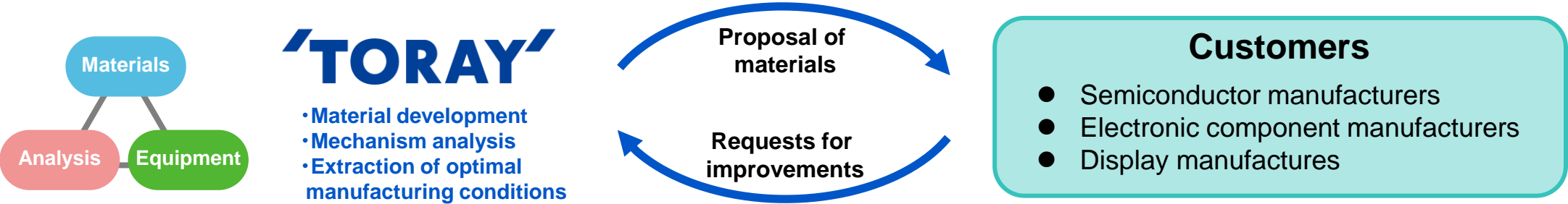
- **Materials:** Propose high-performance materials with added value that suit customer needs
- **Equipment:** Provide all-around packaging, inspection and measurement equipment that offers precision, speed and performance
- **Analysis:** Provide various analysis using optimum analytical technologies, developed based on identified needs



Initiatives Leveraging the Collective Strengths of the Toray Group

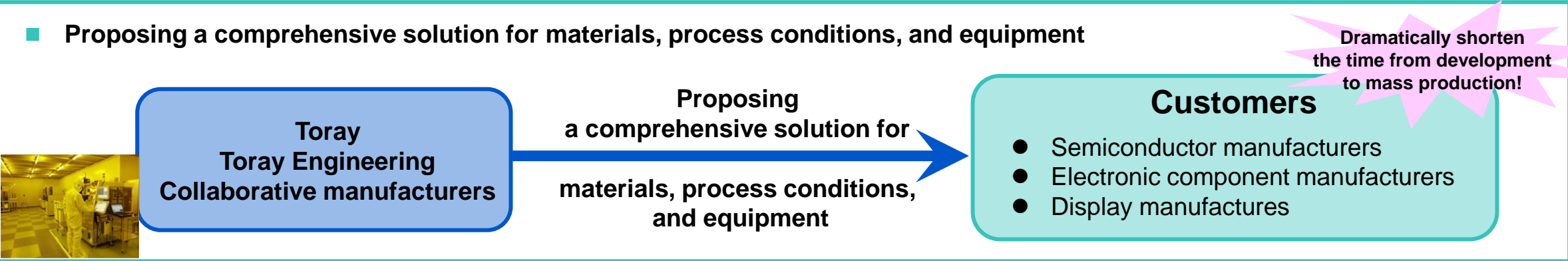
Examples of Initiatives with Manufacturers Developing Cutting-edge Products

- By collaborating on materials, equipment and analysis, we can rapidly rotate the cycle of proposing materials to customers, identifying further needs, and proposing improved materials.



Examples of Initiatives with Emerging Manufacturers

- Proposing a comprehensive solution for materials, process conditions, and equipment



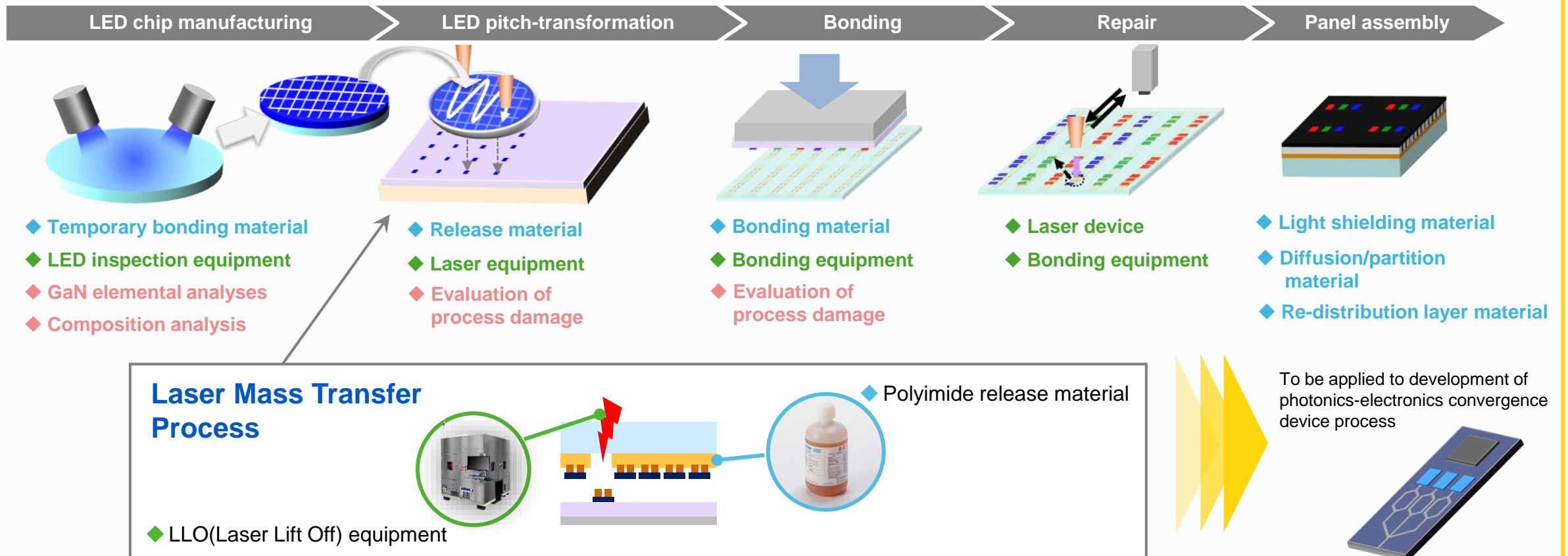
Development of Micro-LED Display Related Technology

Micro-LED Display

- Very small LED compose pixels
- Notable as the next-generation display due to features of high brightness, high contrast and low power consumption

Providing solutions for materials, equipment, and analysis to build mass production technologies

◆ Materials ◆ Equipment ◆ Analysis



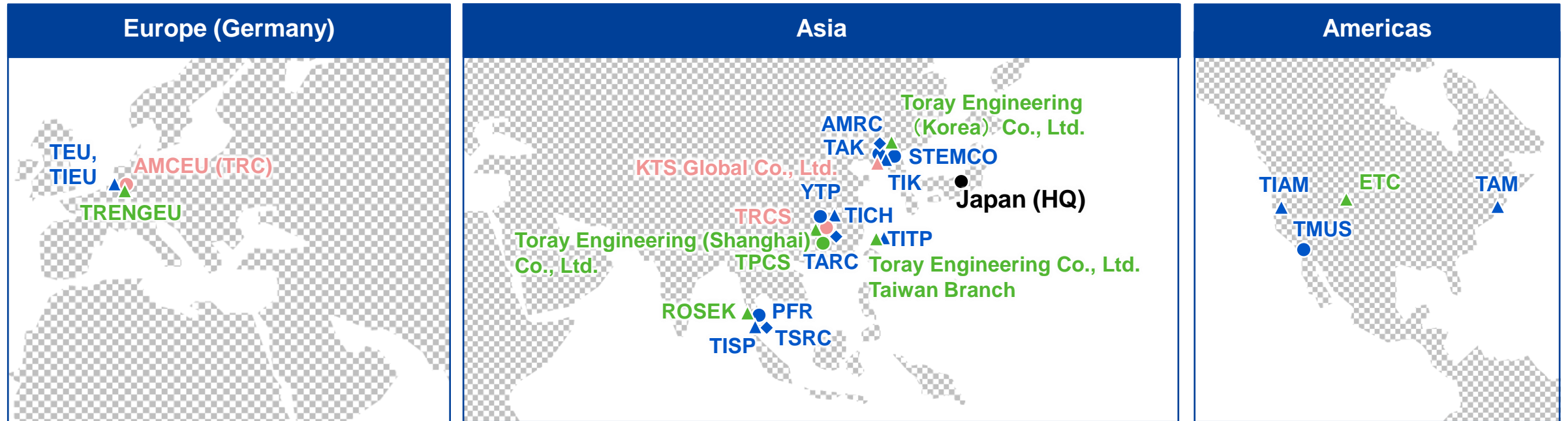
Global Location

- Established global network of locations for production & processing, R&D, sales, marketing and technical service that are closer to manufacturing and development bases of major customers (semiconductors & displays) to strengthen the collaborative relationship with them, promptly responding to customer needs and requests.

[Global Location]

DI business ●: Production and processing bases ◆: R&D bases ▲: Sales, marketing and technical service bases

Blue: Materials, Green: Equipment, Pink: Analysis



- TAM :Toray Industries (America), Inc.
- TEU :Toray Industries Europe GmbH
- TIEU :Toray International Europe GmbH
- TIK :Toray International (Korea), Inc.
- TICH :Toray International (China) Co., Ltd.
- TISP :Toray International Singapore Pte. Ltd.
- TIAM :Toray International America Inc.

- TITP : Toray International Taipei Inc.
- STEMCO: STEMCO, Ltd.
- AMRC : Advanced Materials Research Center
- TARC : Toray Advanced Materials Research Laboratories (China) Co., Ltd.
- TSRC : Toray Singapore Research Center
- TAK : Toray Advanced Materials Korea Inc.
- TMUS : Toray Membrane USA, Inc.

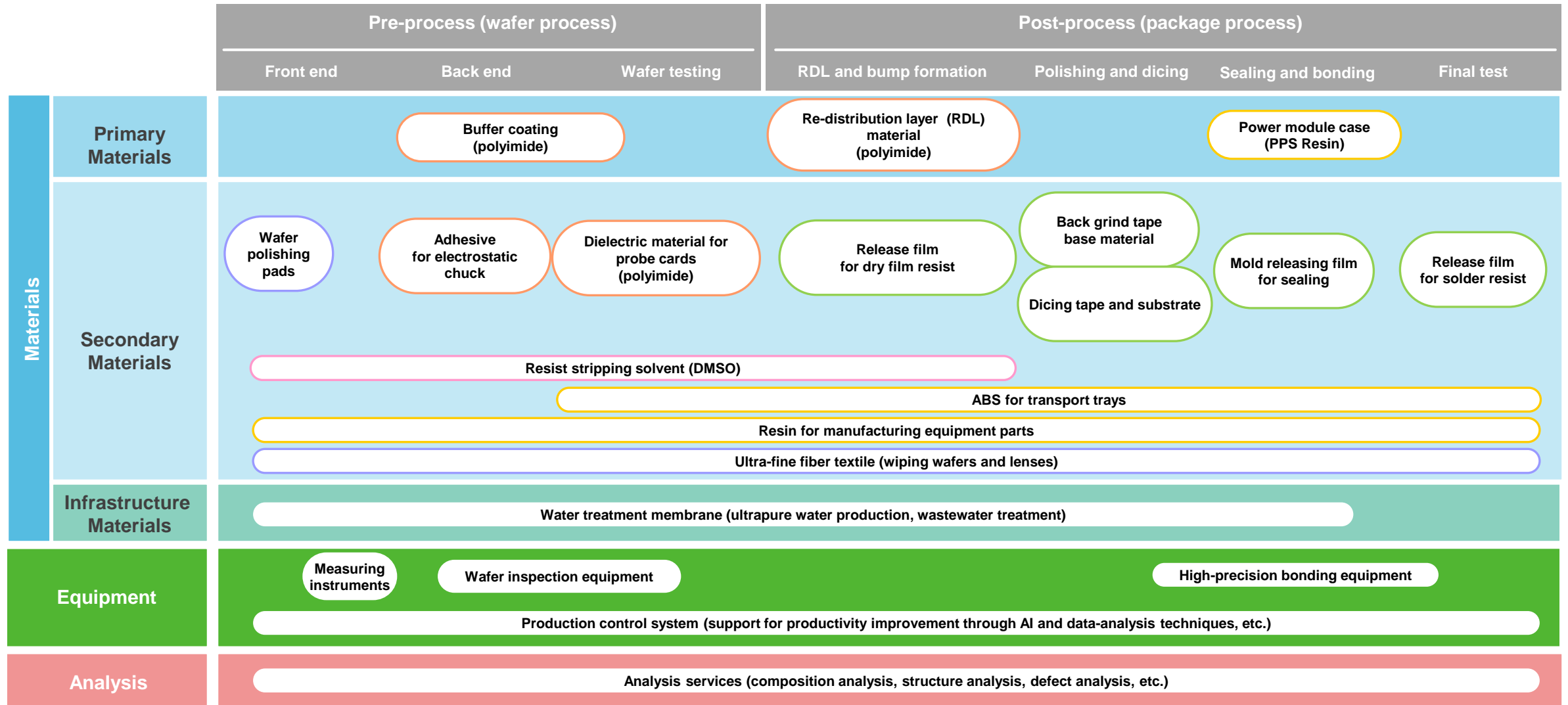
- YTP : Yihua Toray Polyester Film Co., Ltd.
- PFR : Penfibre Sdn. Berhad
- TRENGEU: Toray Engineering Europe GmbH
- ROSEK : ROSEK (Malaysia) Sdn.Bhd.
- TPCS : Toray Precision (Suzhou) Co.Ttd.
- ETC : Engineering Technology Corp.
- TRCS : Toray Research Center (Shanghai) Co., Ltd.
- AMCEU : Toray Automotive Center Europe



Main Products and Future Prospects

Toray Group's Development in the Semiconductor Field

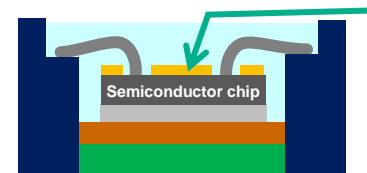
Providing semiconductor industry with **materials, equipment, and analytical solutions**



(1) Power Semiconductors: Polyimide Insulation Materials

Business Environment

- The power semiconductor market continues to expand due to the growing demand on renewable energy and power efficiency improvement.
- Average annual growth rate of the market: 10%



Buffer coating

- Protects the chip surface
- Micro-aperture on electrode area

Cross section of power semiconductor

Strengths and Value Proposition

- Over 50 years of **experience in polyimide design, long-standing track record, and industry standard materials**
- High reliability in terms of heat resistance, mechanical properties, and chemical resistance
- **Diverse product lineup (photodefinable/non-photodefinable) to fit different processes**

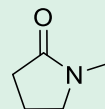
Top class Market Share

Business Growth Strategy

- Capturing the increasing demand through a **global customer support system**
- Expansion of polyimide materials for semiconductors → **Production capacity expansion underway in Japan**
- **Gaining market share by developing products that comply with environmental regulations**

NMP(N-methylpyrrolidone)

Used in polymerization solvents of polyimide, but regulations are tightened due to concerns about reproductive toxicity



REACH Control



EPA (Ministry of the Environment) regulations



Elimination of NMP by using non-NMP solvents

PFAS (Per- and polyfluoroalkyl substances)

Any of almost all organofluorine compounds containing CF₃ or CF₂ groups
Polyimide-based materials fall under "General PFAS"
Although health hazards are unspecified, there is a move toward regulation from a precautionary viewpoint



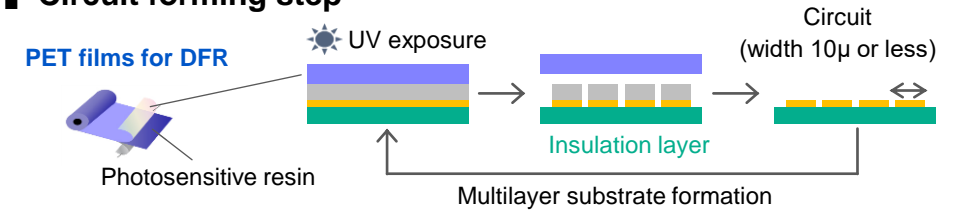
Elimination of PFAS through molecular structural designs that replace CF₃ groups

[Materials] (2) Dry Film Resist (DFR) Film

Business Environment

- Growth of the semiconductor market
- Increasing demand for continuous quality improvement due to fine pitch wiring
- Average annual growth rate of the market: 10%

■ Circuit forming step



Strengths and Value Proposition

- Advanced film surface design technology and quality control
- Production sites close to demand areas (China and Southeast Asia)
- Global de facto standard material in the high-end market

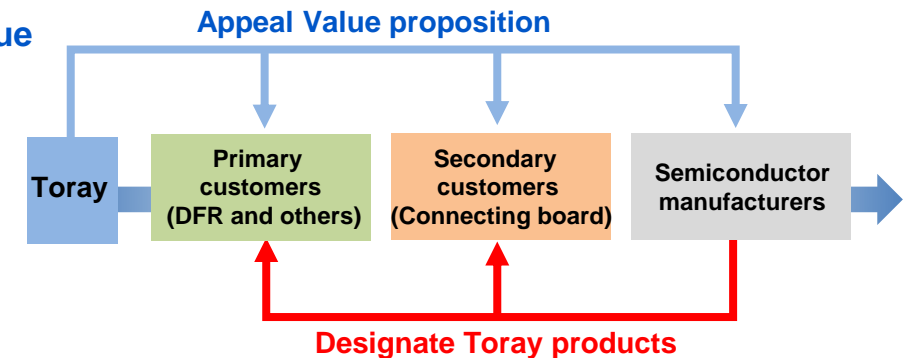
No.1
Market Share
in High-end Market

Business Growth Strategy

- Appeal of surface design and advanced quality control capability for fine pitch wiring application.
- Contributing to improving customer yields and product value
- Wide range of product line-up from high-end to mid-range

Enhance product value → Strategic pricing
Fine wiring capability → Designation by end customer

■ Semiconductor supply chain

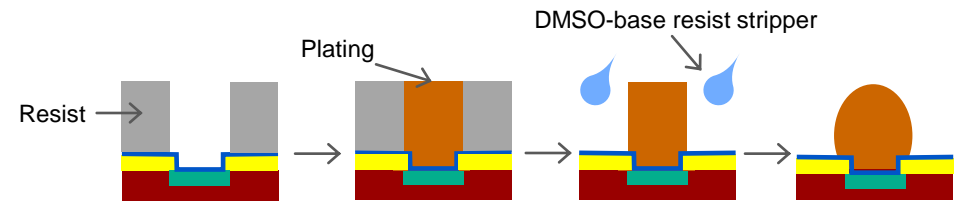


(3) Stripping Solution/Cleaning Solution DMSO (Dimethyl sulfoxide) (Toray Fine Chemicals Co., Ltd.)

Business Environment

- Growth of the semiconductor market
- Stricter impurity (metal) management
- Average annual growth rate of the market: 7%

* Usage Example Bump formation process



Strengths and Value Proposition

- The only DMSO manufacturer in Japan
- Global business reach with 2 production locations (Japan and China)
- World-class impurity management and analytical capabilities

No.1 Market Share in Semiconductor Market

Business Growth Strategy

- Increasing production output to meet growing demand
- Establishing a stable supply system by deepening global supply operations
- Continuously responding to customer needs for quality improvement and deeper analysis
- Capturing demand for replacing regulated solvents such as NMP
- Reducing the environmental impact by promoting recycling

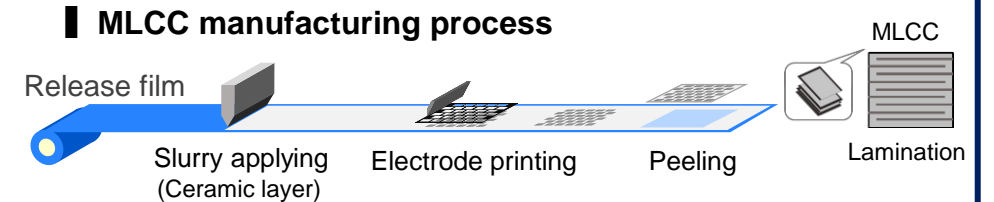
	<chem>CSC(C)=O</chem> DMSO	<chem>CN1CCCC1=O</chem> NMP
GHS Classification	None	

*GHS: the hazards of chemicals are standardized into uniform standards worldwide, and displayed in an easy-to-understand manner using pictorial displays, etc. NMP is applicable for health and environmental hazards, but DMSO is not.

[Materials] (4) Films for Multilayer Ceramic Capacitors (MLCC)

Business Environment

- MLCC market expands, as its end use such as smartphones, new energy vehicles, and AI servers keep developing.
- Average annual growth rate of the market : 6%



Strengths and Value Proposition

- Industry-leading smoothness enabled by surface design technology
- High quality (free from contamination and scratches), in addition to uniform thickness
- Global production capacity

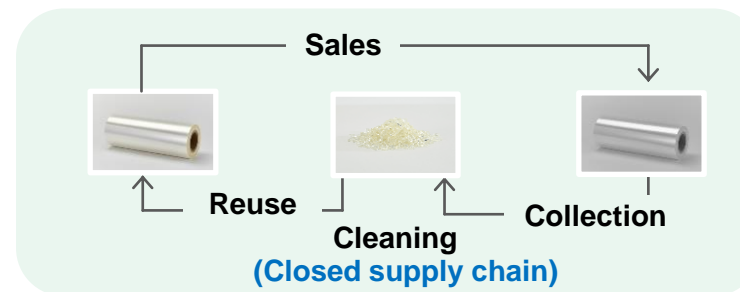
No.1 Market Share

Business Growth Strategy

- Production sites in three regions: Japan, South Korea, and Malaysia
- New production facilities to be launched at Gifu, Japan, in 2025
→ Production capacity expansion underway in Japan
- Deepening collaboration with supply chain companies and establish mechanical recycling system

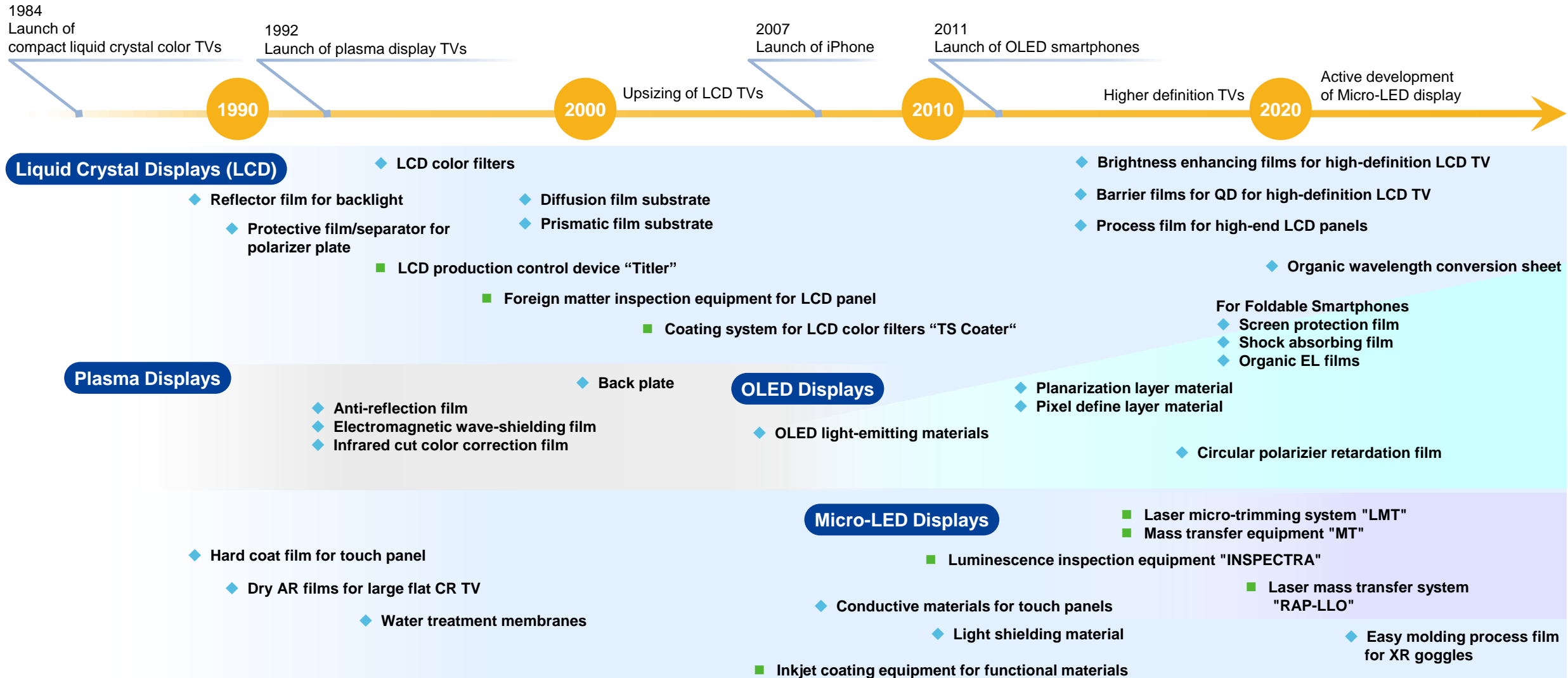
Recycled PET Films
Ecouse™ Lumirror™

Recycling system for high-end film
(World's first commercial application)



Drastically reduce the amount of CO₂ emitted in the process of manufacturing film, which is made from film recovered from customers

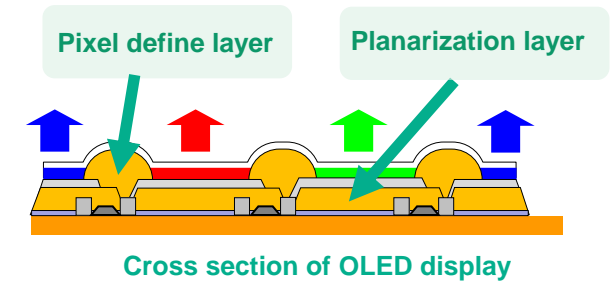
Expansion of Toray Group's Products in the Display Field



[Materials] (5) Polyimide for OLED Displays

Business Environment

- **Further growth** in smartphones with OLED displays
- **Market expansion by** Increased ratio of tablets and notebook PC with OLED displays
- **Average annual market growth rate: 7%**



Strengths and Value Proposition

- **De-facto standard materials in the industry** for pixel define layer and planarization layer (Overwhelming track record in mass production)
- **High reliability (display quality improvement)** and simplification of manufacturing processes at customers' sites (cost reduction)

No.1
Market Share

Business Growth Strategy

- **Capturing the increasing demand** accompanying market expansion
- **Leveraging our developed relationships with customers** to obtain their future needs **at earliest timing**. Maintaining the top market share through rapid introduction of new products and building a network of robust intellectual properties.
- **Developing technologies to meet customer needs** for new design or improvement (foldable display, higher brightness, etc.)
- **Developing products that comply with environmental regulations**

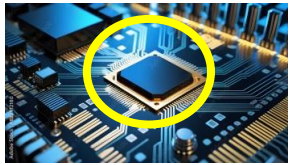


Introduction of Toray Research Center (TRC)'s DI Related Business

- Cutting-edge analytical instruments and proprietary analysis menus to support the research and development of customers in the semiconductor and display fields.
- Provide high-value-added information to customers based on the experience and a track record of more than 45 years.

Semiconductor Field

Achieve high-precision cross-sectional processing of a wide range of several hundred μm in width, a depth of 1 nm or more and a few tens of nm in depth, which was previously impossible.



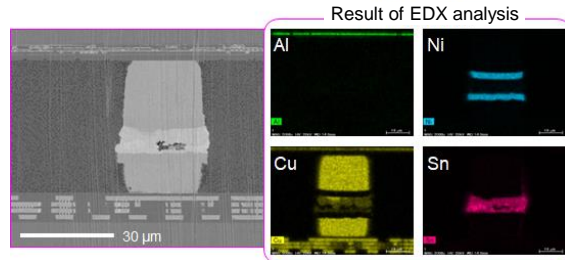
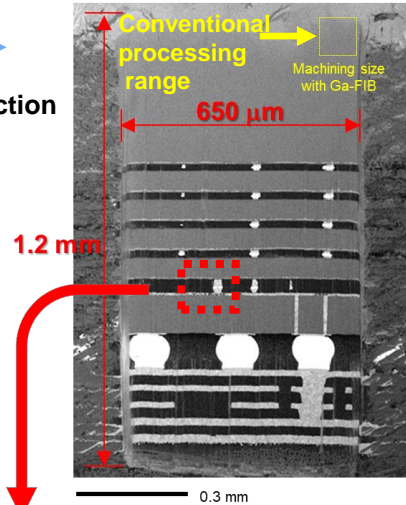
GPU: Graphics Processor



Plasma FIB with multi ion

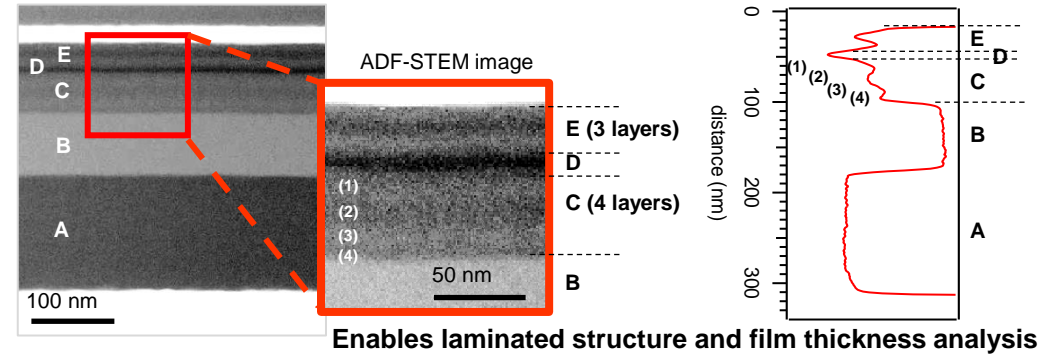
The first implementer of the equipment in Japan

High-precision, wide-range cross-section processing

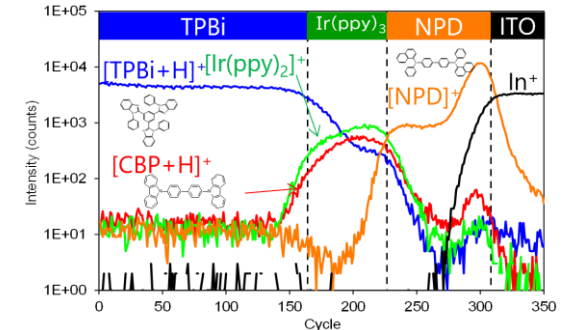
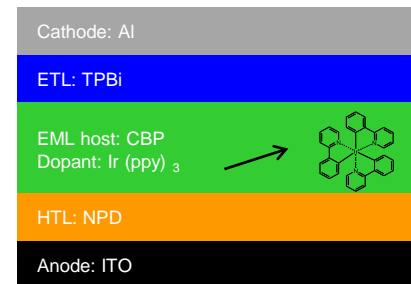


Display Field

TRC's proprietary high-contrast STEM technology allows for the acquisition of layer structures with higher contrast than conventional techniques, enabling more detailed evaluation of OLED stacking structures



Analysis of component distribution in OLED stack using GCIB-TOF-SIMS



Decomposition products analysis is available for deteriorated products

Introduction of Toray Engineering (TRENG)'s DI Related Business

Provide high-quality solutions by making full use of manufacturing and assembly expertise, engineering knowledge, and accumulated know-how through the experience in various business field.

- High-precision coating and laser technologies based on mechanical technologies in the textile and film fields as a backbone

Coating Equipment

Semiconductor Field

Display Field



Slit nozzle coater



Inkjet coater

Laser Processing Equipment

Semiconductor Field

Display Field



Mounting Equipment

Semiconductor Field

Display Field



Visual Inspection Equipment

Semiconductor Field

Display Field



Semiconductor wafers optical inspection equipment



Electron beam semiconductor wafer pattern inspection equipment

Measuring Instruments

Semiconductor Field



Oxygen analyser



Ultrasonic transducer

Descriptions of predicted business results, projections, and business contained in this material are based on predictive forecasts of the future business environment made at the present time.

The material in this presentation is not a guarantee of the Company's future business performance.

'TORAY'

Innovation by Chemistry