



# Medium-term Business Plan

Fiscal 2020~2022

Tosoh Corporation

May 17, 2019



# Agenda

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    8. Energy Conservation and Effective Use of CO<sub>2</sub>
- (Ref.) Tosoh Products' Contribution to Society



# I. Summary of Fiscal 2017~2019 Medium-term Business Plan (MTBP)

# 1. General Comments

## Business Objectives

- ✓ Strengthen commodity and specialty businesses
  - Commodity
    - Increase competitiveness and profitability with current capacities
  - Specialty
    - Increase investment in growth businesses
    - Expand areas of business through R&D and M&A
- ✓ Maintain and strengthen the financial base
  - Build solid financial foundation that enables flexible investment in growth
- ✓ Promote safety reforms
  - Establish technologies for safe and stable operations
  - Eliminate troubles and abnormal occurrences

## General Comments

- ✓ Strengthened commodity and specialty businesses as planned
  - Commodity
    - Strengthened base through large-scale investment to increase efficiency
    - Significantly exceeded profit target on the strength of favorable market conditions
  - Specialty
    - Strengthened capacity in growth fields
    - Constructed system for acquiring advanced technologies
    - Did not achieve profit target due to factors such as worsening trade conditions
- ✓ Construct solid financial foundation
  - Equity ratio: 61.6% as of end of March 2019
  - Interest-bearing debt: ¥101.1 billion as of March 2019
  - Net debt-to-equity ratio: 0.01 as of March 2019
  - Rating: Raised to A+ in August 2018
- ✓ Response from safety reform initiatives
  - Continued capital injections into strengthening preventive maintenance
  - Steadily reduced problems and abnormal events
  - Recertified for high-pressure gas safety (Nanyo Complex)



## 2-1. Performance: Results

- ✓ Business performance achieved all targets; Chlor-alkali Group's Urethane Division drove profits due to high market prices.

(Unit: billion yen)

	FY2019		
	Target	Actual	Variance
Net Sales	750.0	861.5	+111.5
Operating Income	85.0	105.7	+20.7
Operating Income Ratio	over 10%	12.3%	Achieved
ROE	over 10%	15.1%	Achieved

ASSUMPTIONS	Dollar	¥/\$	110	110	0
	Euro	¥/€	120	130	10
	Naphtha	¥/kl	40,000	49,475	9,475
	Benzene	\$/T	600-650	745	120
	PVC	\$/T	750-850	888	88
	VCM	\$/T	600-650	725	100
	Liquid caustic soda	\$/T	300-350	413	88
	MDI (monomeric)	\$/T	1,450-1,550	2,788	1,288
	MDI (polymeric)	\$/T	1,000-1,100	1,701	651

\*Market price difference is calculated by comparing with average prices

## 2-2. Performance: By Business Group

- ✓ Petrochemical Group: Did not achieve targets despite maintaining high naphtha cracker operating rate due to factors including increasing prices of raw materials such as naphtha.
- ✓ Chlor-alkali Group : Bolstered by high market prices, significantly exceeded targets.
- ✓ Specialty Group: Did not achieve targets due to high raw material prices, weak market conditions, and delayed sales expansion plans.

(Unit: billion yen)

		FY2019			
		Target	Actual	Variance	
<b>Net Sales</b>	Petrochemical	164.0	183.9	19.9	
	Chlor-alkali	277.0	337.4	60.4	
	Specialty	184.0	197.4	13.4	
	Engineering/Ancillary	125.0	142.7	17.7	
	<b>Total</b>	<b>750.0</b>	<b>861.5</b>	<b>111.5</b>	
<b>Operating Income</b>	Petrochemical	17.0 10.4%	13.4 7.3%	-3.6 -3.1%	
	Chlor-alkali	21.0 7.6%	46.0 13.6%	25.0 6.1%	
	Specialty	40.0 21.7%	35.3 17.9%	-4.7 -3.9%	
	Engineering/Ancillary	7.0 5.6%	11.0 7.7%	4.0 2.1%	
	<b>Total</b>	<b>85.0 11.3%</b>	<b>105.7 12.3%</b>	<b>20.7 0.9%</b>	

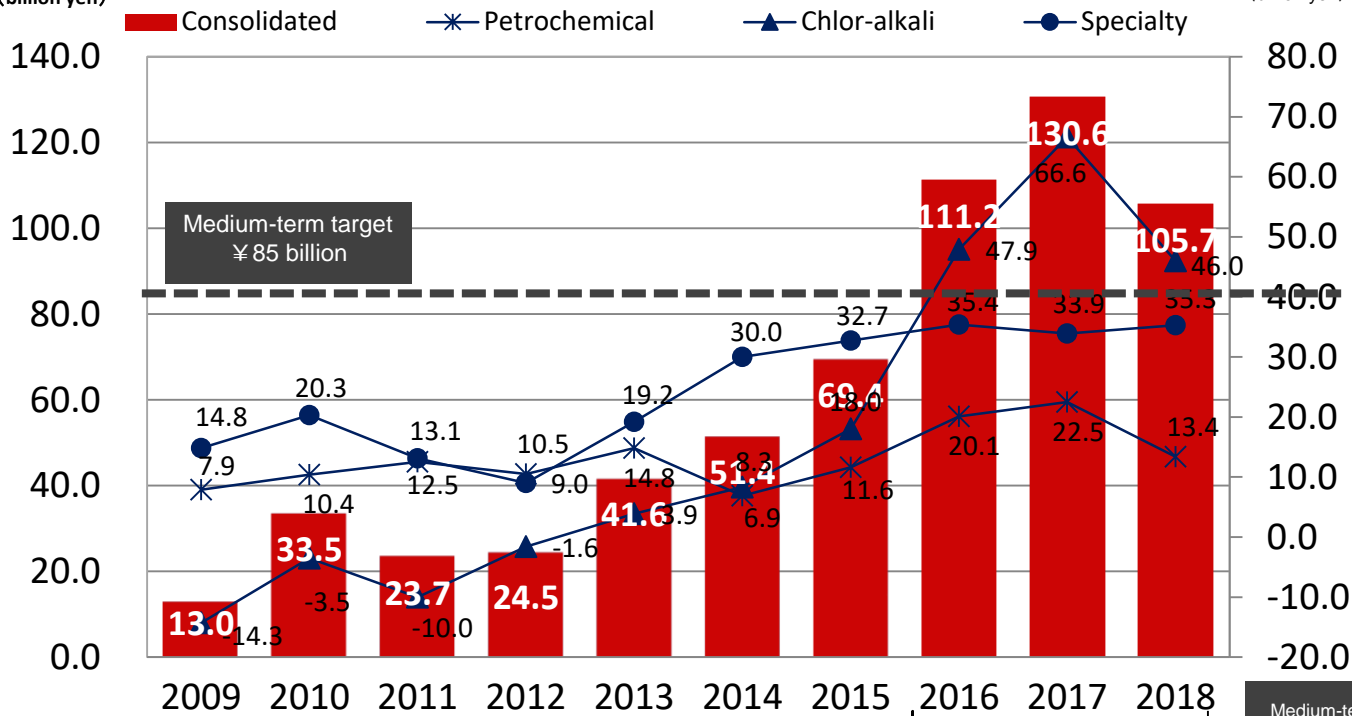


## 2-3. Performance: Trends

- ✓ Petrochemical: Increased profitability by maintaining high naphtha cracker operating rate, promoting differentiated polymer products.
- ✓ Chlor-alkali: Significantly increased profitability through reduced amortization for vinyl isocyanate and high market prices.
- ✓ Specialty: Raised profit levels through selective investment in growth businesses.

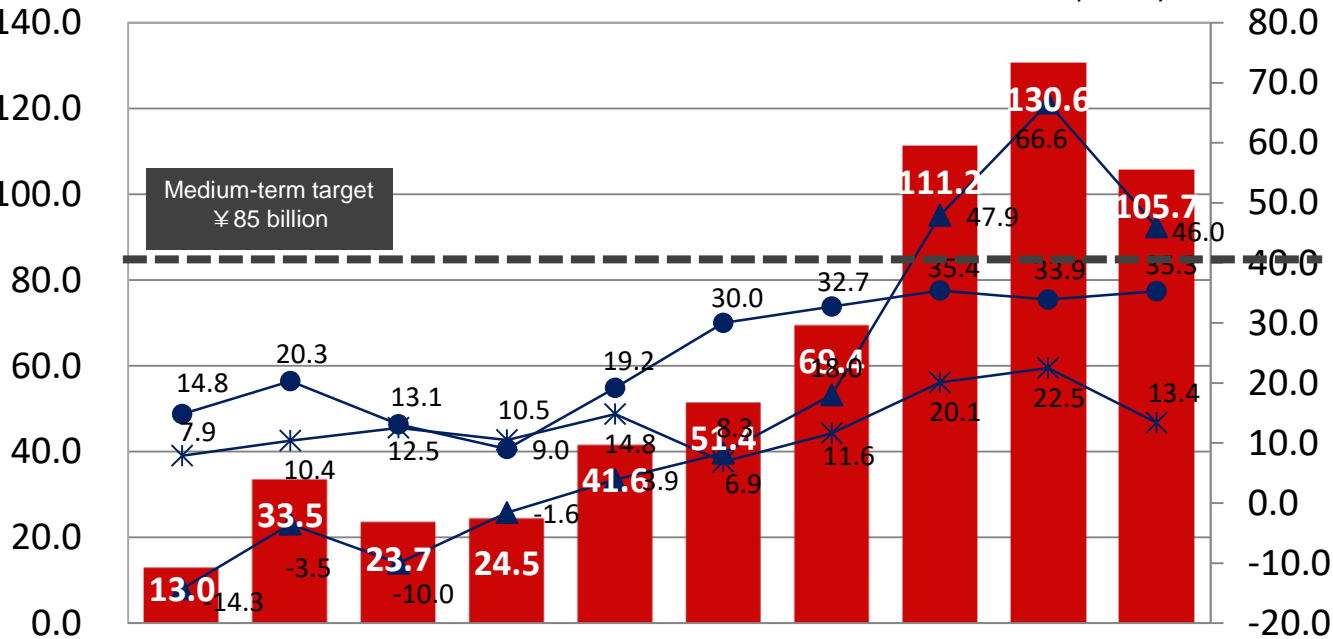
### Operating Income (Consolidated)

(billion yen)



### Operating Income by segment

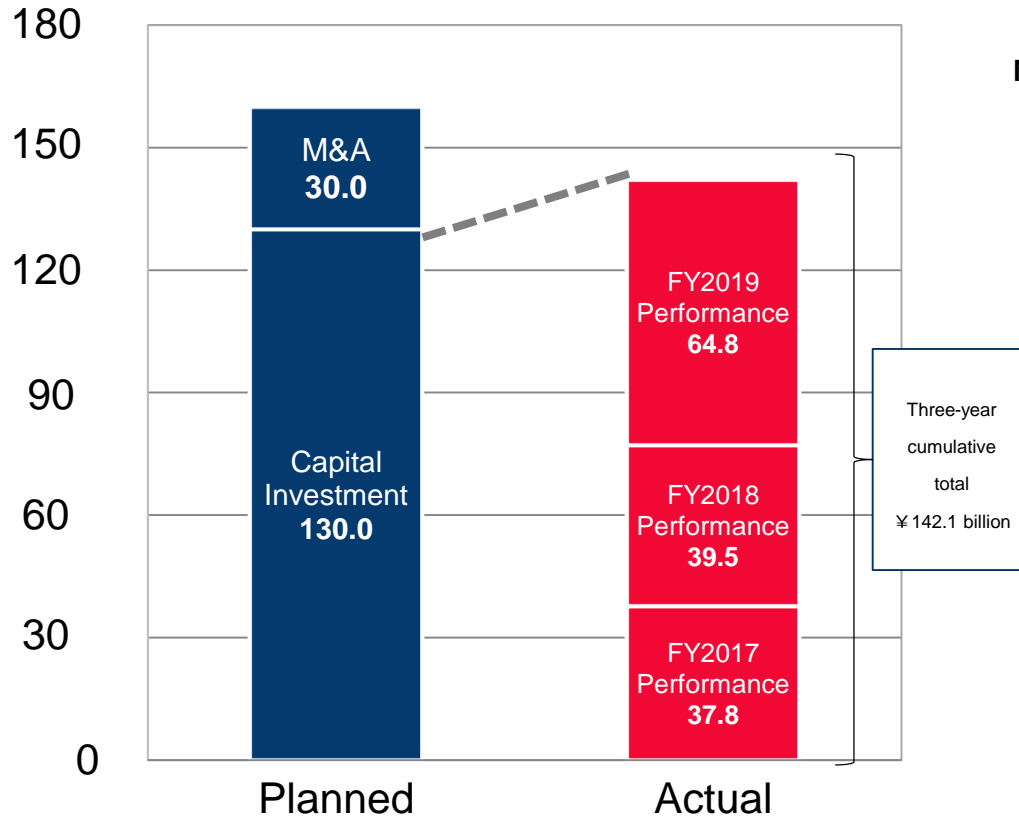
(billion yen)



### 3. Investments: Performance

- ✓ Capital investment: Exceeded planned facility investment due to factors such as unplanned investment in semiconductor-related projects and building reconstruction.
- ✓ M&A: Did not result in execution of large-scale M&A projects despite actively searching for opportunities primarily in life science fields.

(billion yen)



#### Major Investment Projects:

##### Constructed:

- New high-silica zeolite plant (Malaysia)
- Nanyo Complex's new main building
- New research facilities (Nanyo and Yokkaichi)

##### Increased capacity for:

- High-silica zeolite (Nanyo Complex)
- Zirconia (Nanyo & Yokkaichi Complexes)
- TOYOPEARL® separation and purification media
- Quartz materials, fabricated etching parts for semiconductor industry
- Silica at Tosoh Silica Corporation (Nanyo)
- Polyvinyl chloride (PVC) at Philippine Resins Industries, Inc.

##### Increased efficiency for:

- Bromine
- In-house power generation
- Naphtha cracker, and installation of gas turbine





## II. Overview of Fiscal 2020 - 2022 Medium-term Business Plan



# 1. Corporate Philosophy

*“Tosoh contributes to bettering society through the chemistry of innovation.”*

With the aim of bringing this vision to fruition, we practice the following:

1. **Contribute to the development of a sustainable society through our business activities**
  - Resolve social issues and offer products that contribute to improving the quality of life
2. **Secure safe and stable operation**
  - Recognize safety as top-priority management issue, tackle head-on
3. **Promote a free and open corporate culture**
  - Cultivate an open work environment that respects human rights and diversity
4. **Preserve global environment**
  - Minimize environmental burden across activities in the entire value chain
5. **Pursue our activities with integrity**
  - Continue to be a reliable partner that is worthy of trust and respect by acting with transparency and integrity in all that we do

## 2-1. Business Objectives: Business Environment

### Assumptions

- ✓ **Prolonged trade friction between the United States and China**
  - Prolonged US-China trade war, expanded trade protectionism  
⇒ **stagnation in global economy**
- ✓ **Turmoil in Europe's economy**
  - Political instability in European Union member countries (United Kingdom, France, Germany, Italy), Brexit  
⇒ **European economy instability**
- ✓ **Chinese environmental regulation trends**
  - Easing of regulations will lead to China's return to overproduction  
⇒ **Decline in overseas market conditions**
  - Strengthening of regulations will lead to impact on China's economy  
⇒ **Slowdown in Chinese economic growth**
- ✓ **Worsening labor shortage**
  - Increase in construction and logistics costs  
⇒ **Deterioration of large-scale investment profitability**
- ✓ **CO<sub>2</sub> emission regulation trends**
  - Environmentally friendly business operation ⇒ **Examination of CO<sub>2</sub> emission reduction/effective use**



Presumed business environment under the new Medium-term Business Plan remains highly uncertain.

## 2-2. Business Objectives: Positioning

Items	Previous Medium-term Business Plan	New Medium-term Business Plan
Commodity	Strengthened business base	Further strengthen business base
Specialty	Strengthened capacity of growth businesses (high-silica zeolite, zirconia, separation media, semiconductor-related)	<ul style="list-style-type: none"> <li>• Increase scale of business through product differentiation and capacity increase of growth businesses</li> <li>• Cultivate new businesses</li> </ul>
Infrastructure	Reconstruction/renewal of buildings	Strengthen and increase efficiency of logistics infrastructure
R&D	<ul style="list-style-type: none"> <li>• Strengthened open innovation</li> <li>• Built structure for acquiring advanced technologies</li> <li>• Reformed and expanded functionality of R&amp;D infrastructure</li> </ul>	Accelerate development of new products based on measures from previous Medium-term Business Plan
Safety Reform	Strengthened initiatives	Continue initiatives
Financial base	Further strengthened	Maintain solid foundation
Energy Conservation	<ul style="list-style-type: none"> <li>• Increased efficiency of naphtha cracker</li> <li>• Launched Committee for the Advancement of CO<sub>2</sub> Reduction &amp; Effective Use</li> </ul>	<ul style="list-style-type: none"> <li>• Promote energy-saving investment</li> <li>• Explore CO<sub>2</sub> reduction/effective use</li> </ul>



## 2-3. Business Objectives: Basics

### Basic Objectives

- ✓ **Stabilization and expansion of profits through leveraging the dual nature of our businesses**
  - Commodity
    - Improve competitiveness and profitability by further strengthening the base with potential capacity increases under consideration
  - Specialty
    - Expand scale of business through product differentiation and capacity increases, while maintaining and expanding to further grow businesses and cultivate new businesses
- ✓ **Maintain safety as top priority**
  - Safe plant operation is our societal responsibility, and takes precedence over all else
- ✓ **Maintain solid financial foundation**
  - Maintain solid financial foundation enabling timely execution of large-scale investment and M&A
- ✓ **Promotion of energy conservation and effective use of CO<sub>2</sub>**
  - Investment in energy conservation and CO<sub>2</sub> efficiency as our societal responsibility will continue



## 2-4. Business Objectives:

### Stable management through strengthening of both pillars

- ✓ Strengthen the balance between Commodity and Specialty, which differ in role and nature, through building a business portfolio that can withstand changes in the business environment.

#### Role of Commodity

- Demand for basic raw materials remains solid even under changing business conditions
- Steady demand ensures basic cash flow and profitability
- Fuel Tosoh products with highly competitive utilities and basic raw materials

#### Nature of Specialty

- Requires lead time of over 10 years from development to high-performance, profitable business
- Continuous research and development required to maintain specialty margins
- Reduces risk from fluctuation in Commodity by recording stable profits

## 2-5. Business Objectives: Performance Targets

- ✓ Counterbalance the softening of the Commodity market with Specialty, aim for operating income in excess of ¥100 billion

(billion yen)

	FY2019 Actual	FY2020 Forecast	FY2022 Target
Net Sales	861.5	860.0	890.0
Operating Income	105.7	95.0	110.0
Operating Income Ratio	12.3%	11.0%	above 10%
ROE	15.1%	—	above 10%

\*\*"Net sales" is a reference figure based on the assumptions below. Net sales could increase or decrease significantly due to naphtha prices (formula products) or Commodity product market fluctuations

Dollar	¥/\$	110	110	110
Euro	¥/€	130	125	125
Naphtha	¥/kl	49,475	46,000	46,000
Benzene	\$/T	745	600-700	600-700
PVC	\$/T	888	800-900	800-900
VCM	\$/T	725	650-750	650-750
Liquid caustic soda	\$/T	413	350-450	350-450
MDI(monomeric)	\$/T	2,788	2,200-2,400	2,150-2,350
MDI(polymeric)	\$/T	1,701	1,300-1,500	1,250-1,450

## 2-6. Business Objectives: Performance by Business Group

- ✓ Petrochemical: Increase profits by strengthening naphtha cracker competitiveness; differentiation and sales expansion of functional polymers
- ✓ Chlor-alkali: Cover softening of the polyurethane market by expanding sales of functional polyurethane products; realize increased profits for Chlor-alkali Group through measures such as reduction in fixed costs
- ✓ Specialty: Aim to increase sales and profits through differentiation and sales expansion of key products

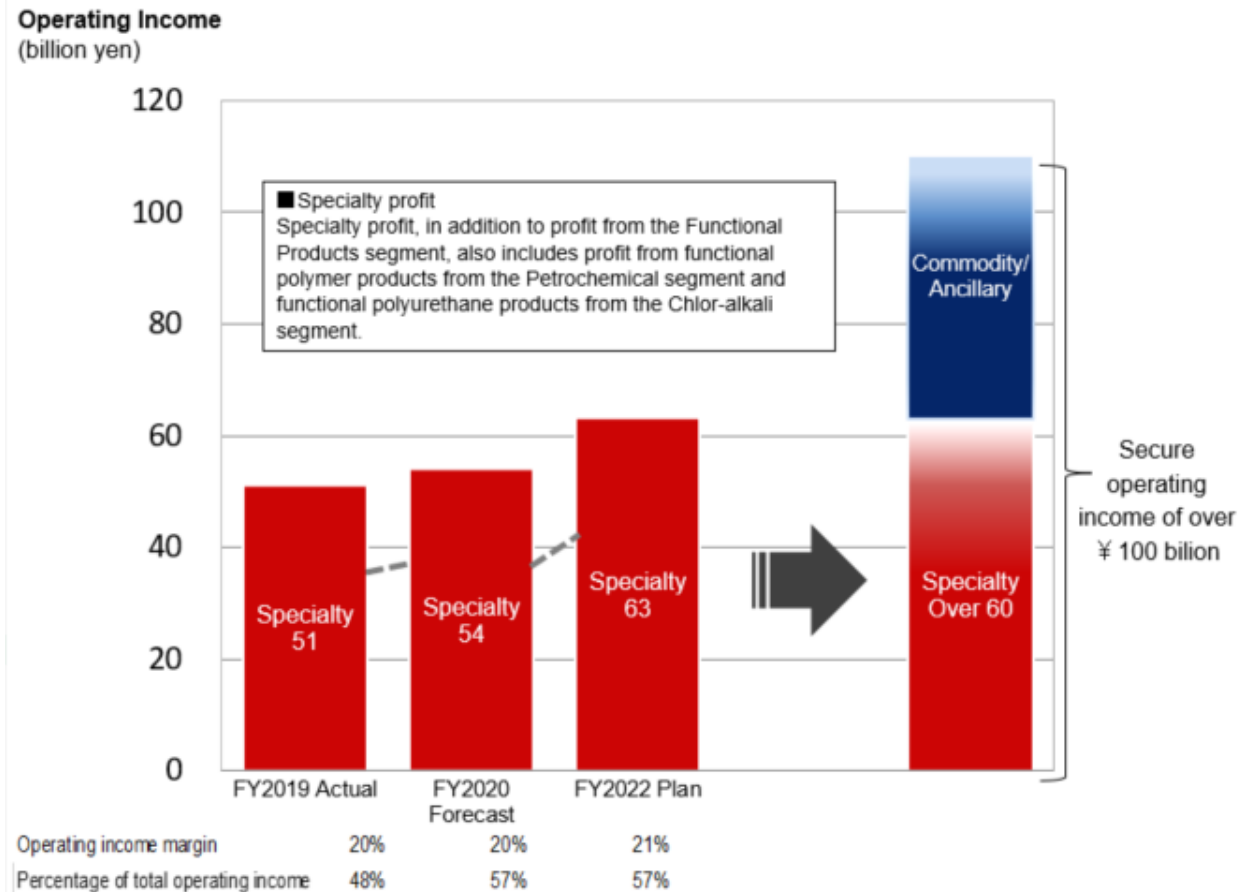
(billion yen)

		FY2019 Actual	FY2020 Forecast	FY2022 Target
<b>Net Sales</b>	Petrochemical	183.9	170.4	175.0
	Chlor-alkali	337.4	324.3	319.0
	Specialty	197.4	212.1	239.0
	Engineering/Ancillary	142.7	153.2	157.0
	<b>Total</b>	<b>861.5</b>	<b>860.0</b>	<b>890.0</b>
<b>Operating Income</b>	Petrochemical	13.4 7.3%	13.2 7.7%	15.0 8.6%
	Chlor-alkali	46.0 13.6%	36.5 11.3%	41.0 12.9%
	Specialty	35.3 17.9%	35.2 16.6%	43.0 18.0%
	Engineering/Ancillary	11.0 7.7%	10.1 6.6%	11.0 7.0%
	<b>Total</b>	<b>105.7 12.3%</b>	<b>95.0 11.0%</b>	<b>110.0 12.4%</b>



## 2-7. Business Objectives: Desired Profit Structure

- ✓ Generate earnings in excess of ¥60 billion in Specialty, which has downward rigidity in earnings, and secure total earnings of no less than ¥100 billion even in weak Commodity markets





## 3-1. Investment Objectives: Capital Investment

### Previous Medium-term Business Plan

#### Commodity

- ✓ **Strengthen business base**
  - Increase efficiency of naphtha cracker and in-house power generation facilities, increase capacity of PVC at Philippine Resins Industries, Inc.
- ✓ **Strengthen derivative products**
  - Increase capacity for sodium bicarbonate, increase shipping-related facilities for hydrochloric acid

#### Specialty

- ✓ **Increase capacity in growth businesses**
  - High-silica zeolites (HSZ), zirconia, separation and purification media/AIA reagents  
\*Able to respond to recent increase in demand
- ✓ **Respond to expanded semiconductor-related demand (capacity increase)**
  - Silica glass materials, fabricated and etching products

#### Infrastructure

- ✓ **Building renewal, expand functionality**
  - Rebuild Nanyo Complex main building, rebuild R&D facilities at Nanyo and Yokkaichi Complexes

### New Medium-term Business Plan

#### Commodity

- ✓ **Further strengthen business base**
  - Strengthen Chlor-alkali foundation (Measures including establishment of new overseas bases under consideration; Taiyo Vinyl Corporation Osaka PVC plant to close), MDI further debottlenecking
  - Increase efficiency of in-house power generation facilities, biomass co-firing for the promotion of energy conservation
- ✓ **Further strengthen derivative products**
  - Calcium hypochlorite, ultrahigh molecular weight polyethylene

#### Specialty

- ✓ **Capacity increase in growth businesses**
  - Chloroprene rubber debottlenecking, new ceramic materials, A1c columns and reagents, bromine and flame retardants
- ✓ **Discern demand trends, make additional investment in semiconductor-related products**
  - Silica glass materials and fabricated products

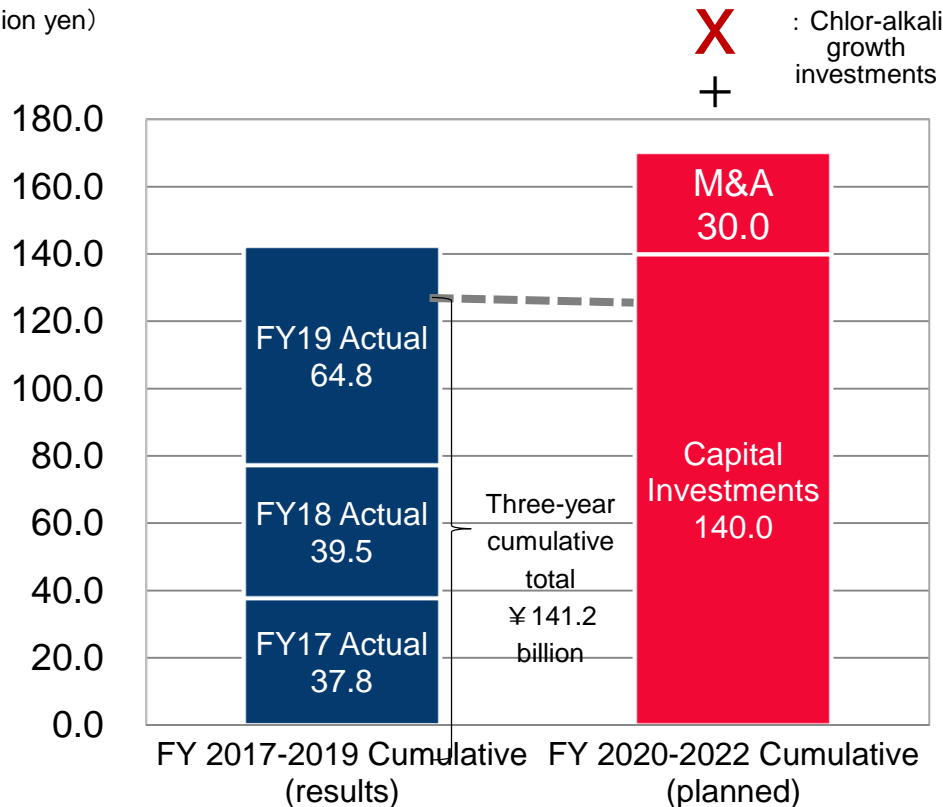
#### Infrastructure

- ✓ **Strengthen and enhance efficiency of logistics infrastructure**
  - Establish new integrated logistics warehouse, renew ethylene and vinyl chloride monomer vessels

## 3-2. Investment Objectives: Plan

- ✓ Total investment amount for FY2020-2022 = ¥140 billion capital investment + ¥30 billion in M&A, etc. + X (whereas X represents chlor-alkali growth investment)
- ✓ ¥30 billion allocated for M&A projects are mainly for pursuing opportunities in life science fields

(billion yen)



### Major Capital Investments:

Construct:

- New ceramics facility
- Integrated logistics warehouse

Renew:

- Bromine plant facilities
- Calcium hypochlorite manufacturing facilities

Expand facilities for:

- Brominated flame retardants
- Semiconductor-related products

Increase efficiency for:

- In-house power generation facilities

Debottlenecking for:

- Chloroprene rubber
- MDI

Others:

- Glycol columns and reagents (automation)
- Ultrahigh molecular weight polyethylene
- Enable power generation boiler biomass co-firing
- Restore ethylene/vinyl chloride monomer vessels



## 4-1. R&D Objectives: Basics

### Previous Medium-term Business Plan

- ✓ **Strengthen open innovation**
  - Build large-scale industry, academia, and government collaborative structure
- ✓ **Build advanced technology acquisition structure**
  - Appoint technology and venture investment specialists in US; also dispatch Tosoh researchers
  - Invest in materials- and life science-related venture capital funds
  - Underwrite US life science-related ventures
- ✓ **Reform, expand functionality of research infrastructure**
  - Rebuild research facilities at Nanyo and Yokkaichi Complexes
  - Strengthen service and customer lab functions
  - Introduce high-performance R&D equipment

### New Medium-term Business Plan

- ✓ **Accelerate new product development in line with previous Medium-term Business Plan**
  - Apply external technologies through open innovation
  - Cultivate and acquire new technologies through joint research
  - Effectively allocate resources (personnel, equipment) to new research facilities, increase work efficiency and generate synergy
  - Accelerate commercialization through joint R&D with users
- ✓ **Increase efficiency of material design by building MI technologies**
  - Advance building of MI technologies through external collaboration/talent acquisition\*  
\*MI = materials informatics
- ✓ **Promote R&D based on Sustainable Development Goals (SDGs)**
  - R&D's priority setting in line with SDGs
  - Promote open innovation aimed at resolving social issues

## 4-2. R&D Objectives: Three-themed Focus

- ✓ Accelerate development focusing on three themes: Life Sciences, Environment & Energy, Electronic Materials

### Life Sciences

#### Objectives

- Generate new products to expand separations and diagnostic businesses
- Generate new business through deepening of own technologies and introduction of externally-acquired technologies

<Fields> Biopharmaceutical, biomedical materials, examination and diagnostics, healthcare

### Environment and Energy

#### Objectives

- Generate innovative products and technologies toward achieving a low-carbon society
- Generate new materials by applying external technologies to powder metallurgy technologies and organometallic complexes

<Fields> Composite materials for mobility, energy conversion materials, battery materials, technologies to combat CO<sub>2</sub> and marine plastics

### Electronic Materials

#### Objectives

- Generate new electronic materials taking full advantage of organic compounds and polymer design technologies and device performance measurement technologies
- Acquire advanced and performance measurement technologies through group companies, industry, academia, and government collaboration

<Fields> Communications materials, semiconductor-related materials, printable electronics materials, display materials

Yokkaichi Complex's New Research Building and Application Lab

#### 四日市事業所 新研究棟・カスタマーラボ棟 完成予想図



**New research building**  
 Floor area: 7,180m<sup>2</sup> (6 floors)

**Application lab**  
 Floor area: 1,270m<sup>2</sup> (2 floors)

Construction end date: Aug 2019

## 4-3. Connection between R&D Themes and SDGs

### Life Sciences



<Fields> Biopharmaceutical, biomedical materials, examinations and diagnostics, healthcare

### Environment & Energy



<Fields> Composite materials for mobility, energy conversion materials, battery materials, technologies to combat CO<sub>2</sub> and marine plastics

### Electronic Materials



<Fields> Communications materials, semiconductor-related materials, printable electronics materials, display materials



## 4-4. Case Studies

### Open Innovation

- Established joint research course at Niigata University for the purpose of exploring a new urinary marker
  - Researched new urinary marker and developed new diagnostic technologies for diabetes and other lifestyle-related diseases
- Participated in trichology diagnostic consortium organized by Rikagaku Kenkyusho (RIKEN) and others
  - Developed new diagnostic technologies using health data stored in human hair follicles
- Participated in next-generation biopharmaceutical manufacturing technology research association
  - Industry-, academia-, and government project for the purpose of developing next-generation manufacturing technology for biopharmaceuticals
- Conducted joint research on printable electronics with Yamagata University
  - Built collaborative structure at Yamagata University to verify materials developed by Tosoh
- Conducted joint research on cross-coupling reaction with Kyoto University
  - Developed new method enabling coupling reaction using inexpensive aromatic nitro compound

### Fund/Venture Investment

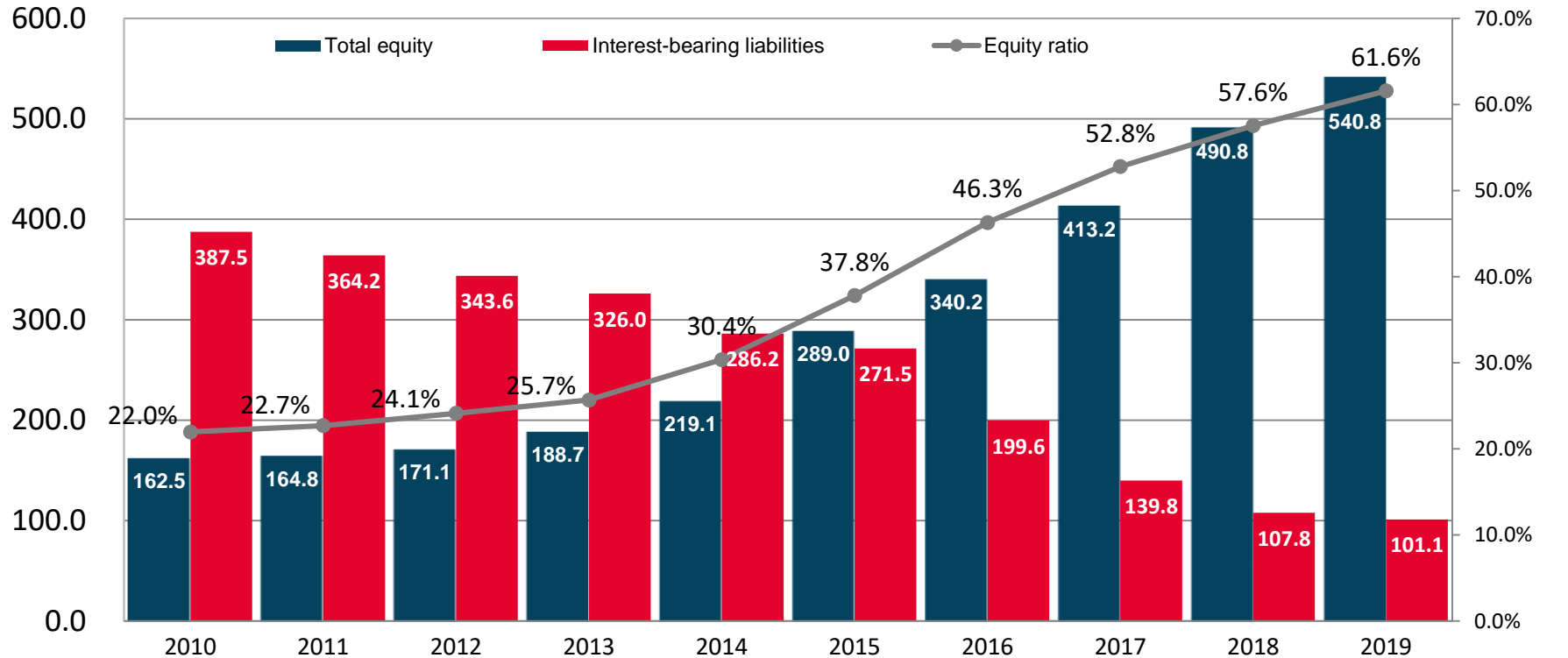
- Invested in material- and life science-related venture capital funds
  - Targeted to evaluate 2,000 technologies annually, acquire technologies where synergy can be expected
- Invested in regenerative medicine venture company launched by Keio University
  - Aimed for commercialization of technology to artificially manufacture platelets from stem cells derived from subcutaneous adipose tissue
- Increased investment in US life science venture company Semba Biosciences, Inc.
  - Combined Tosoh's separation media and Semba Biosciences' continuous chromatography technology to increase efficiency of biopharmaceutical manufacturing



# 5-1. Financial Objectives

- ✓ Maintain solid financial foundation enabling Tosoh to:
  - ✓ Executes large-scale investments and M&A in a timely fashion
  - ✓ Continue stable dividends

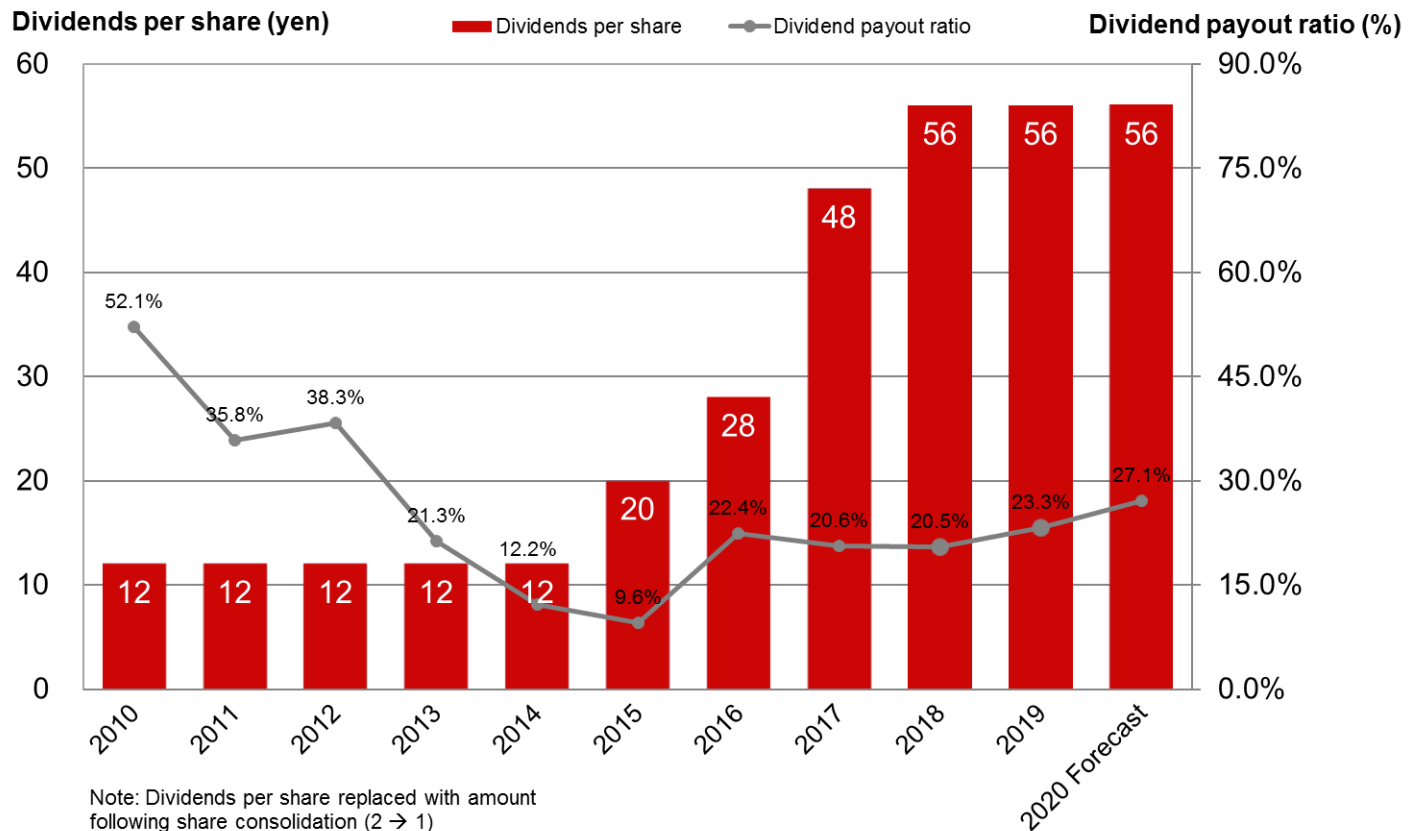
Equity capital and interest-bearing debt  
(Unit: billion yen)





## 5-2. Shareholder Returns

- ✓ Continue stable dividends
- ✓ Dividends determined by thoroughly considering results for the period, free cash flow, future business development, and other factors
- ✓ Set target for dividend payout ratio of around 30%



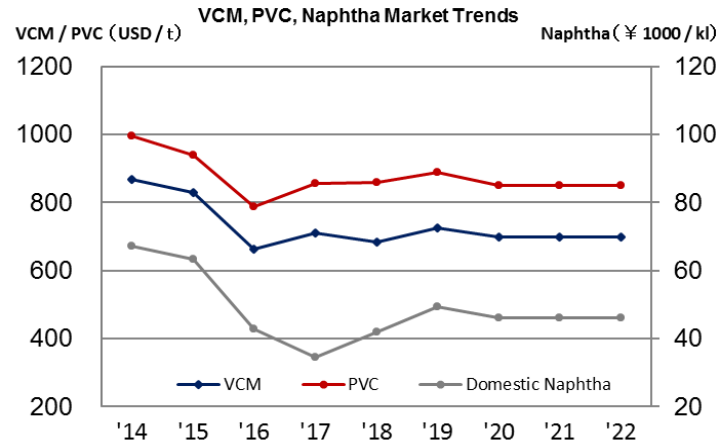
# 6-1. Business Strategies: Basic Chemicals

## Assumptions

- Limited global capacity increase for chlor-alkali
- Changes in Chinese environmental regulations to persist

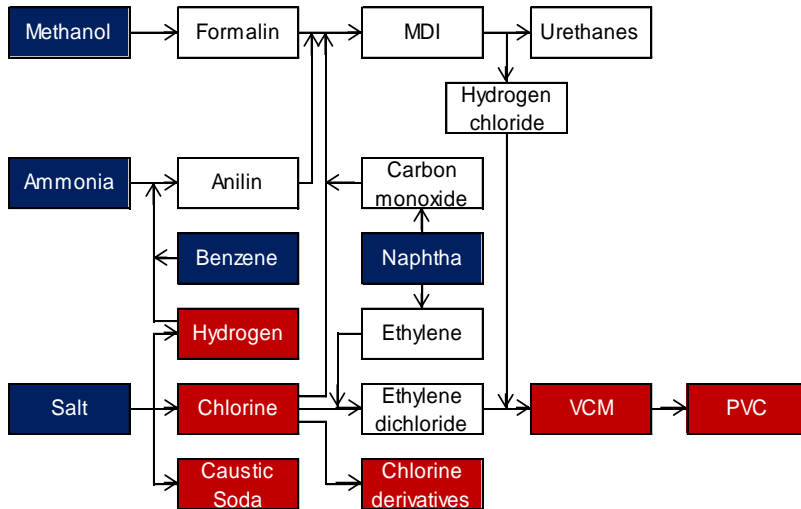
## Objectives

Strengthen business foundation, consider capacity increases



## Vinyl Isocyanate Chain

Chlor-alkali products : ■



## Key measures

- ✓ Optimize PVC manufacturing structure
  - Closure of Taiyo Vinyl Corporation's factory in Osaka
- ✓ Strengthen profitability of caustic soda and chlorine derivatives
  - Calcium hypochlorite (increase production efficiency / Tohoku Tosoh Chemical Co., Ltd.)
- ✓ Increase efficiency of in-house power generation facilities, biomass co-firing (promote energy conservation)
- ✓ Consider capacity increases, including the establishment of new overseas bases



TOSOH

## 6-2. Business Strategies: Urethanes

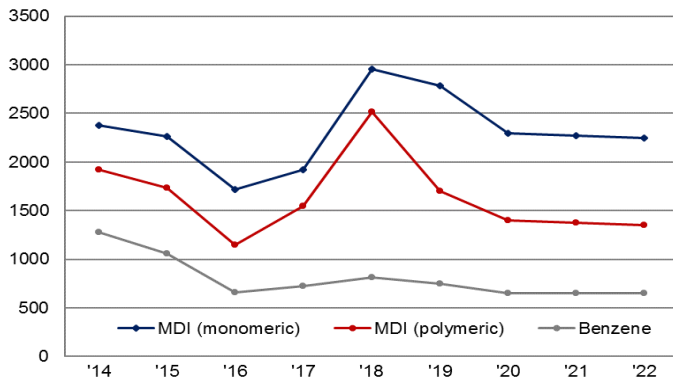
### Assumptions

- Softening demand due to capacity increases by manufacturers overseas
- Changes in Chinese environmental regulations to persist

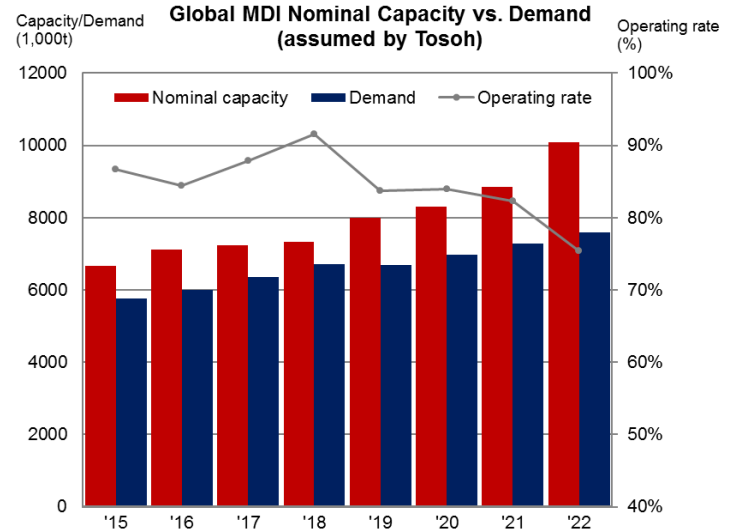
### Objectives

Stabilize and expand profits by offering high value-added products and diversifying customers

MDI/Benzene Market Trends



\*In FY2018, the supply-demand balance tightened due to plant issues that occurred with manufacturers overseas and strengthening of environmental regulations in China, resulting in strong market conditions. Figures for FY 2020-2022 are projections by Tosoh



### Key measures

#### MDI

- ✓ Expand sales of specialty MDI, such as modified MDI
- ✓ Expand sales in growing markets such as India and Southeast Asia
- ✓ Expand production of monomeric MDI
- ✓ Increase capacity by debottlenecking manufacturing operations

#### Functional Polyurethanes

- ✓ Increase supply and sales structure for medical devices
- ✓ Product differentiation of HDI derivatives (e.g. special curing agents)

## 6-3. Business Strategies: Olefins

### Assumptions

- As Japan's largest buyer of ethylene, Tosoh is in a favorable position to maintain a high naphtha cracker operating rate.
- Exports of US shale-derived ethylene to Asia, including derivatives

### Objectives

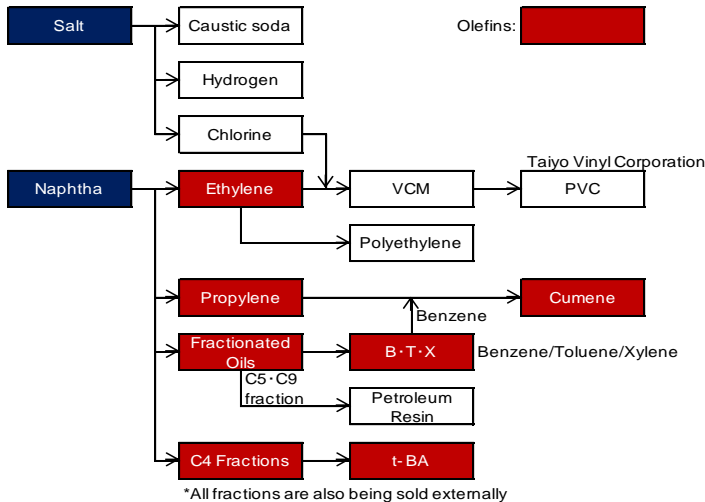
Strengthen competitiveness and maintain high operating rates for naphtha cracker

### Yokkaichi Complex Naphtha Cracker



Under the previous Medium-term Business Plan, it was decided to increase the efficiency of the naphtha cracking furnace and install a gas turbine. The gas turbine became operational in February 2019. Efficiency enhancement of the cracking furnace is scheduled for completion in 2020. Through a series of investments, the cost competitiveness of the Yokkaichi Complex will greatly improve.

### Yokkaichi Complex Product Flow



### Key measures

- ✓ Maintain high cracker operating rates through diversification of sales destinations
- ✓ Add high value to unused fractions
  - Aromatize unused fractions using Tosoh's catalysts
- ✓ Secure stable profits through the appropriate spread

## 6-4. Business Strategies: Polymers

### Assumptions

- Weak demand in Asia for polyethylene resin due to inflow of shale products
- Supply-demand balance of chloroprene rubber to remain tight

### Objectives

Grow profits through product differentiation and adding high value

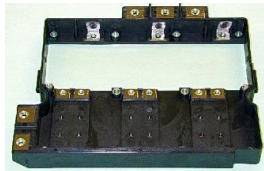
### Polyphenylene sulfide (PPS) compound with improved thermal shock resistance

#### Characteristics

- Improved resistance to temperature changes by 80% compared to industry-standard products

#### Applications

- Demand forecast to grow due to shift toward use of non-metal materials so as to reduce automobile weight
- Growing demand for materials with enhanced thermal resistance for the manufacture of automobile parts that are made through metal insert-molding.



(Part formed through metal insert molding)

### Key measures

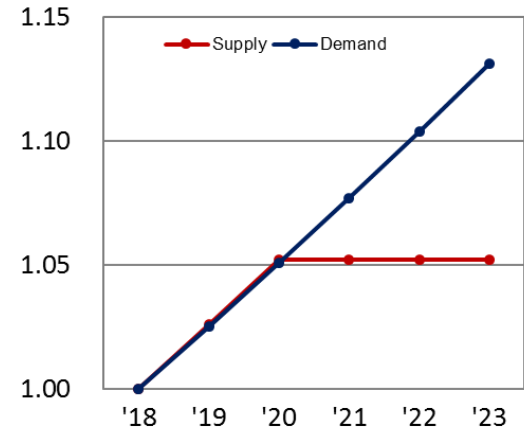
#### Polyethylene

- ✓ Continue research to promote product differentiation using application lab at new research facility
- ✓ Take ultra-high molecular weight polyethylene to market

#### Functional Polymers

- ✓ Further debottlenecking of chloroprene rubber plant and considering additional lines
- ✓ Market launch of new high-performance PPS compound and considering additional lines
- ✓ Expand sales of PVC paste, advanced vinyl-acetate products for automobiles

Global Chloroprene Rubber Supply-Demand Trends (assumed by Tosoh)



Indexed with 2018 supply-demand at "1"

## 6-5. Business Strategies: Advanced Materials (High-silica zeolite)

### Assumptions

- Increased demand for catalysts due to tightening of automobile gas exhaust emission regulations in 2020-2025 (China, India, Europe)
- Expanded demand for applications such as volatile organic compound adsorption due to tightening of environmental regulations

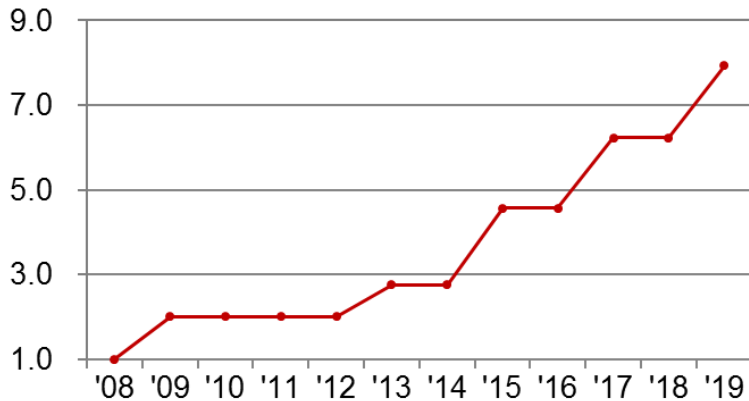
### Objectives

Development and sales expansion of high-performance grades in automotive fields, expand business for molded products in petrochemical and environmental fields by cultivating high-end niche demand

### Key measures

- ✓ Continue to introduce differentiated grades into market.
- ✓ Establish new brand and ensure stable production
- ✓ Expand molded grades for use (for environmental remediation use)

High-silica Zeolite Production Capacity Trends



Indexed with 2008 production capacity at "1"

### High-silica zeolite (HSZ®)

#### Characteristics

Features high thermal and acidity resistance, used in catalytic or hydrophobic adsorbent applications

#### Applications

Automobile exhaust cleaning catalyst, petroleum refining catalyst/petrochemical catalyst, volatile organic compound adsorbent, etc.

#### Product forms

In addition to powdered form, HSZ is also offered in molded products (pellets, beads etc.)



(Powder)



(Beads)



(Pellets)

## 6-5. Business Strategies: Advanced Materials (Zirconia)

### Assumptions

- Dental materials: In addition to steady demand in Japan, America, and Europe, zirconia is gradually becoming well known in emerging nations as well
- Decorative applications: Increasing demand for use in high-end devices such as mobile devices and wristwatches
- Grinding & dispersion media: Demand for laminated ceramic capacitors for automotive applications will expand rapidly

### Objectives

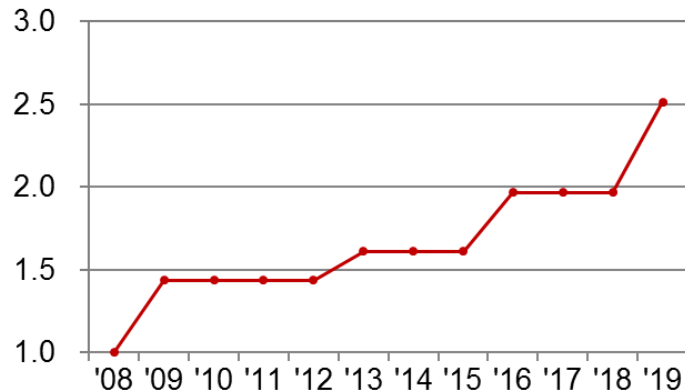
Maintain majority share in high-end markets by introducing differentiated grades

### Key measures

- ✓ Dental materials: Offer new functionality in addition to translucency
- ✓ Decorative: Expand applications by ascertaining customer needs

Zirconia Production Capacity Trends

\*Indexed with 2008 production capacity at "1"



### Zirconia

#### Characteristics

- Aesthetic, high-strength fine ceramic, can be colored

#### Applications

- Dental materials (natural tooth color shade and translucency), decorative products (bezels for high-grade watches), grinding media

Zirconia sintered body with color adjustment  
(Dental materials)



(Zirconia grinding media)



(Zirconia two-color sintered body)



## 6-5. Business Strategies: Advanced Materials (Silica glass)

### Assumptions

- ~1H FY20: Semiconductor market stagnated due to drop in memory growth.
- 2H FY20 ~ : Recovery in the memory market, recovery with the rise in demand for 5G
- Strong demand in fields other than memory as IoT and AI for electric vehicles become more available

### Objectives

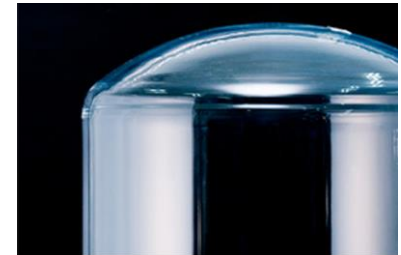
Identify demand trends, invest further as opportunity appears

### Key measures

- Increase production capacity of silica glass materials and fabricated quartzware
- Silica glass materials (Tosoh SGM Corporation)
  - Strengthen cost competitiveness in line with capacity increase
- Fused silica products for semiconductor manufacturing equipment (Tosoh Quartz Corporation)
  - Increase deposition and etching process parts through miniaturization and lamination
  - Promote labor saving through automation of hot processing

### Fabricated quartzware

(Tubes)



(Flanges)



(Large flanges)



(Plates)



(Rings)





## 6-6. Business Strategies: Organic Chemicals

### Assumptions

- Ethyleneamines: Supply-demand continues to soften for mainly low-margin ethyleneamines
- Bromine and bromine-based flame retardants: Production increases at overseas manufacturers constrained by raw material and environmental issues.

### Objectives

Expand and strengthen profit base by increasing production capacity of existing businesses and commercializing new products

### Key measures

#### Amines

- ✓ Stabilize profits by focusing on high-margin ethyleneamines
- ✓ Promotes sales by diversifying grades of RZETA® (low-emission polyurethane catalyst)

#### Bromine/Bromine-based Flame Retardants

- ✓ Expand profit base through capacity increases
  - Increase efficiency of bromine production by renewing and expanding facilities for flame retardants

#### New Products

- ✓ Commercialize new conductive polymer materials, aldehyde scavengers, etc.

### Bromine

#### Applications

Primarily used as a flame retardant. Also as a water treatment sterilizer, specific gravity adjustment for oil drilling, pharmaceutical intermediate, etc.

#### Production Method

- Overseas manufacturers extract bromine from salt lakes (Dead Sea, etc.), brine (underground saline spring)
- Tosoh extracts bromine from seawater

#### Demand

Global demand expected to be just under 600,000 tons, with annual growth rate of 3%

#### Supply

Amidst tightening environmental regulations, lower salt lake water levels, and reduced brine concentration, manufacturers overseas are struggling to increase capacity



(Bromine)

## 6-7. Business Strategies: Bioscience

### Assumptions

- Separations and purification: Growing in demand for columns and separation and purification media for biopharmaceuticals
- Immunoassay diagnostics: Competition intensifies due to measures to reduce healthcare expenditures in Europe and America; Growth in demand forecast in emerging nations due to economic growth
- A1c diagnostic systems: Growth in demand in emerging nations as economies grow

### Objectives

Expand business fields and sales in emerging markets through the integration of Tosoh and external technologies

### Key measures

#### Analyzers

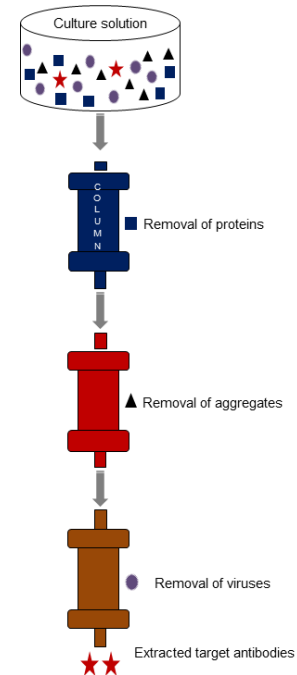
- ✓ Expand product lineup of columns for biopharmaceuticals and separation media

#### Diagnostics Systems

- ✓ Development and marketing of new diagnostic markers
- ✓ Expand sales in China and India

#### Liquid Chromatography

- ✓ Increase production capacity for A1c columns and reagents



### Separation and Purification of Antibody Drugs

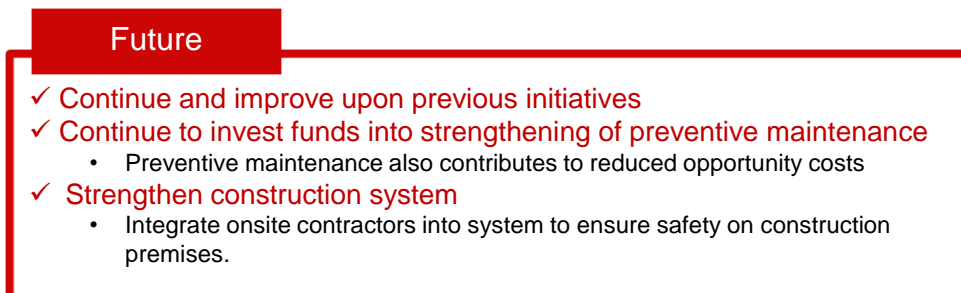
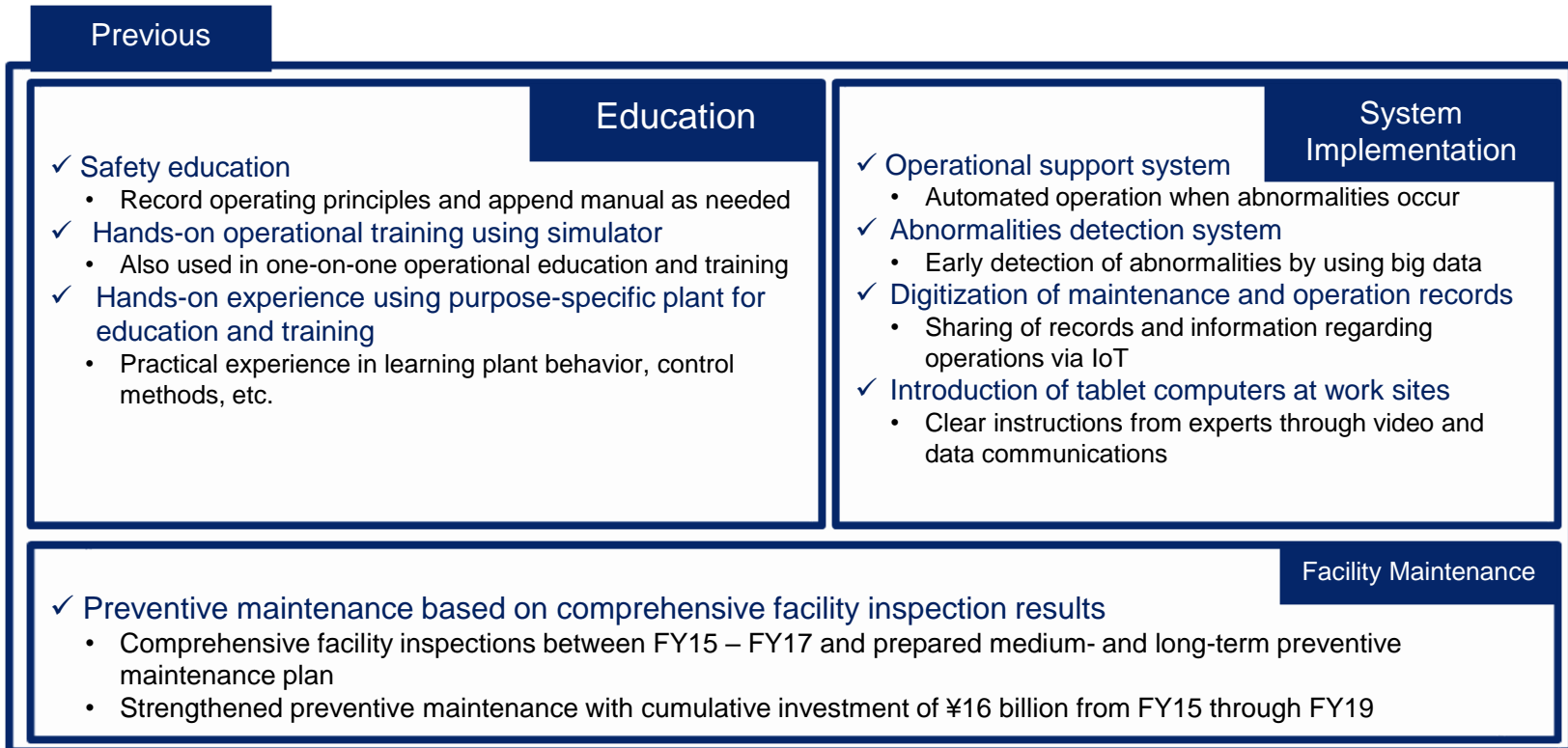
#### Antibody Drugs

- Biopharmaceuticals with antibodies as principal ingredient
- Treatment with minimal side effects as antibodies only act against one target (antigen)
- Columns are replenished with separation and purification media, antibodies are extracted



Columns, and separation and purification media

## 7-1. Safety Strategies: Strengthening Safety Foundation



Purpose-specific Training Plant (Nanyo Complex)

## 7-2. Safety Strategies: Cultivating a Culture of Safety

### Previous

- ✓ **President's visit to control rooms (since FY 2013)**
  - President affirms that safety is top priority directly to employees
- ✓ **Strengthen Hazard Prediction Training<sup>1</sup>**
  - All employees at Yokkaichi and Nanyo Complexes take Hazard Prediction courses from external instructors
- ✓ **Strict observation of the 5S principles<sup>2</sup>**
  - Complex-wide 5S activities instead of partial (i.e. individual divisions and departments)

### Future

- ✓ **Continue and improve upon previous initiatives, aim to further enhance safety awareness**
- ✓ **Deepen hazard risk assessment**
  - Strengthen identification of sources of danger and countermeasures

<sup>1</sup> Hazard Prediction training is training where the potential causes of hazards at work are discussed prior to work, and awareness is achieved regarding danger points.

<sup>2</sup> The 5S principles - Sort, Set in order, Shine, Standardize, and Sustain – are activities to maintain and improve the workplace environment.

## 8. Promotion of Energy Reduction and Effective Use of CO<sub>2</sub>







### Previous Initiatives

- ✓ **Use refuse at cement plant (since FY2008)**
  - Effectively use waste as heat energy (plastic waste, crushed remains of automobiles and consumer electronics products, others)
- ✓ **Remodel energy-saving electrolysis facilities (since FY2010)**
  - Gradually replace with Tosoh-developed equipment that boast global-standard energy-saving performance
- ✓ **Introduce advanced control system at ethylene plant (since FY2015)**
  - Introduced system that automatically adjusts to optimal operating conditions, established advanced energy-saving operating technology
- ✓ **Reduce shipping costs of coal through large-scale coal transport (since FY2017)**
  - Used public docks as an opportunity to gradually increase coal transport via large-scale transport vessels (Panamax)
- ✓ **Achieved effective fuel use by increased efficiency of naphtha cracker and installation of gas turbine (FY2019)**
  - Through increased efficiency, used surplus methane byproduct as gas turbine fuel, and used high-temperature gas turbine exhaust gas as a heat source for cracking furnace
- ✓ **Inauguration of Committee for the Advancement of CO<sub>2</sub> Reduction & Effective Use**
  - Launched companywide cross-departmental organization to consider CO<sub>2</sub> reduction and effective use

### Future Initiatives

- ✓ **Introduce cutting-edge technologies at in-house power generation facilities (from FY2020)**
  - Gradually renew turbine rotors
- ✓ **Introduce advanced control system at in-house power generation facilities (from FY2020)**
  - Enhance efficiency by introducing optimal load balancing system
- ✓ **Expand facilities for using waste material at cement plant (from FY2022)**
  - Expand plastic waste treatment facilities that are capable of processing low-grade waste plastic
- ✓ **Reduce volume of coal used in power generation boiler (from FY2022)**
  - Remodel facility so as to reduce coal used in co-firing of construction waste material (biomass)
- ✓ **Develop CO<sub>2</sub> concentration and purification technology, consider transformation of CO<sub>2</sub> into raw material**
  - Allocate budget by prioritizing projects based on cost-effectiveness and complexity of technology, begin comprehensive study on projects starting from those with highest priority

# Tosoh Products' Contribution to Society: Infrastructure

Product Name	Application	Notes	Related SDGs
Portland cement	Civil engineering and construction work	Portland cement is used in construction projects, and is the most highly versatile cement. About 70% of the cement used domestically is Portland cement.	 <p>3 GOOD HEALTH AND WELL-BEING</p>
Blast-furnace slag cement	Large-scale construction projects including construction of dams and ports	Blast furnace cement is Portland cement mixed with fine powder from blast furnace slag emitted from steel mills. It is characterized by the fact that its strength increases over time.	
Polyvinyl chloride (PVC)	Water and sewage pipes	PVC resin is excellent in durability, and a PVC pipe has strength similar to that of a new one even after several decades. Excellent chemical resistance (strong against both acid and alkali).	 <p>6 CLEAN WATER AND SANITATION</p>
	Wire coating	PVC has high electrical insulation characteristics. It also has superior weather resistance and flame retardancy, and plasticizer hardness can easily be adjusted.	
Water treatment systems	Pure water production at power plants	Systems that produce high-purity water are used at power plants. To ensure long-term safe operation at power plants, water from which impurities have been removed is circulated, and converted to steam to drive the turbines.	 <p>7 AFFORDABLE AND CLEAN ENERGY</p>
	Water purification at municipal water facilities	Systems that perform water purification to remove turbidity and trace amounts of harmful substances, and installation of advanced water treatment technologies that utilize activated carbon and ozone.	
	Wastewater treatment at sewage treatment facilities	Systems that clean wastewater produced at households and factories. Removes nitrogen and phosphorous that cause eutrophication.	
Sodium hypochlorite	Sterilization of water at water supply and sewage facilities	Sterilization using chlorine components. Sodium hypochlorite is saved and used in an aqueous state. As it is a liquid, the amount used can be easily adjusted.	 <p>9 INDUSTRY, INNOVATION AND INFRASTRUCTURE</p>
Polyaluminum chloride (PAC)	Coagulation treatment of impurities at municipal water facilities	PAC is used as a flocculant (promotes the clumping of particles) in sewage water treatment.	 <p>11 SUSTAINABLE CITIES AND COMMUNITIES</p>
Light-emitting diode (LED) materials	Traffic lights	There are times when conventional traffic lights using incandescent or halogen-based light bulbs appear to be blinking due to the afternoon sun, and LED-type lights prevent that phenomenon from occurring, thus helping to reduce traffic accidents	
Calcium chloride	Snow-melting agent	Calcium chloride reacts with water and generates a large volume of heat, plus it is ideal for freeze proofing and melting snow on roads.	 <p>13 CLIMATE ACTION</p>
Heavy metal treatment agent	Removal of heavy metals (garbage incineration)	Harmful heavy metals such as lead are found in fly ash produced from trash incinerators. Heavy metal treatment agents are used to capture these metals in the fly ash, so that they can be disposed of in a landfill.	
	Removal of heavy metals (wastewater treatment)	Harmful heavy metals in wastewater from factories and other facilities are captured using a heavy metal treatment agent, and after being precipitated with a flocculant, the supernatant is filtered and discharged.	



## Tosoh Products' Contribution to Society: Construction and Residential

Product Name	Application	Notes
MDI (polyurethane raw material)	Insulation	MDI is one of the main raw materials used in the manufacture of polyurethane foam. By locking in air and high thermal insulation gas, the foam can gain thermal insulation properties.
	Waterproof paint	Applying liquid polyurethane resin to surfaces such as roofs forms a waterproof layer. It is liquid so it can also be used on complex shapes. Polyurethane resin has high elasticity and resists cracking.
HDI (polyurethane-based non-yellowing curing agent)	Exterior paint	Polyurethane-based paint with HDI used as a hardening agent does not suffer yellowing deterioration to its coating film from ultraviolet rays and is highly durable.
TOYOCAT® (polyurethane foam catalyst)	Insulation	Toyocat is a foam catalyst compatible with low global-warming-potential polyurethane blowing agent, a next-generation Freon hydrofluoroolefin (HFO). It is used in polyurethane insulation sprays.
Polyvinyl chloride (PVC)	Sash for window frames	PVC resin has high thermal insulation properties (resin does not easily conduct heat), and features superior weather and water resistance.
	Rain gutter	PVC resin has superior weather and water resistance, and does not rust like metal.
	Waterproof sheets	Forms a waterproof layer by affixing it to a sheet-form waterproof material. PVC resin has superior weather and water resistance, and is also flame resistant as more than half the raw material is salt.
	Exterior wall (siding)	PVC resin has superior weather and water resistance and thermal insulation properties, and is also flame resistant.
PVC paste	Wallpaper	PVC paste is a special PVC where the particle size is precisely controlled. It becomes a paste with good liquidity when mixed with a plasticizer at normal temperatures, and is easy to process. It also has good printability.
	Flooring	PVC paste has superior weather and water resistance like PVC resin, and is also flame resistant. It is moldable at normal temperatures (heat is unnecessary in processing), contributing to energy conservation.
Ethylene-vinyl acetate copolymer (EVA)	Solar panels (solar cell encapsulation materials)	EVA features superior weather resistance, adhesiveness, and optical transparency, and is used as a film raw material in preserving and sealing solar battery cells.
Diethylzinc	Solar panels (transparent conductive film)	Diethylzinc is used as a raw material in zinc oxide film for thin-film solar cells (transparent conductive film).




## Tosoh Products' Contribution to Society: Automotive

Product Name	Application	Notes
Caustic soda	Aluminum parts	In the aluminum manufacturing process, bauxite is heated and melted and the alumina component is extracted; in doing so, large volumes of caustic soda are used. Aluminum parts are often used as they can reduce the weight of automobiles.
MDI (polyurethane material)	Parts (rebound polyurethane, other)	Thermoplastic polyurethane resin (TPU) is resin that combines the elasticity of rubber and the toughness of hard plastic.
	Seat cushions	Polyurethane foam can be produced with varying levels of strength and elasticity by changing the compounding ratio of raw materials.
	Seat covers	Polyurethane synthetic leather is made by applying polyurethane resin to non-woven fabric. It has a texture similar to natural leather.
HDI (polyurethane-based non-yellowing curing agent)	Paint (polyurethane-based paint)	Paint that is used with HDI as a hardening agent does not suffer coloring deterioration from ultraviolet rays, and is highly durable.
RZETA® (polyurethane foam catalyst)	Seat cushions	RZETA reduces volatile organic compounds (VOC) that are emitted from the use of catalysts, making the manufacture of low-odor polyurethane foam possible.
TBA (brominated flame retardant)	Electronic circuit board	TBA contributes to high flame retardancy in brominated epoxy used in laminated boards (electronic circuit boards). Demand is growing in line with progress in automotive electrification.
PVC paste	Underbody coating for preventing rust and stone damage	PVC paste becomes a paste with good liquidity when mixed with plasticizer at normal temperatures, and can be used as a spray coating. It also features superior adhesiveness.
Chloroprene rubber (CR)	Parts (belts, boots, hoses, other)	CR features superior oil, chemical, heat, and weather resistance, and has high mechanical strength. Crystal resistant grade does not easily become hard even in low temperatures.
Chlorosulfonated polyethylene (CSM)	Parts (various types of hoses, other)	CSM has the same characteristics of CR, but has even higher heat and weather resistance. Moreover, it is a synthetic rubber that can be easily colored. Tosoh is the world's only manufacturer.
Polyphenylene sulfide (PPS)	Parts around the engine	PPS is an engineering plastic with extremely high heat resistance and stability. It is used in parts around the engine that require resistance to temperature changes. It also contributes to the reduction of automobile weight.
Silica	Fuel-efficient tires	Using silica as a reinforcing filler in fuel-efficient tires improves rolling resistance performance (impacts fuel consumption) and wet grip performance (gripping power on wet surfaces).
High-silica zeolite® (HSZ)	Exhaust gas cleaning catalyst	HSZ is used as a catalyst that assists in chemically breaking down the NOx emitted from diesel-powered vehicles.






# Tosoh Products' Contribution to Society: Healthcare

Product Name	Application	Notes	Related SDGs
Glycohemoglobin analyzer	Aid in the diagnosis of diabetes, others	Based on the principles of high-speed liquid chromatography, it performs separation measurement of hemoglobin in the blood which serves as an index to aid in the diagnosis and monitoring of diabetes and blood sugar control.	
Immunoassay analyzers and reagents	Blood and urine tests	Through fully automated immunoassay analyzers, biological components such as proteins and hormones in blood and urine are measured; used in tumor and disease examinations.	
Genetic testing equipment and reagents	Genetic testing of infectious diseases etc.	A small, automated system based on the TRC (transcription-reverse transcription concerted reaction) method, it rapidly performs viral and bacterial nucleic acid purification, amplification, and detection; used in infection disease testing.	
Water production equipment for pharmaceuticals	Production of water for pharmaceuticals	Equipment that produces purified water used in manufacturing pharmaceuticals	
Trifluoroethanol (TFEA)	Anesthetics	TFEA is a fluorine compound, and is used as a raw material for anesthetics.	
Low-density polyethylene (LDPE)	Eye drop containers	LDPE is flexible and strong against shock and rupture, and has superior chemical resistance.	
Linear low-density polyethylene (L-LDPE)	IV infusion bags	L-LDPE incorporates the characteristics of LDPE, and also features superior low-temperature sealability (a bag can be crimped and sealed at low temperatures).	
Chloroprene rubber	Surgical rubber gloves	Rubber gloves are used in operating rooms where gloves are required to fit snugly. If the material is synthetic rubber, allergies to natural rubber can be circumvented.	
Zirconia	Dental materials	Zirconia is a fine ceramic material with high strength and toughness (not brittle). Dentures and teeth made from zirconia have color tone and translucency that looks similar to real teeth.	
Medicinal oxygen	Medicinal oxygen	Medicinal oxygen is subject to High Pressure Gas Safety Act and Pharmaceutical Affairs Act (gas concentration, properties, purity test, and more are specified) regulations.	
Baking soda (sodium bicarbonate)	Gastrointestinal medicine	Baking soda neutralizes the acidity of gastric juice, and relieves inflammation.	
	Artificial dialysis	Baking soda is used as an artificial dialysis agent. To return acidic bodily fluid to a low alkaline state in the event of kidney failure, baking soda is included in dialysis fluid as an alkalization agent.	
MDI/TDI (polyurethane raw materials)			

## (Reference) Social Contribution of Tosoh Products / Electronics

Product Name	Application	Notes	Related SDGs
Silica glass ingots	Fabricated silica glass products	Silica glass is glass that is extremely low in impurities (almost all of its elements consist of silicon dioxide). High in purity, it features superior heat resistance, optical transmission, and chemical resistance.	 <p>9 INDUSTRY, INNOVATION AND INFRASTRUCTURE</p>
Fabricated silica glass products	Jigs for semiconductor manufacturing	In addition to heat resistance, optical transmission, and chemical resistance, semiconductor manufacturing jigs are required to have chemical purity (non-reactive to semiconductor materials). Silica glass is a material that meets these requirements.	
	Photomask substrate for LCDs	Photomask substrates are required to have high optical transmission, and they use fused quartz made from chemically fused silica which is higher in purity than fused quartz made from melted crystal powder.	
Sputtering targets	Thin film materials	Sputtering targets are materials used when forming micron-level metal thin films essential to the semiconductor and flat-panel display manufacturing processes.	
Photoresist monomer	Photoresist materials	Photoresist material are used in semiconductor manufacturing.	
High-performance etching gas	Etching in semiconductor manufacturing	The ability to perform deep drilling and high-performance etching gas with low resist damage (improved yield) is required in 3D-NAND technology, which stacks memory cells vertically in multiple layers.	
High-purity phosphoric acid	Etching in semiconductor manufacturing	High-purity phosphoric acid is manufactured using the dry method, which has few impurities. It is used in the etching process in semiconductor manufacturing.	
Ultrapure water production equipment	Cleaning of electronic parts	Equipment for producing ultrapure water (water from which impurities have been removed) used in cleaning and other processes in semiconductor manufacturing. Impurities in cleaning water leads to defective products.	
Multi-functional water production equipment		Water purification equipment that can further purify ultrapure water to produce purified water with excellent cleaning properties, such as hydrogen infused water and ozonated water. In addition to improved cleaning performance, a reduction in chemical use can be achieved.	
Electron transport materials and hole transport materials	Organic electroluminescence (EL) materials	Electronic transport material and hole transport material for organic EL. Organic EL elements are comprised of a transparent anode, a hole transport layer, a light emitting layer, an electron transport layer, and a cathode.	



## **Note:**

This presentation contains information and medium-term plans and forecasts based on data available at the present time. As such, Tosoh Corporation makes no guarantees regarding forward-looking plans or forecasts as the operating environment is subject to risks and uncertainties that may result in substantial changes in the future.