Electronic Materials Business Division

Business Briefings

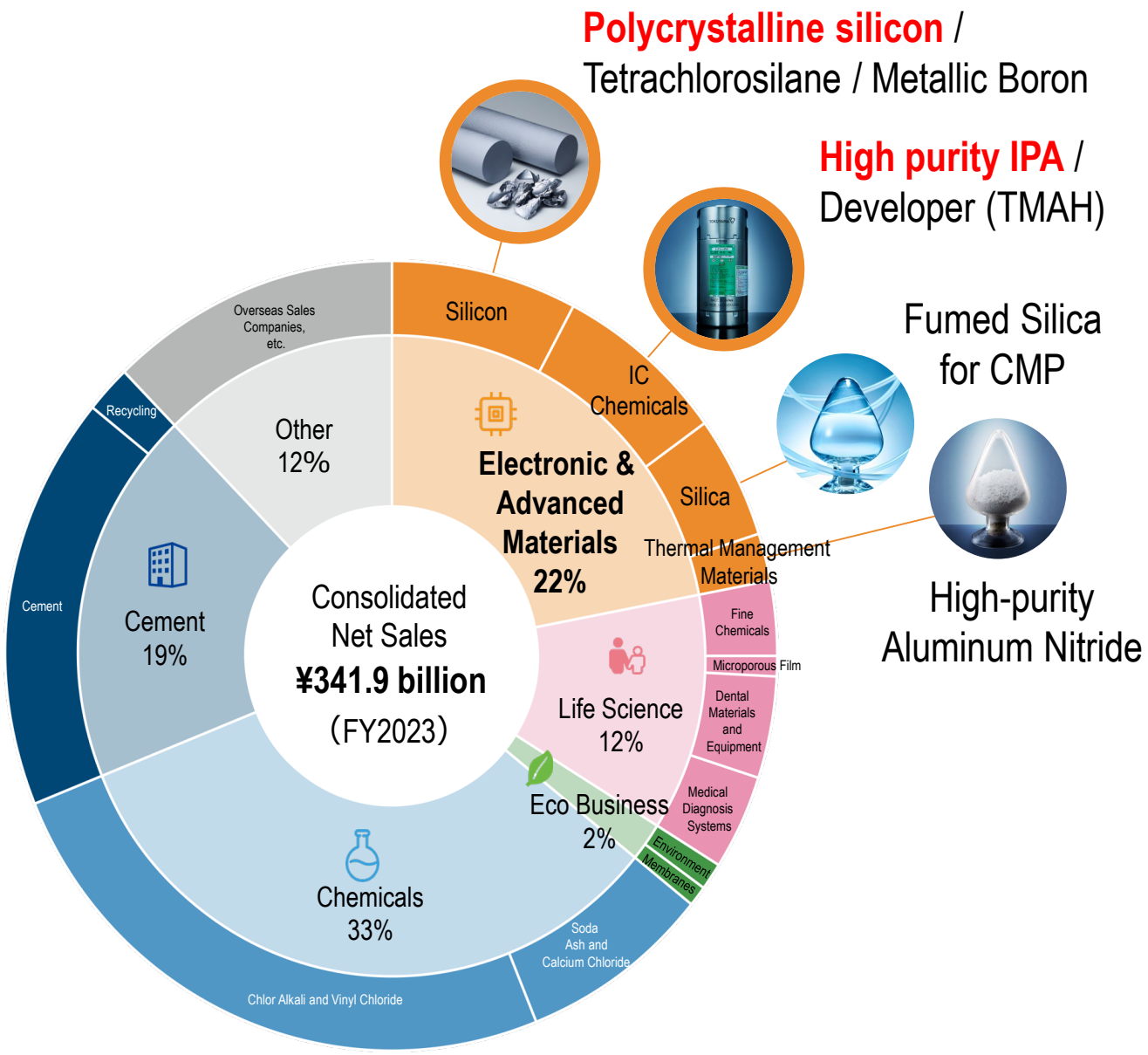
September 20, 2024

Tokuyama Corporation

Contents

1. About the Electronic Materials Business Division

Electronic Materials Business Division



Electronic & Advanced Materials Business Goal

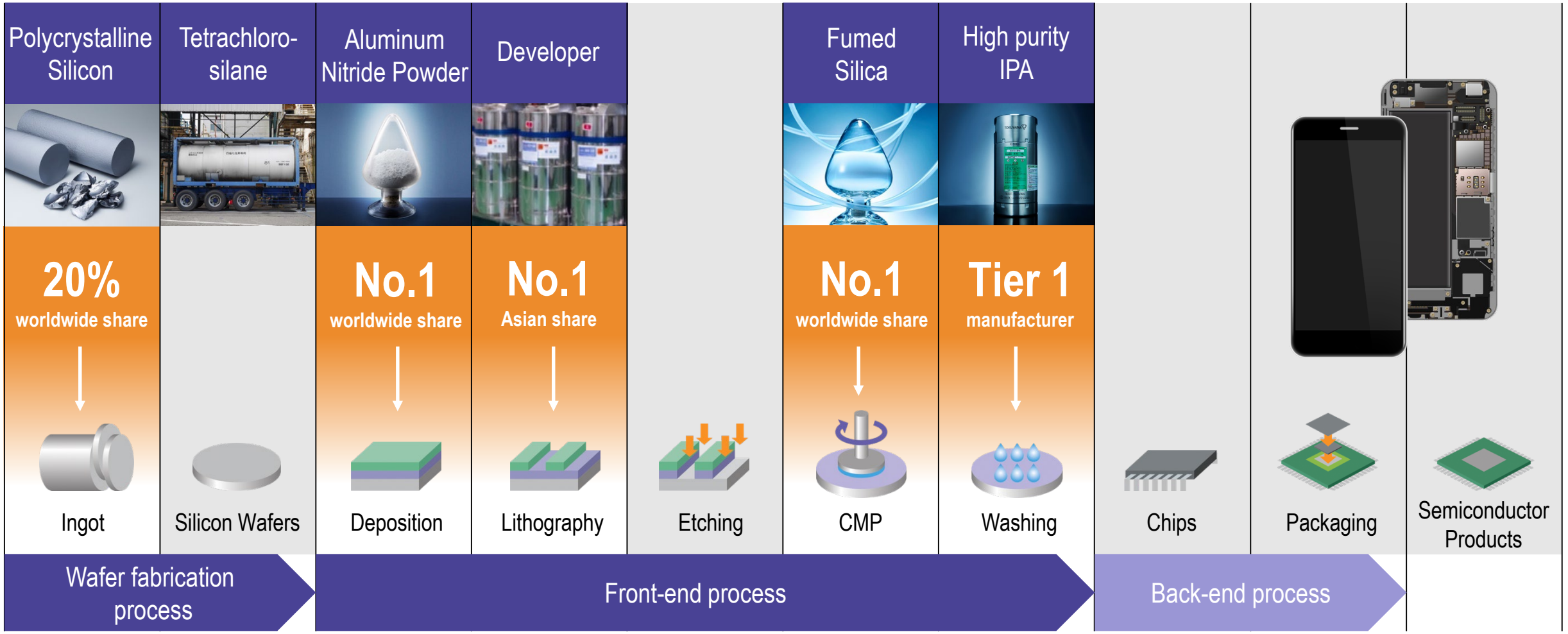
Push forward with globalization, and capture top share in the high-purity and thermal management materials fields supporting the miniaturization and stacking of semiconductors

Priority Measures

- **Pursue aggressive expansion in overseas markets**
- **Develop new applications, expand product portfolio**
- **Produce high-quality products, pursue analysis technology**

Tokuyama Products Used in Semiconductor Manufacturing Processes

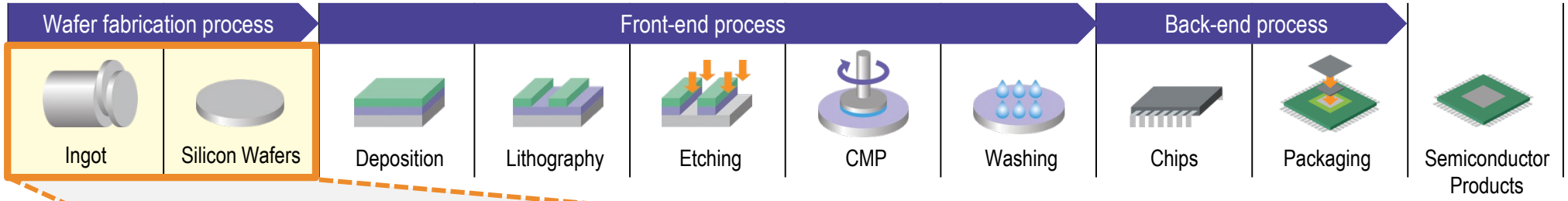
Tokuyama Group supplies the market with materials that are essential to semiconductor manufacturing.



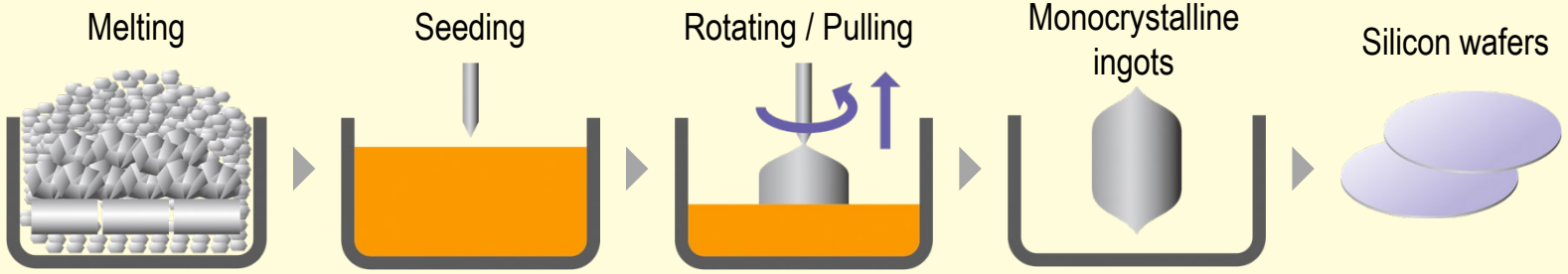
2. Semiconductor-grade Polycrystalline Silicon Business

About Polycrystalline Silicon

Polycrystalline silicon is the raw material for monocrystalline silicon wafers and is considered the underlying initial material for various semiconductor products.

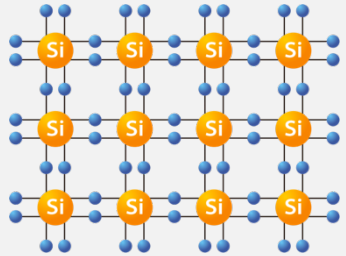


Polycrystalline silicon



Crystal perfection is integral to producing high quality wafers

High purity is required to prevent device failure



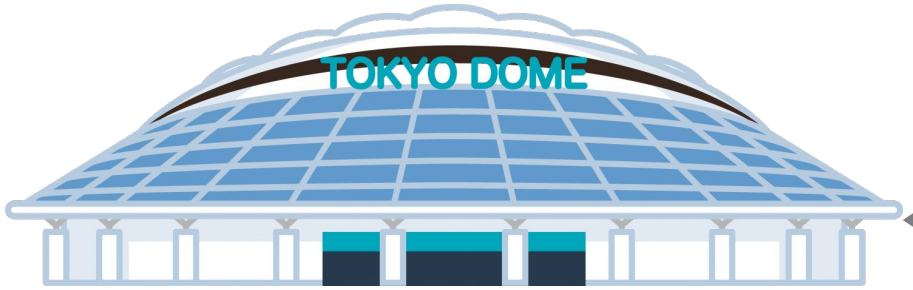
Various sizes are required for the better filling of crucibles

High purity is required to prevent device failure

Purity Required for Semiconductor-grade Polycrystalline Silicon (Image)

The purity required for semiconductor-grade polycrystalline silicon is at the parts per trillion (ppt) level.
This represents the salinity level of one teaspoon of salt dissolved in a cup of water the size of Tokyo Dome.

Semiconductor-grade polycrystalline silicon



The volume of water required to fill Tokyo Dome:
1.24 million tons

Saline concentration (salinity): 4pptw

* In practice, control concentrations vary from element to element.

Requirements for Application as an Advanced Product

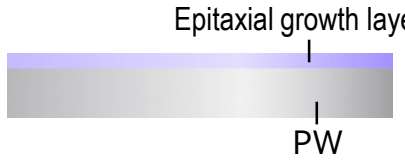
TOKUYAMA

Cutting-edge application example (logic)

A17 line width 3nm (TSMC)
1/10 line width after 10 years

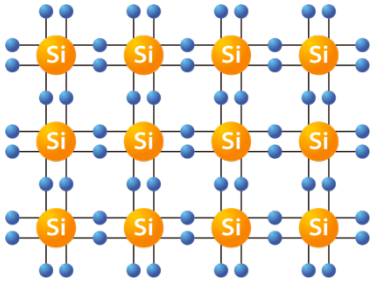
Wafers used: **High crystallinity and flatness required**

Epi wafer

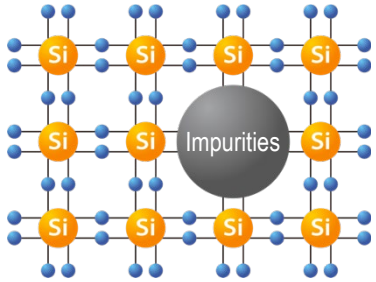


Wafer with high quality Si layer grown on PW

Good condition



Poor condition



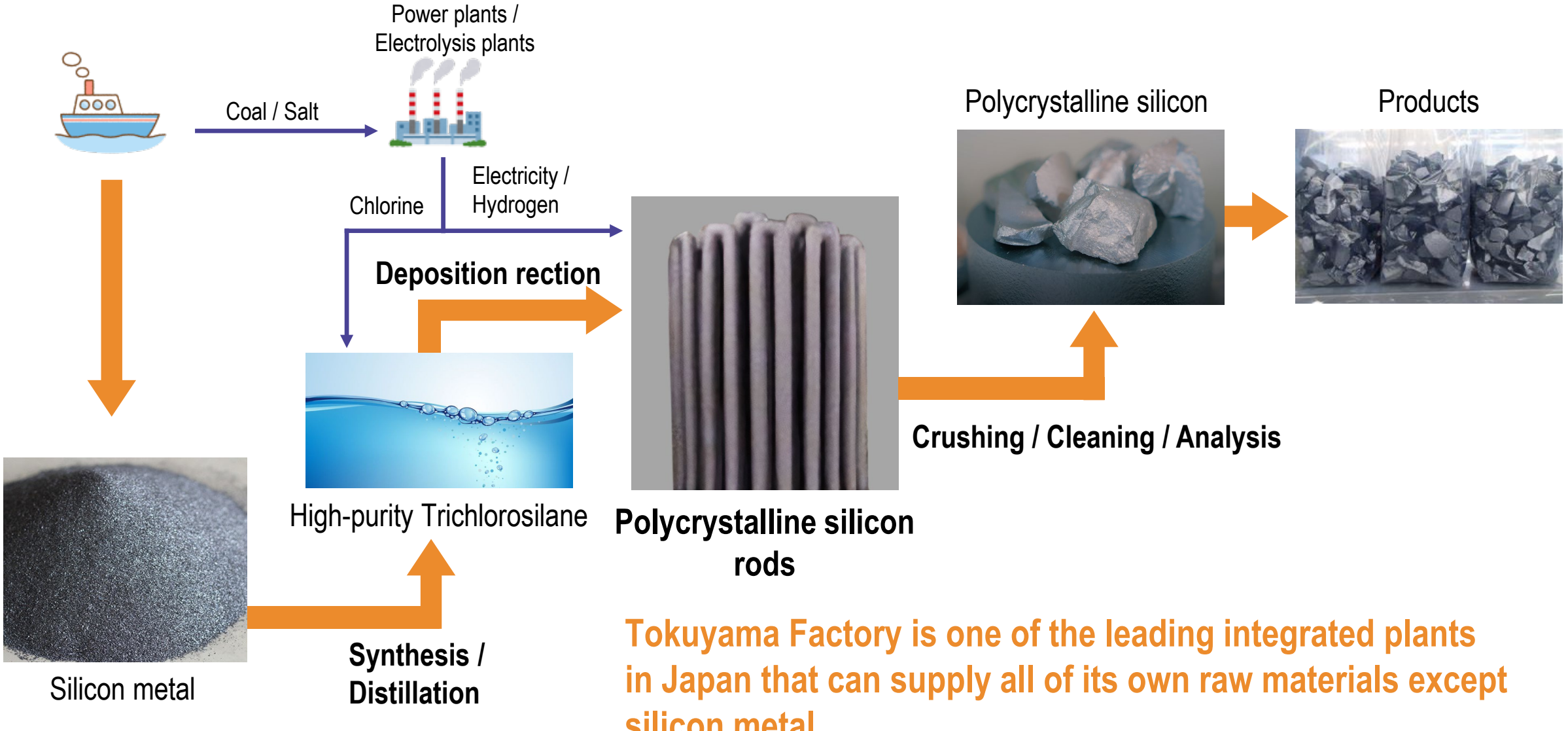
Slight impurities cause a deterioration in performance, including electrical characteristics and defects

Requirements for polycrystalline silicon, the main raw material for wafers

Extremely high levels of purity	High degree of cleanliness including surfaces	Quality stability

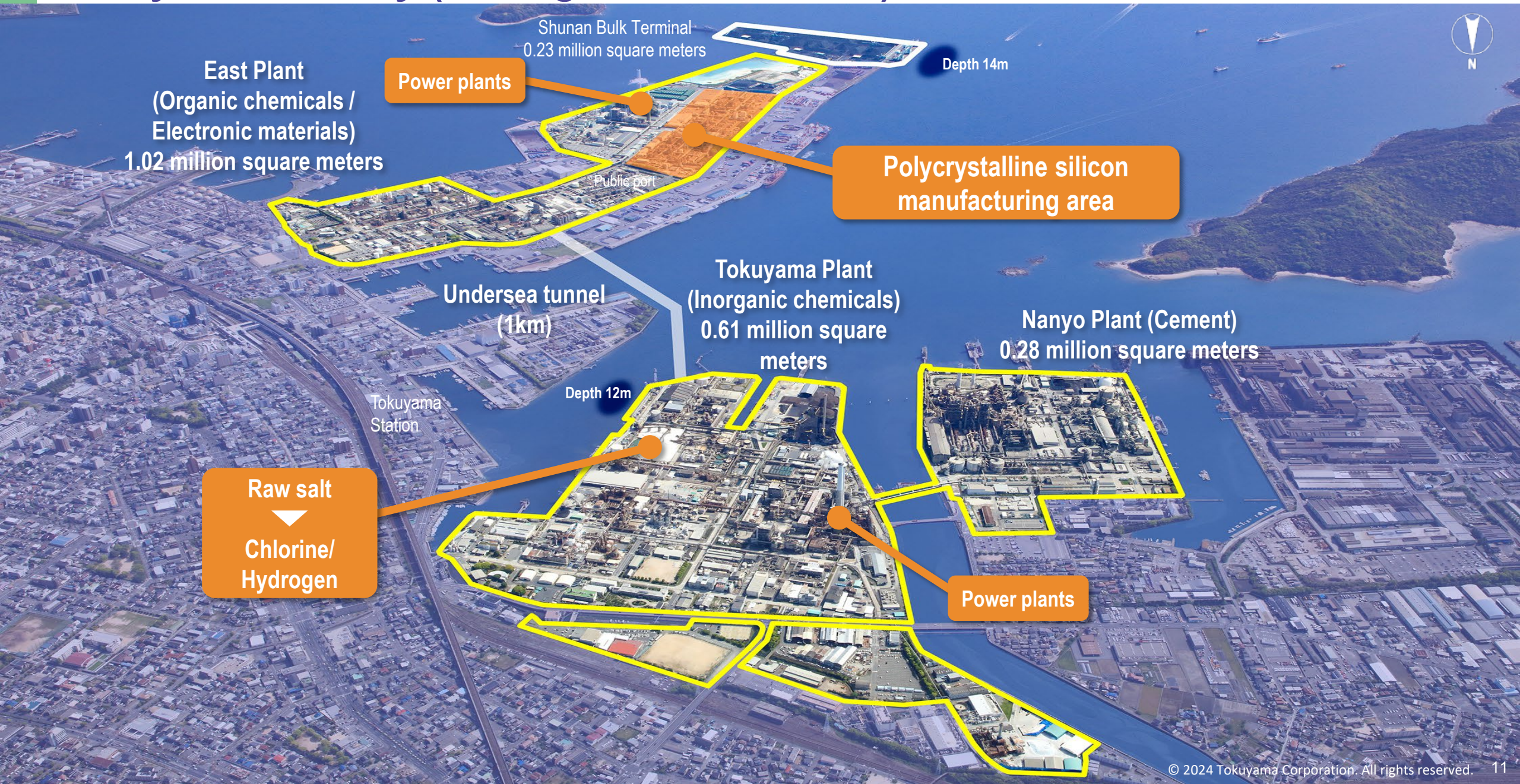
Polycrystalline Silicon Manufacturing Process

The manufacture of polycrystalline silicon requires large amounts of energy (electricity), hydrogen, chlorine, and silicon metal.



Tokuyama Factory is one of the leading integrated plants in Japan that can supply all of its own raw materials except silicon metal.

Tokuyama Factory (Yamaguchi Prefecture)



Technologies Required for the Manufacture of Polycrystalline Silicon

The manufacture of polycrystalline silicon requires high-purity, cleaning, and analysis technologies coupled with strict quality control. Leveraging its inherent strengths, Tokuyama is positioned to manufacture high-quality polycrystalline silicon.

Synthesis / Distillation	Deposition rection	Crushing / Cleaning	Product analysis
			
Distillation operating technology	**Reaction technology**	**Cleaning technology**	**Analysis / management technology**
Extremely high raw material purification	Pollution-free synthesis of highly purified raw materials	Cleansing of crushed polycrystalline silicon surfaces to remove impurities	Process management and the stable manufacture of products

Reasons for the Selection of Tokuyama's Polycrystalline Silicon

High purity

Tokuyama's strength in

Synthesis and high-purity technology

Quality improvement capability

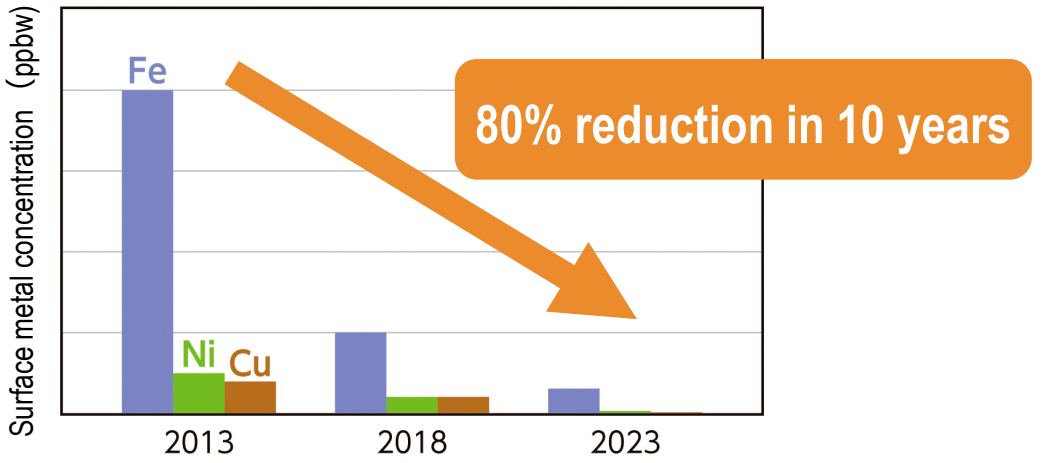
Quality improvement track record

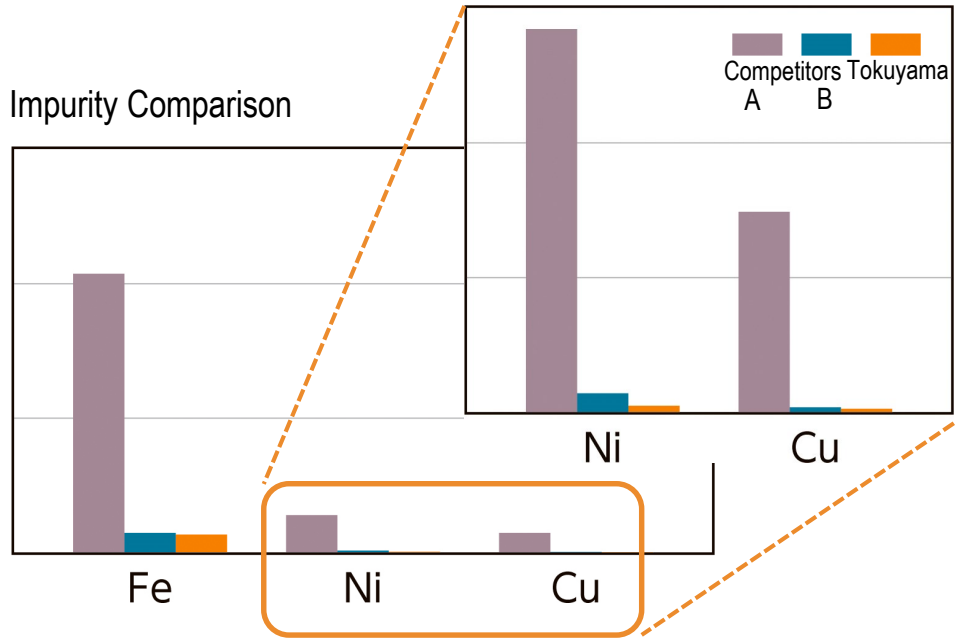
in support of customers' quality improvement roadmaps

Stability

Quality control

based on advanced analysis technologies

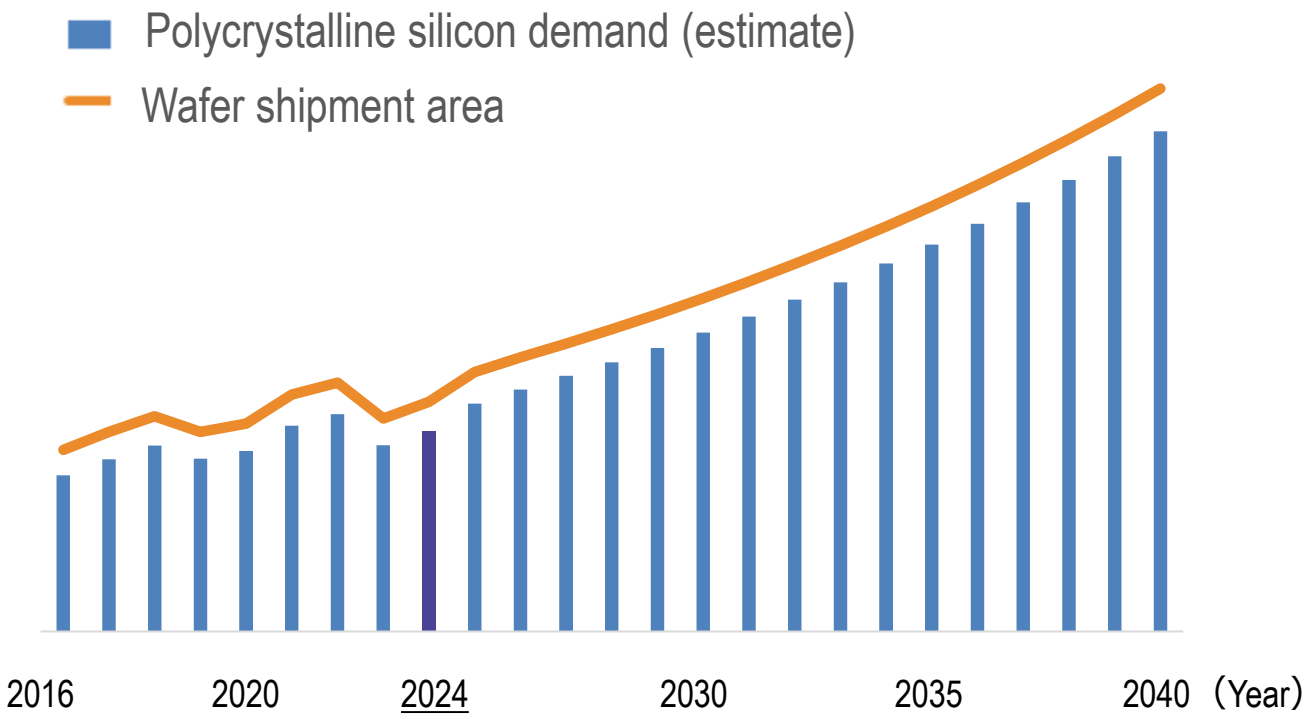




Market Growth and Expectations of Tokuyama

Market projected to experience continued growth due to the increase in semiconductor applications triggering significant expectations of Tokuyama

Semiconductor-grade polycrystalline silicon market forecasts (Tokuyama estimate)



Expectations of Tokuyama

Efforts to improve quality and analysis technologies in response to further miniaturization and layering

Resolution of environmental issues (reduction of GHG emissions)

New challenges

New Production Base (Malaysia)

Decision made to establish a joint venture with OCI, based in South Korea, to address market needs, including the stable supply of semiconductor-grade polycrystalline silicon and the use of clean energy.
Plans in place to manufacture semi-finished polycrystalline silicon at the joint venture.

Annual production capacity :

Approx. 8,000 metric tons

Major shareholder / Ratio of shareholding :

TOKUYAMA **50%** OCI **50%**

Construction site:

Samalaju Industrial Park, Sarawak, Malaysia

Site area : 93,000 square meters

Green power application

Bakun Dam Hydroelectric Power Plant, Sarawak

Refer from Google map

Initiatives to Ensure a Sustainable Business

Establish a stable supply structure and systems

at both Japan and Malaysia bases

Pursue the world's highest quality

required for cutting-edge applications

Establish a quality control system

backed by advanced analysis technologies

Provide green polycrystalline silicon

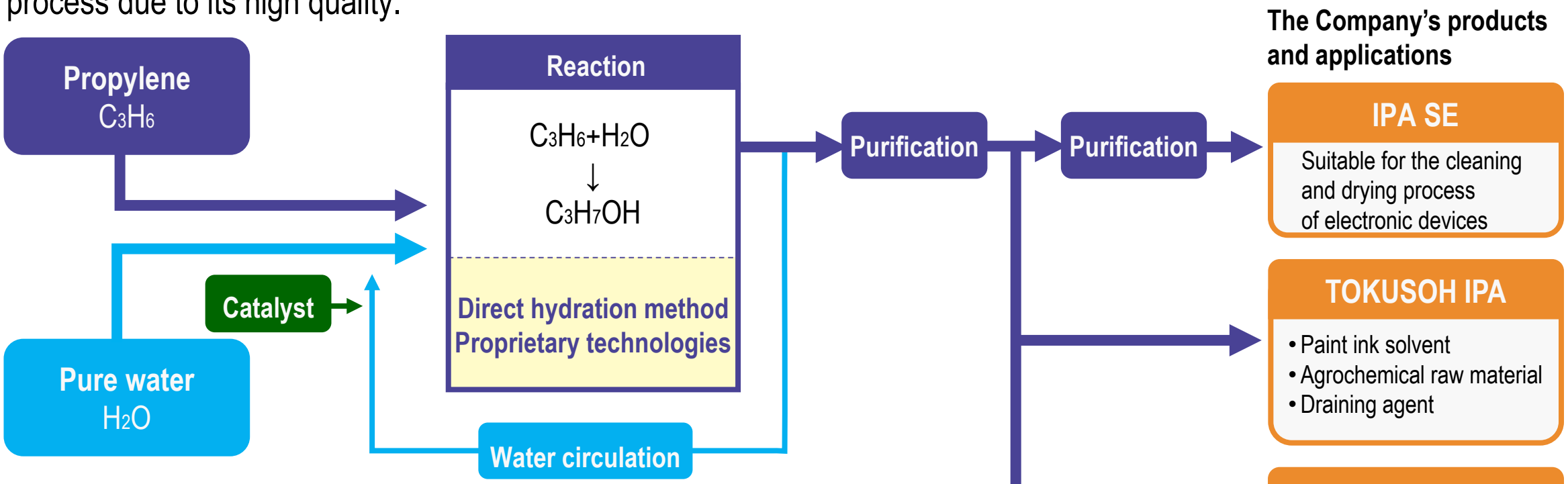
with minimal GHG emissions

Trust from customers and society

3. High purity IPA Business

About IPA (Applications and Manufacturing Methods)

Tokuyama commenced the manufacture of isopropyl alcohol (IPA) using proprietary technologies in 1972 for application across a wide range of industries as a solvent for paints and inks.
Currently, the Company's IPA is used as a cleaning agent in the electronics industry in the semiconductor manufacturing process due to its high quality.



Features of the direct hydration method [Tokuyama Process]

- Minimal secondary reactants through a simple reaction
- No external wastewater, pollution (in-system recycling)

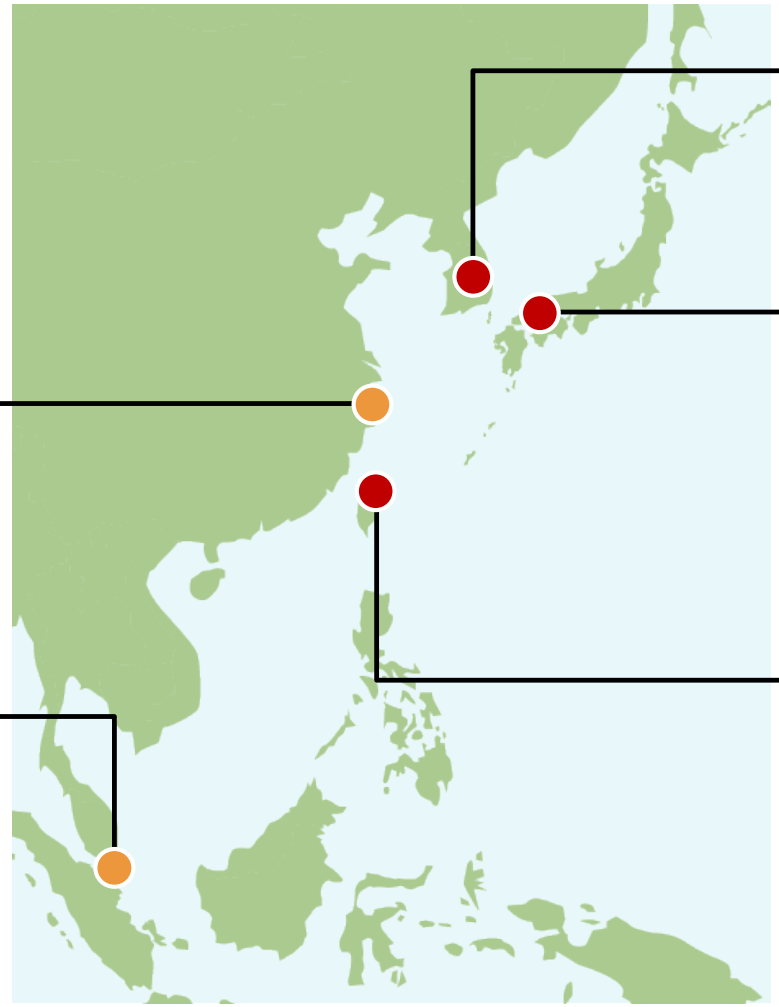
Enables the manufacture of high purity IPA with low environmental impact

Tokuyama Group's Sites

Tokuyama will seize opportunities for market expansion by leveraging its strengths in Asia and work to uncover opportunities that will help enter new markets in a bid to further expand global operations.

<Production Sites for High-Purity IPA for Electronics Manufacturing>

- Production/sales from raw materials
- Production/sales from supplies received from manufacturing bases



Korea (STAC) Annual production capacity:30,000MT
- Entering markets where strong demand expected
- Responding to high quality requirements

Japan (Tokuyama) Annual production capacity:74,000MT
- Responding to growing domestic demand for semiconductors where trends are expected to recover
- Serving as a support base for each region, including human resources/technology

China (Tokuyama Chemicals (Zhejiang))
- Stable supply to growing markets

Taiwan (FTAC) Annual production capacity:30,000MT
- Expanding sales to meet strong demand
- Supporting customers' cutting-edge production lines with higher quality

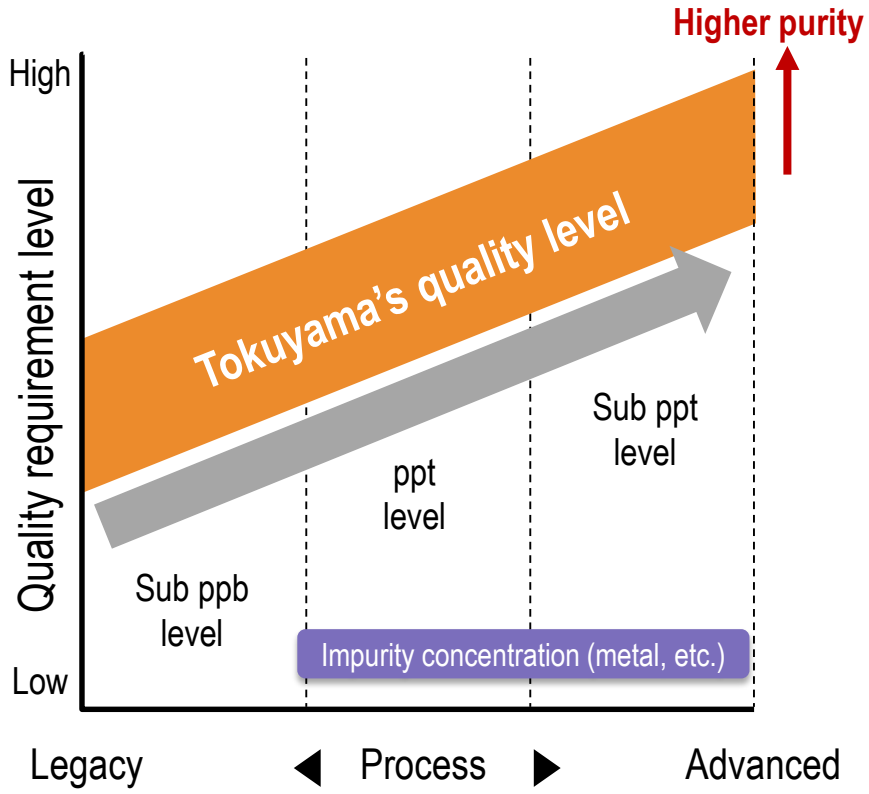
Singapore (Tokuyama Singapore)
- Sole local supplier
- Expanding sales to markets where further growth expected

Tokuyama's IPA Strengths

Against the backdrop of growing calls for higher quality in line with the focus on miniaturization, Tokuyama is continuing to address the demand of high quality at points of customer use.

Tokuyama three IPA strengths

- **Manufacture of high-purity IPA using proprietary processes**
- **High analysis capabilities**
- **Strict quality control including containers**



Direct shipment from the manufacturing plant of high-purity IPA that satisfies customers' requirements

Manufacturing, Filling, and Shipping

Tokuyama


ISO Container


Lorry


Canister

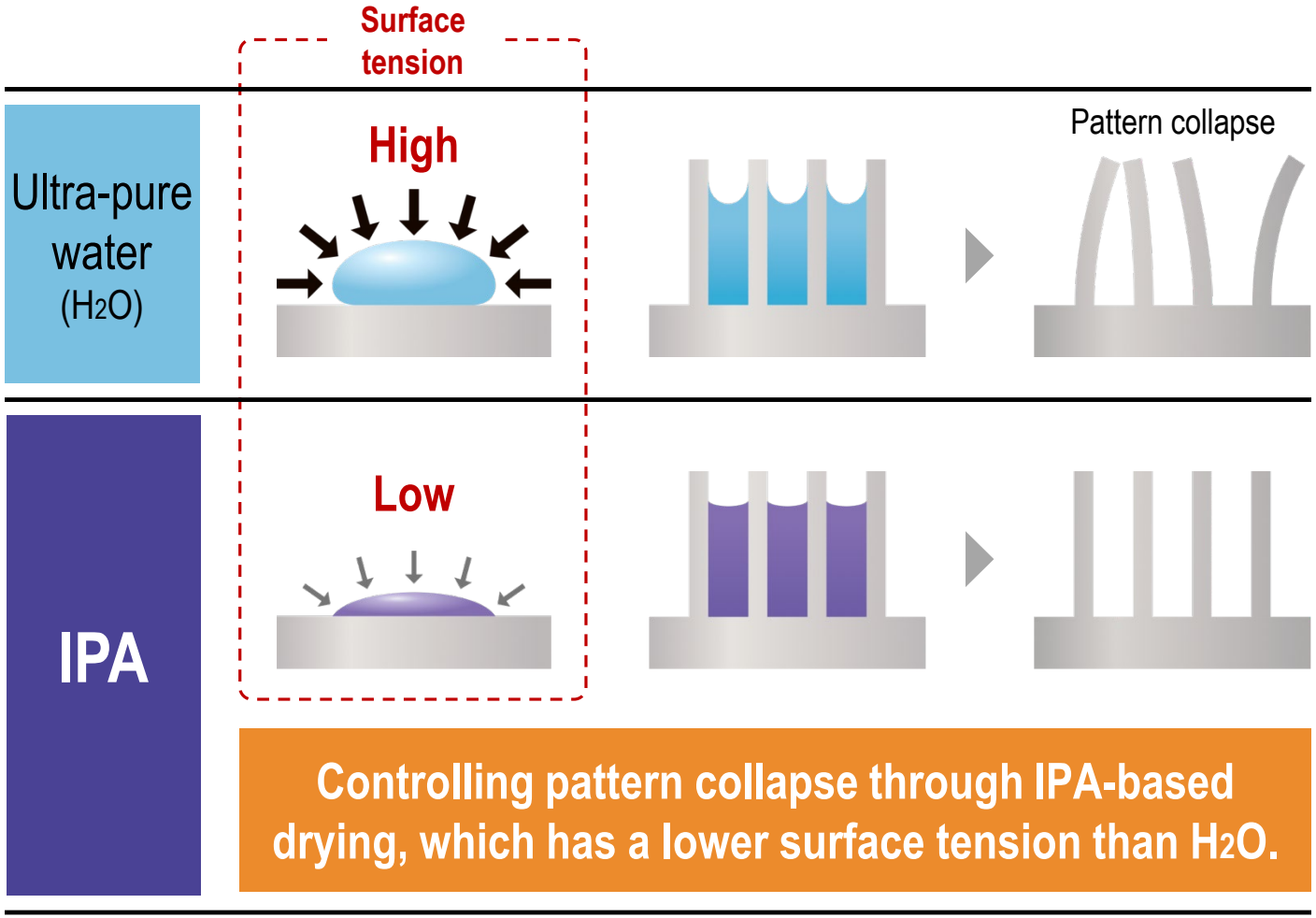
Customers

Container control

Return of Containers

Application of IPA in the Drying Process in Advanced Semiconductor Processes

Tokuyama's high-purity IPA is used to prevent pattern collapse amid the risk of increasingly evident pattern collapse due to surface tension associated with the miniaturization and higher aspect ratio of semiconductors.



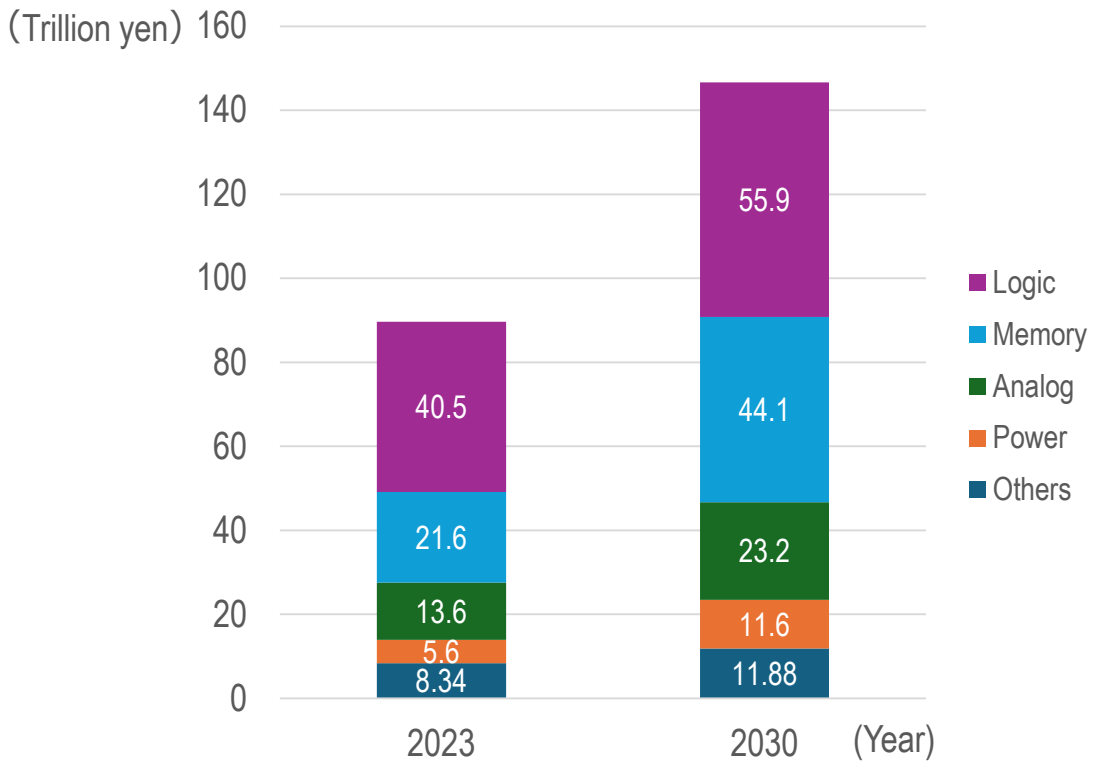
Advantages of Tokuyama's High Purity IPA

- Fewer particles
- Fewer metallic impurities
- Fewer organic impurities

Market Size and Market Forecast Outlook

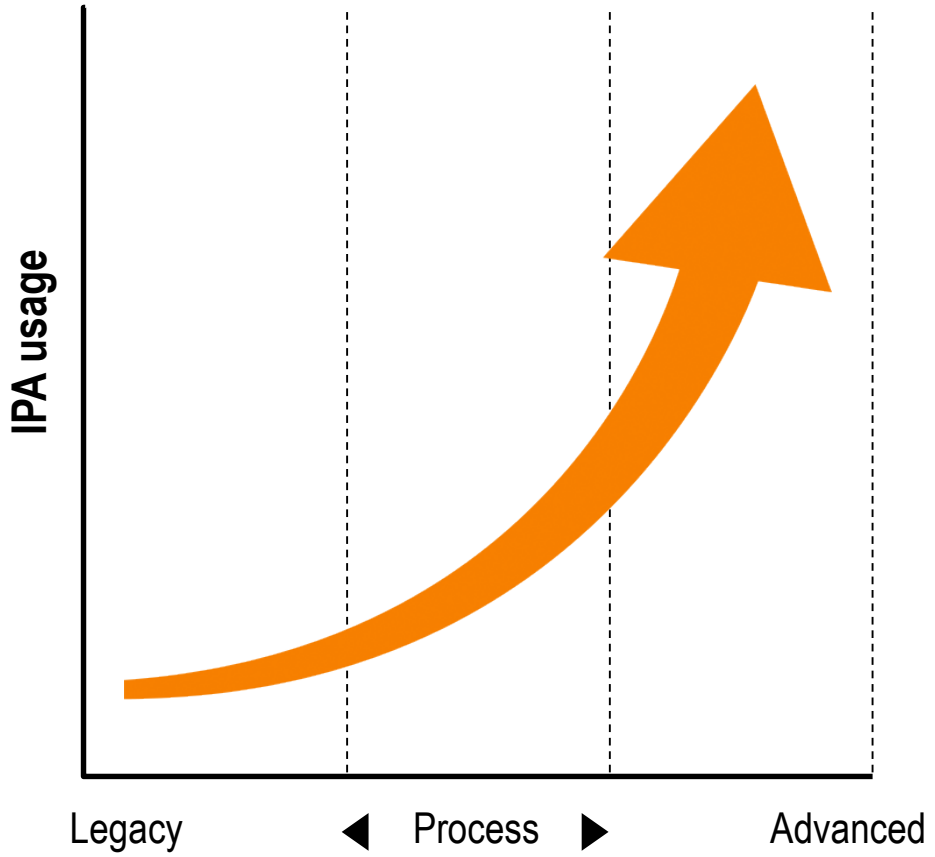
In addition to growing semiconductor demand, IPA application is estimated to expand further in line with the quality requirements associated with the increased miniaturization of advanced semiconductors.

Global semiconductor demand



(Source) OMIDA
11th Semiconductor and Digital Industry Strategy Review Conference
(May 31, 2024, Japan's Ministry of Economy, Trade and Industry)

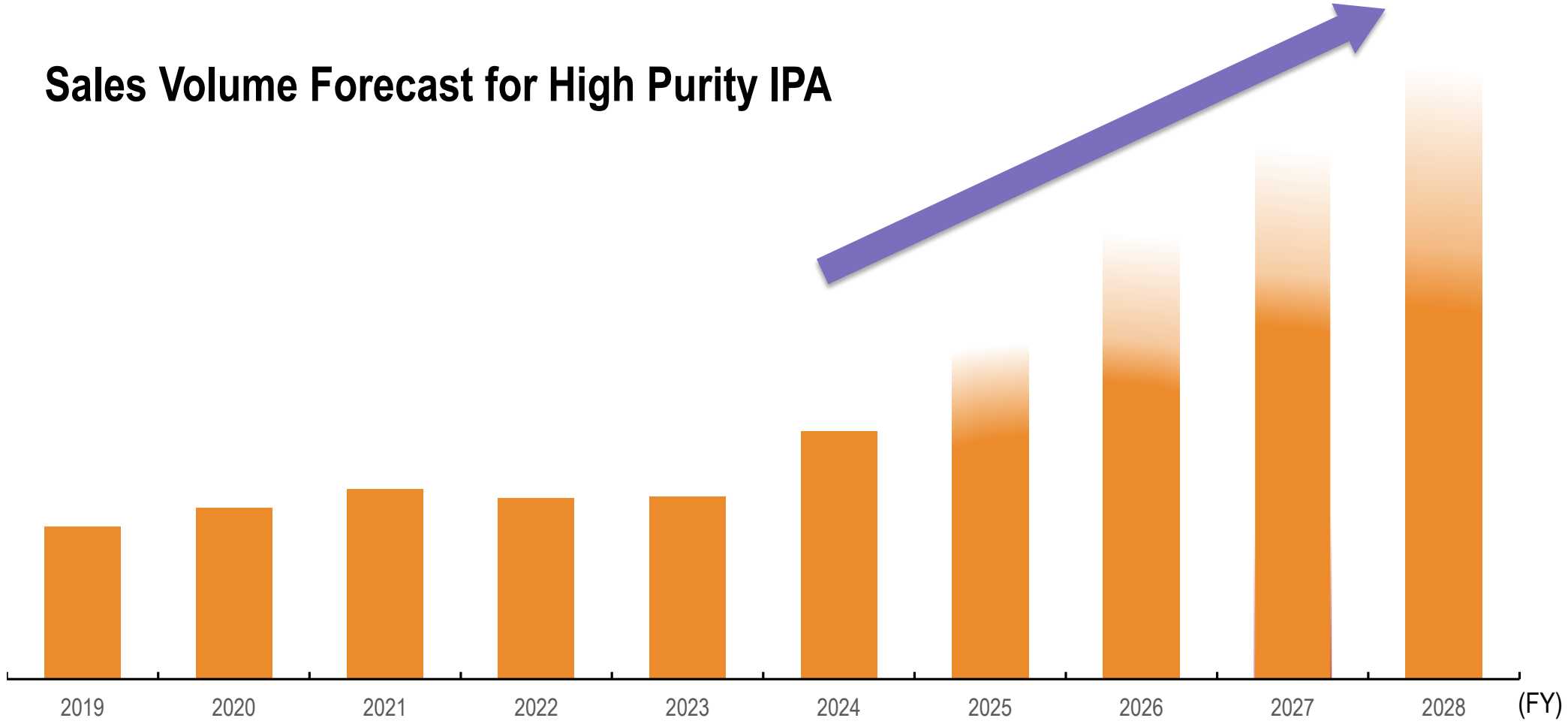
Semiconductor process and IPA usage (illustration purpose)



Tokuyama Group's IPA Business Strategy and Sales Volume Forecasts

- Maximize customer satisfaction by refining product performance and continuing to meet user demands
- Undertake investments that match the market scale of each region in a timely manner while expanding business

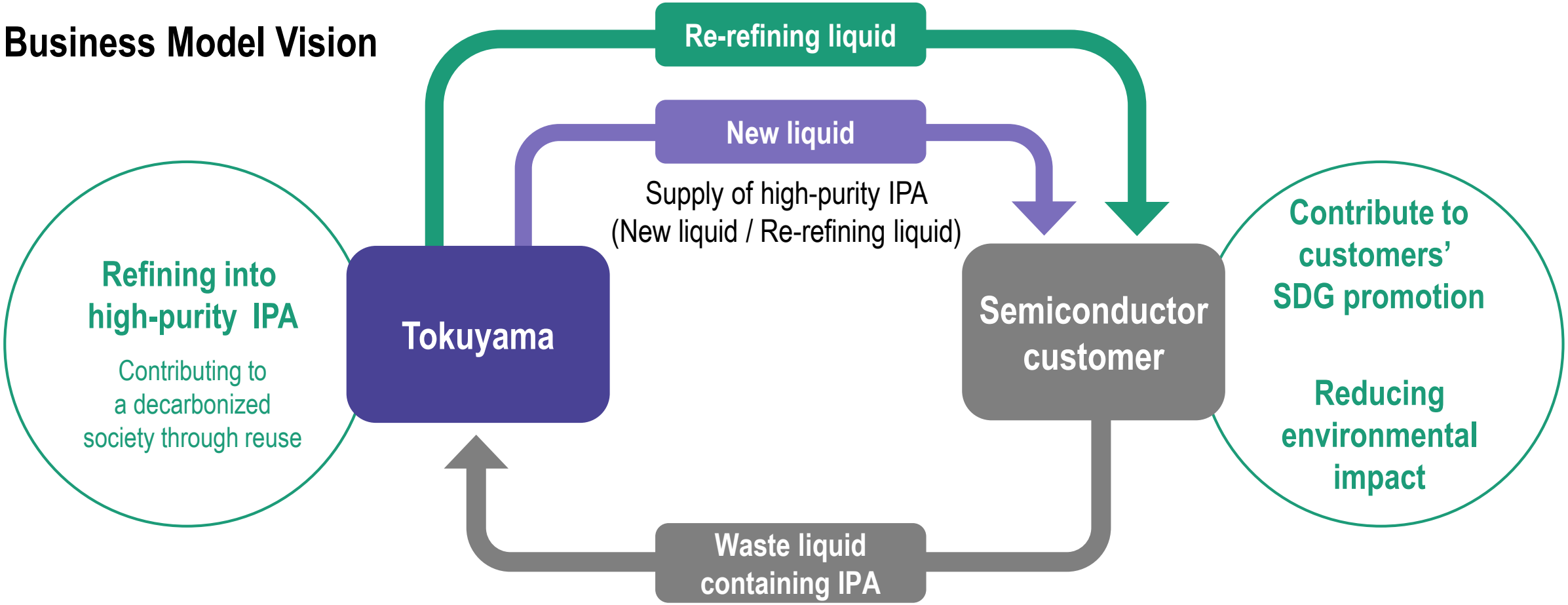
Sales Volume Forecast for High Purity IPA



Environmental Initiatives

Develop recycling technologies and re-refine IPA-containing waste liquids discharged from semiconductor plants into high-purity IPA. Build a recycling-oriented business model and work to help customers reduce their environmental impact.

Business Model Vision



For the People of Tomorrow

TOKUYAMA