

Electronic Devices Business Strategies

May 31, 2018

Fuji Electric Co., Ltd.


Electronic Devices Business Group

■ Business Overview

■ Review of FY2017

■ FY2018 Management Plan

- Business Policy
- Business Plan
- Market Trends
- Priority Measures
- Capital Investment / Research and Development

Businesses	Major products	Application	Production bases
<p>Semi-conductors</p>	<p>Power semiconductors</p> 	<p>Inverters UPS PCS Air conditioners Automobiles Power supplies</p>	<p>【Front-end processes】</p> <ul style="list-style-type: none"> ▪ Fuji Electric Matsumoto Factory ▪ Fuji Electric Yamanashi Factory ▪ Fuji Electric Tsugaru Semiconductor Co., Ltd. ▪ Fuji Electric (Malaysia) Sdn. Bhd. <p>【Back-end processes】</p> <ul style="list-style-type: none"> ▪ Fuji Electric Power Semiconductor Co., Ltd. ▪ Fuji Electric (Shenzhen) Co.,Ltd. ▪ Fuji Electric Philippines, Inc. ▪ Fuji Electric (Malaysia) Sdn. Bhd.
	<p>Photoconductors</p> 	<p>Copiers Printers</p>	<ul style="list-style-type: none"> ▪ Fuji Electric (Shenzhen) Co.,Ltd.
<p>Magnetic disks</p>	<p>Aluminum substrate magnetic disks Glass substrate magnetic disks</p> 	<p>HDD</p>	<ul style="list-style-type: none"> ▪ Fuji Electric (Malaysia) Sdn. Bhd.

* UPS: Uninterruptible power systems

* PCS: Power conditioning sub-systems

Semiconductors Business Overview

※% of total sales is FY2017 Results.

Application

Industrial field [% of total sales : 73%] [48%] [25%]

Inverters, NC machine tools, elevators, UPS, PCS (wind/solar power generation), air conditioners, etc.



Inverters



NC machine tools



PCS

Industrial equipment, communication equipment, servers, PCs, flat-screen TVs, video game consoles, copiers, printers, etc.



Servers



Flat-screen TVs

Automotive field [% of total sales : 27%]

HEV motor controls, Engine controls, transmission controls, brake controls, steering controls, etc.



Automobiles

Products

Modules

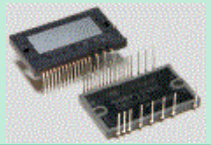
IGBT modules



SiC modules

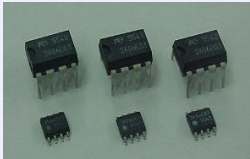


RB-IGBT* modules



Discrete devices

Power supply control ICs



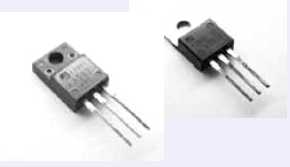
Diodes



Photoconductors



MOSFETs



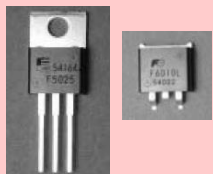
Automotive IGBT IPMs



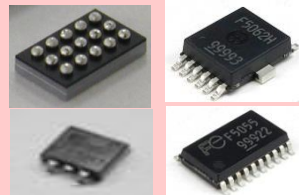
Pressure sensors



Igniters



Power ICs



Features

Unique devices that greatly improve power conversion efficiency (**SiC**, **RB-IGBT***) and packaging technologies that realize high reliability

High-voltage power supply IC and SJ-MOS* technologies that respond to energy saving standards for power supplies

Small, light-weight, and high-reliable devices critical for driving, turning, and stopping created by utilizing unique technologies (direct liquid-cooling technology, single chip power IC technology)

* RB-IGBT: Reverse Blocking IGBT SJ-MOS: Super Junction MOSFET

Review of FY2017

Review of FY2017

Higher sales and income as strong growth of semiconductor sales counteracted decrease in magnetic disk demand

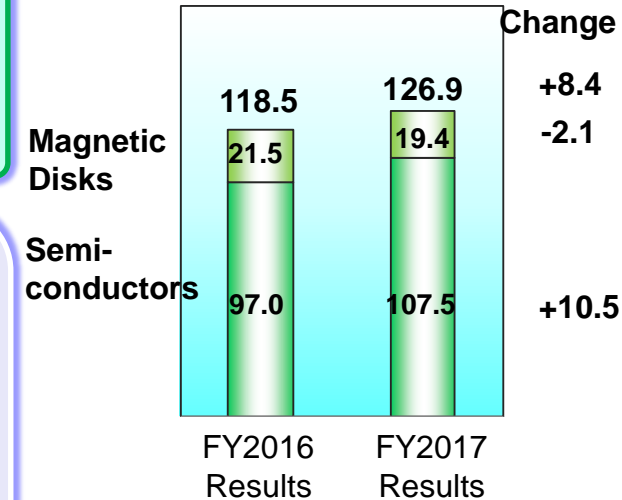
● Semiconductors

- Achieved higher sales and operating results due to demand growth centered on the industrial field
- Worked to have our proposed automotive IGBT modules specification accepted for use in new xEV models and commenced mass-production of 3rd-generation direct liquid-cooling IGBTs
- Increased production capacity of **8-inch wafers**
- Approved approximately **¥20.0 billion worth of investments (to commence in 2019)** aimed at increasing IGBT sales in FY2019 and beyond

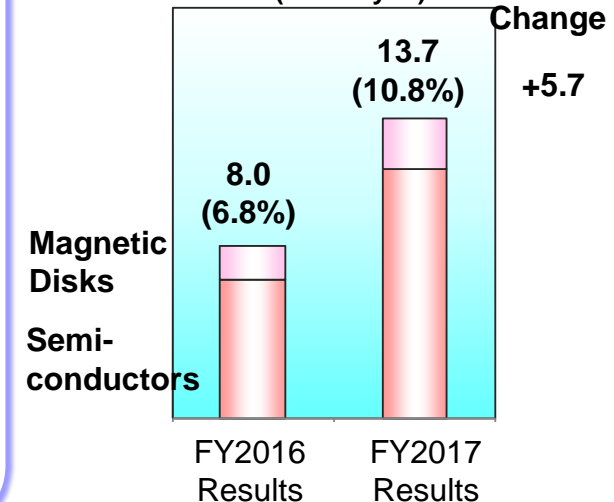
● Magnetic Disks

- Posted lower sales, despite recovery of demand seen in the second half of the fiscal year, but achieved improved operating results following cost reductions
- Advanced development of new products together with a customer

Net Sales by Subsegment (Billion yen)



Operating Income / Income Margin (Billion yen)



FY2018 Management Plan

- ◆ Increase sales and income through proactive investment in growth markets
- ◆ Solidify industry position with world-leading technologies and products

【Semiconductors】

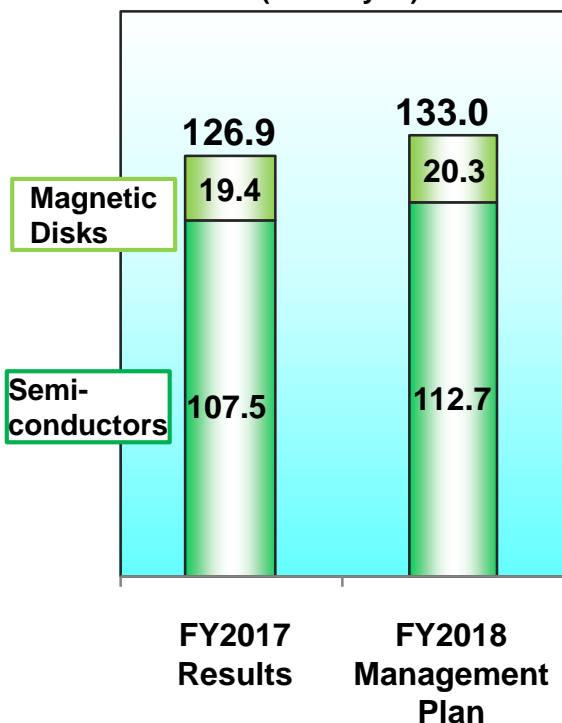
- Accelerate development of new products and bolster production capacity to facilitate future business growth

【Magnetic Disks】

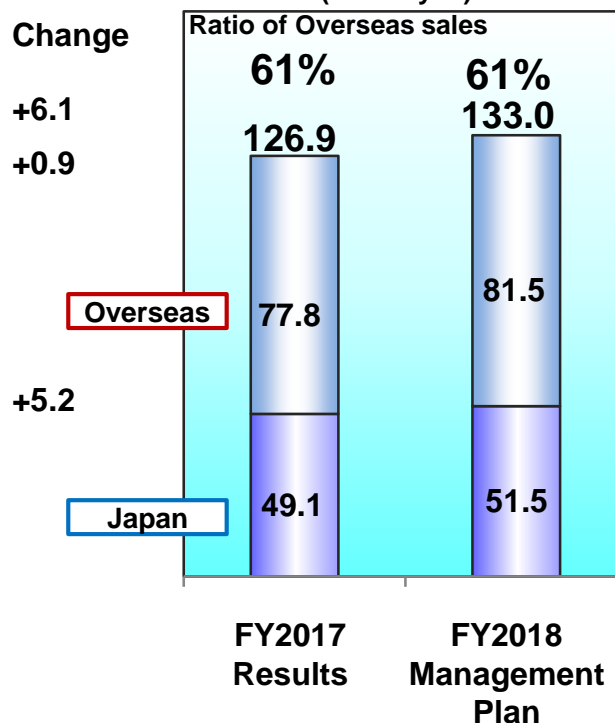
- Accelerate development of new products for nearline models and secure sales and profits

- Increase sales and income centered on semiconductors
- Target **YoY growth of approximately 5% in sales and 12% in income** from semiconductors by growing sales in Japan and overseas
- Project increase of approximately 5% YoY in sales of magnetic disks

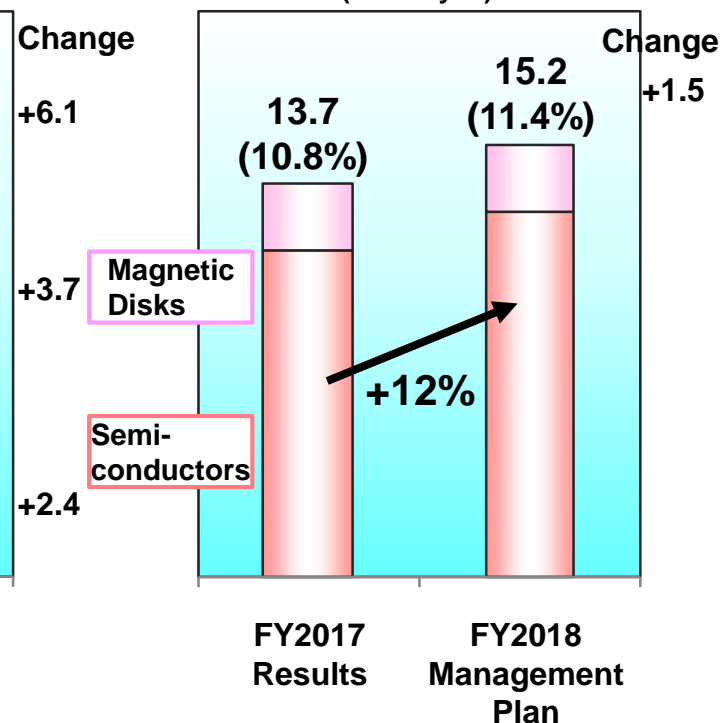
Net Sales by Business
(Billion yen)



Net Sales in Japan / Overseas
(Billion yen)



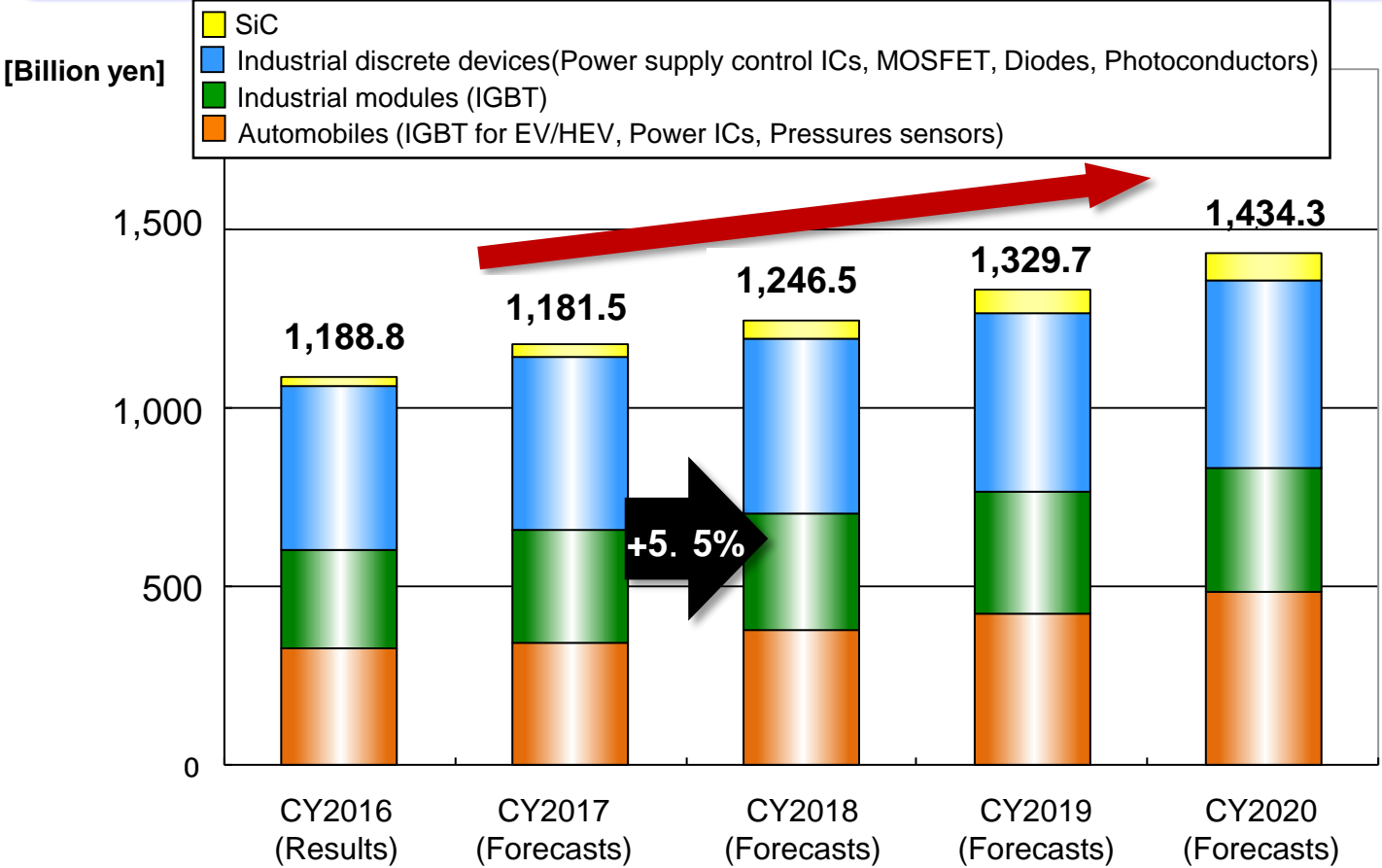
Operating Income / Operating Margin
(Billion yen)



Semiconductors

Market Trends—Power Semiconductor Market Forecasts (Market Segments Targeted by Fuji Electric)

- Overall power semiconductor market growth of 5.5% YoY, CAGR of **approximately 7%** forecast for period from CY2017 to CY2020
- Strong conditions in industrial market to be supported by consistent automation and labor-saving needs
- High CAGR of **approximately 14%** projected in automotive product market in period from CY2017 to CY2020



CY2017-CY2020 CAGR Semiconductors
6.7%

Industrial discrete devices
3.2%

Industrial Modules
4.1%

Automobiles
13.5%

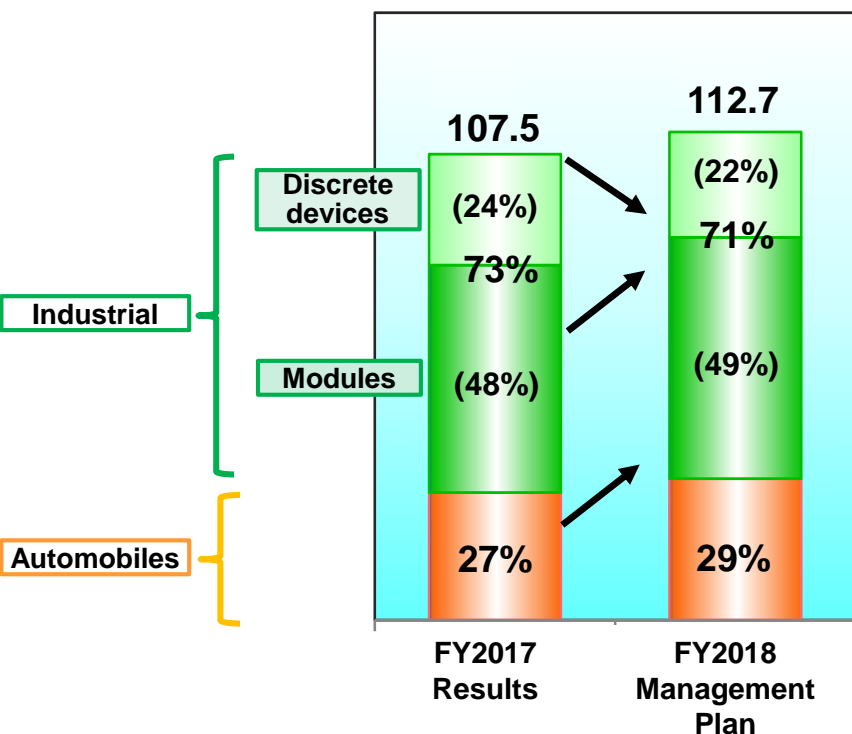
* Company's estimation based on market data released by IHS 2017 and on WSTS fall 2017

- Commence full-fledged mass-production of 7th-generation IGBTs to achieve **increase of 6% YoY in sales** of industrial modules
- Grow automotive field **sales by roughly 10%**, centered on overseas markets, to represent 29% of total semiconductors sales
- Project YoY decrease in sales of industrial discrete devices due to impacts of discontinued products

Net Sales by Business Fields

(Billion yen)

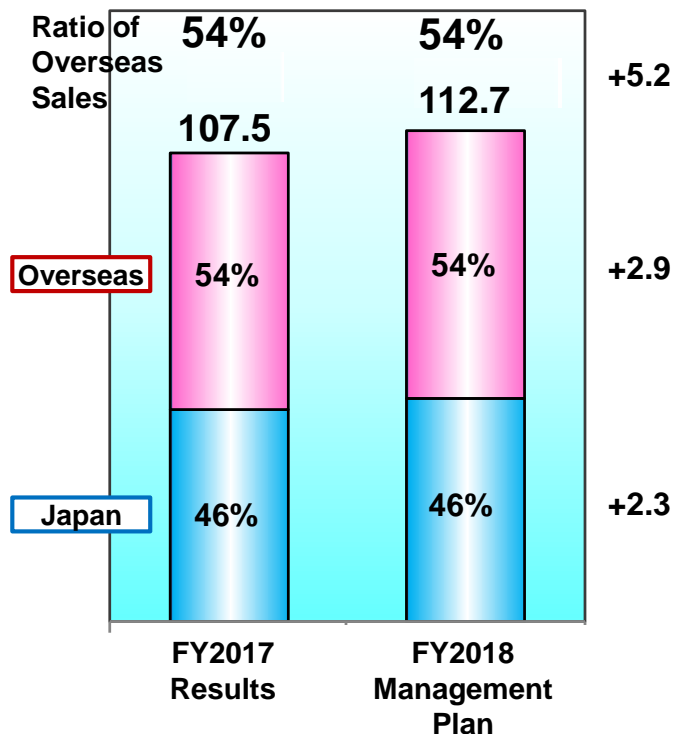
Change



Net Sales in Japan / Overseas

(Billion yen)

Change



- Industrial field:
 - Promote sales of 7th-generation IGBTs
(Take advantage of strong market conditions for NC machine tools, industrial robots, and other motor-drive products, and air conditioners)
 - Bolster back-end production capacity ahead of schedule to respond to demand growth
- Automotive field: Step up development of IGBTs for EVs
 - Enhance development resources
 - Accelerate development of 4th-generation direct liquid-cooling IGBTs (mass-production scheduled to commence in 2019)
- Proactive investment and acceleration of development to facilitate future business growth
 - Front-end: Bolster 8-inch wafer production capacity at Matsumoto Factory and Yamanashi Factory (achieve double 2017 level by 2020)
 - Back-end: Prepare for mass-production of 4th-generation direct liquid-cooling IGBTs
 - Commence mass-production of All-SiC devices (1st-generation trench MOSFETs) and accelerate development of 2nd-generation trench MOSFETs
- Stable component procurement
 - Promote long-term contracts and purchasing from multiple suppliers

Plans for Production Capacity Expansion

Front-end processes

Increase ratio of large-diameter wafer fabrication and improve productivity



Japan (Matsumoto)

- Increase 8-inch wafer production capacity
- Move to full-fledged mass production as SiC device production base
- **Function as mother base**



Japan (Yamanashi)

- **Increase 8-inch wafer production capacity (achieve double 2017 level by 2020)**
- Expand range of IGBTs for automotive and 7th-generation IGBT series manufactured



Japan (Tsugaru)

- Increase ratio of power semiconductor production to 80% (**up 5 ppts. YoY**)
- Expand range of IGBT (FWD)*, power IC, and MOSFET series manufactured
- Transfer production of products for automotive applications



Malaysia

- **Expand range** of 6th-generation IGBT series manufactured

Back-end processes

Expand range of models produced overseas



Japan (3 bases)

- **Bolster production capacity for automotive products**
- Manufacture products for domestic customers
- Function as mother bases



Philippines

- **Increase air conditioner IPM production capacity (by 70% YoY)**
- Bolster production capacity of products for power supplies and pressure sensors for automotive applications



China (Shenzhen)

- Expand range of IGBT module models manufactured (**Commence production of industrial-use IPMs**)



Malaysia

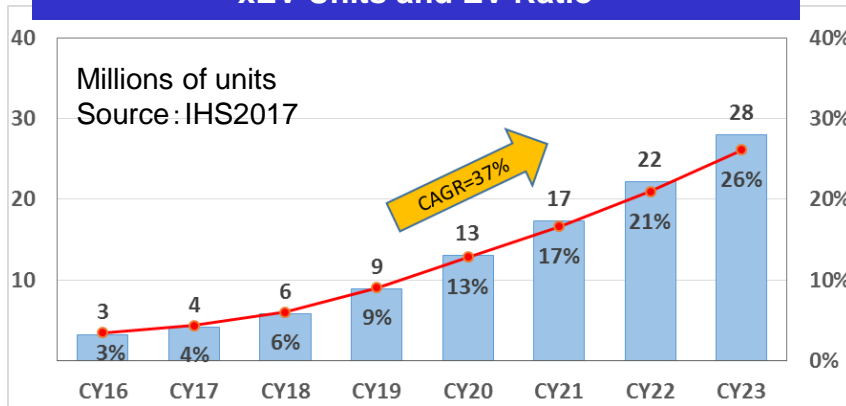
- Expand range of IGBT module models manufactured (**Commence production of 7th-generation IGBTs**)

*Free Wheel Diode

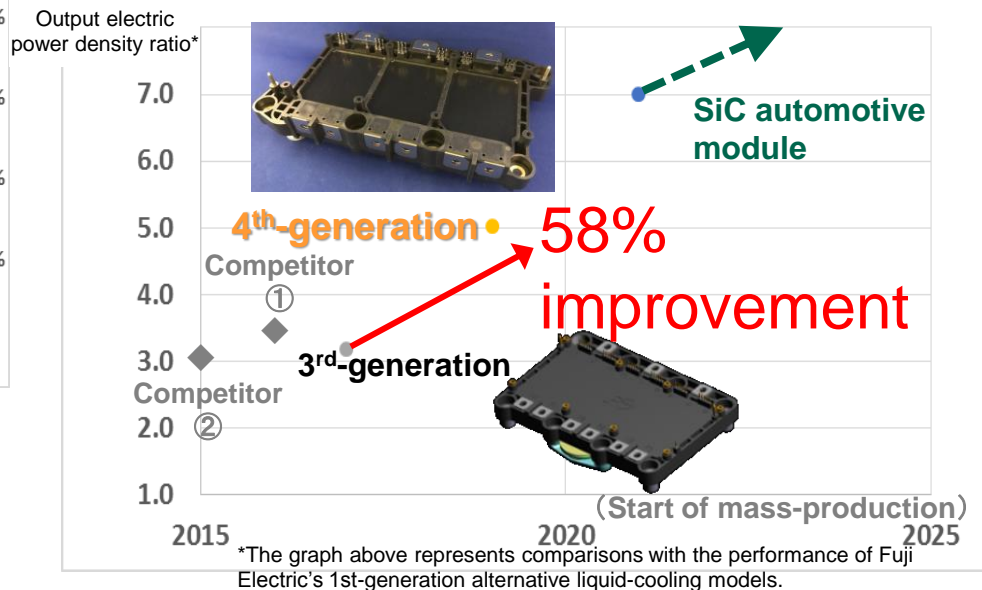
Expansion of Automotive Field Sales

- Commence mass-production of 3rd-generation liquid-cooling IGBTs
- Expand sales by developing 4th-generation IGBTs with higher levels of output electric power density by utilizing cutting-edge chip (RC-IGBT), package, and cooling technologies

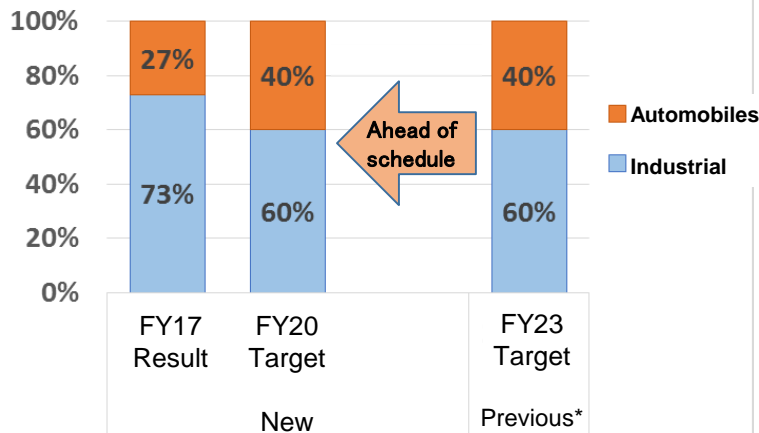
xEV Units and EV Ratio



Plan for Enhancing Performance of Modules for xEV Power Trains



Ratio of Sales from Automotive Products

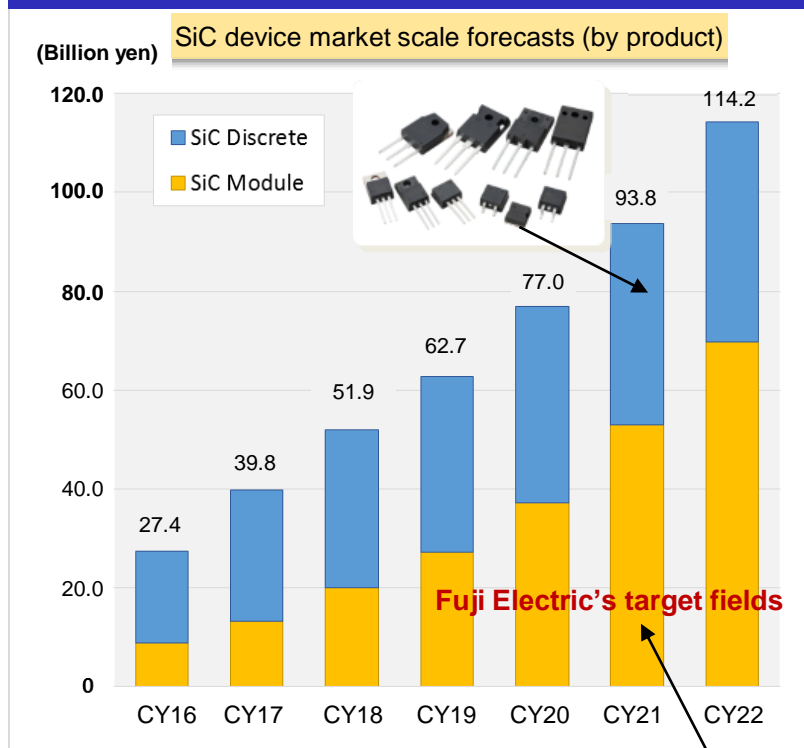


【FY】	2017	2018	2019	2020	2021
3 rd -generation direct liquid-cooling IGBTs	Start of mass-production (Chinese and several other customers)				
4 th -generation direct liquid-cooling IGBTs	Start of mass-production (Company A)				
	Start of mass-production (Company B & Company C)				

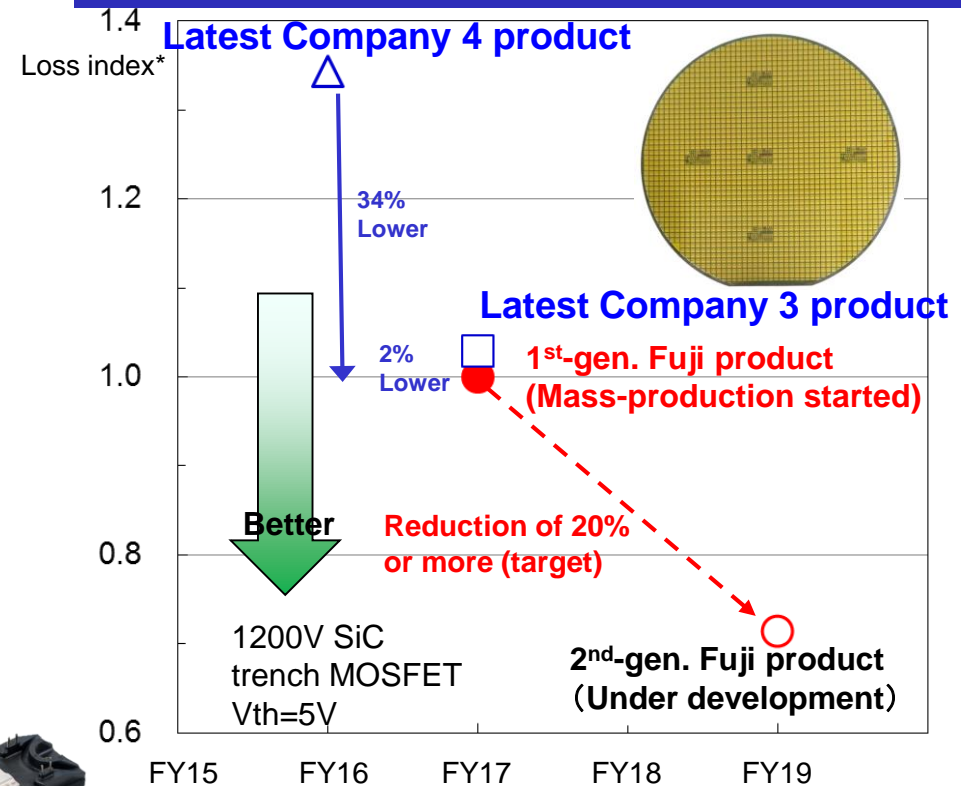
Redoubling of Development Efforts for Increasing SiC Sales

- Focus on development of **All-SiC** modules for module fields expected to see demand growth going forward
- Improve performance and bolster product series of **SiC trench MOSFET chips** (new + existing compatible packages)

SiC Market Trends and Fuji Electric's Target Fields



Performance and Market Position of Fuji Electric's SiC Chips



* Per unit area on-resistance (mΩcm²) under gate drive conditions recommended by each company with Fuji Electric's 1st-generation trench MOSFET indexed to 1
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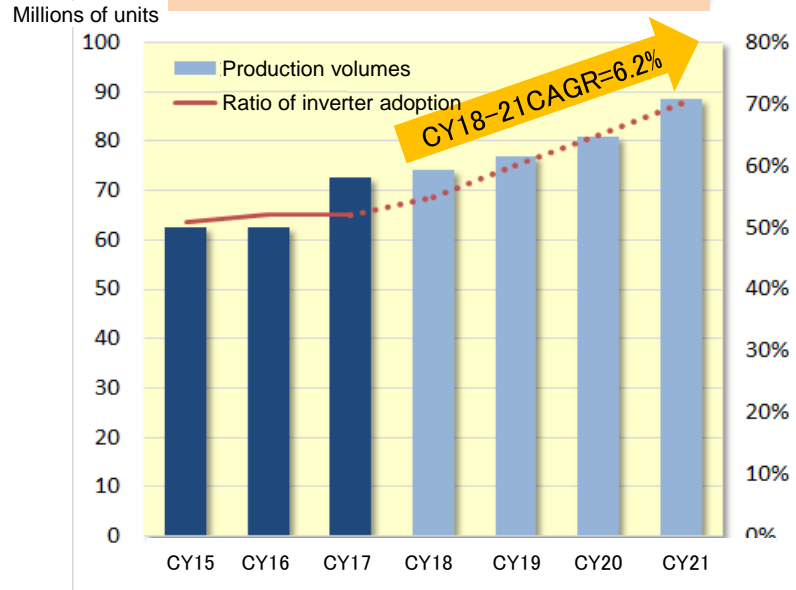


Growth of Air Conditioner IPM Sales

- Grow sales and **expand market shares** in conjunction with increasing ratio of inverter adoption
- Move ahead with underway development of large package models for addressing needs to replace coal-powered heating systems in China

Market

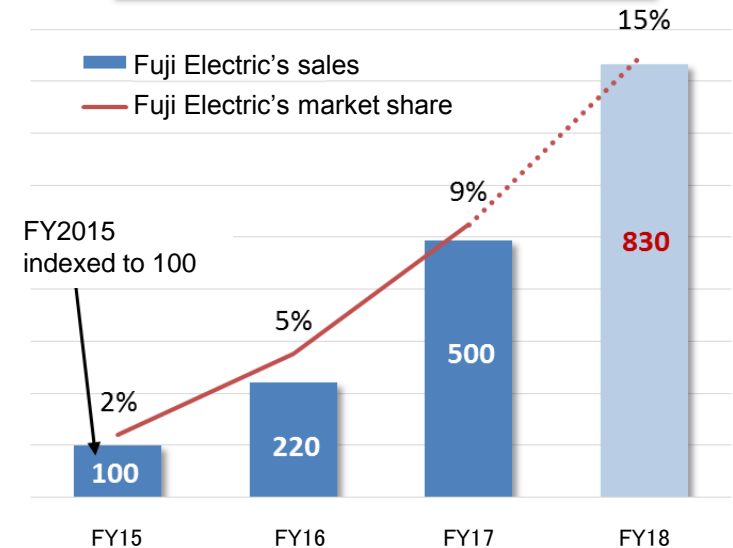
Global Inverter Room Air Conditioner Production Volumes (Forecast)



Sources: FUJI KEIZAI CO., LTD., and Fuji Electric Co., Ltd.

Sales

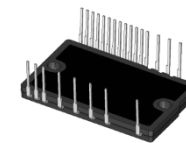
Sales of Fuji Electric's Air Conditioner IPMs and Global Market Share



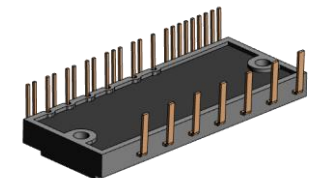
Fuji Electric's Strengths

◆ Increased energy savings realized with 7th-generation IGBTs

◆ Approx. **10% lower** loss than competitors offerings (based on trial calculations by Fuji Electric)



Super mini type
(10-30A)



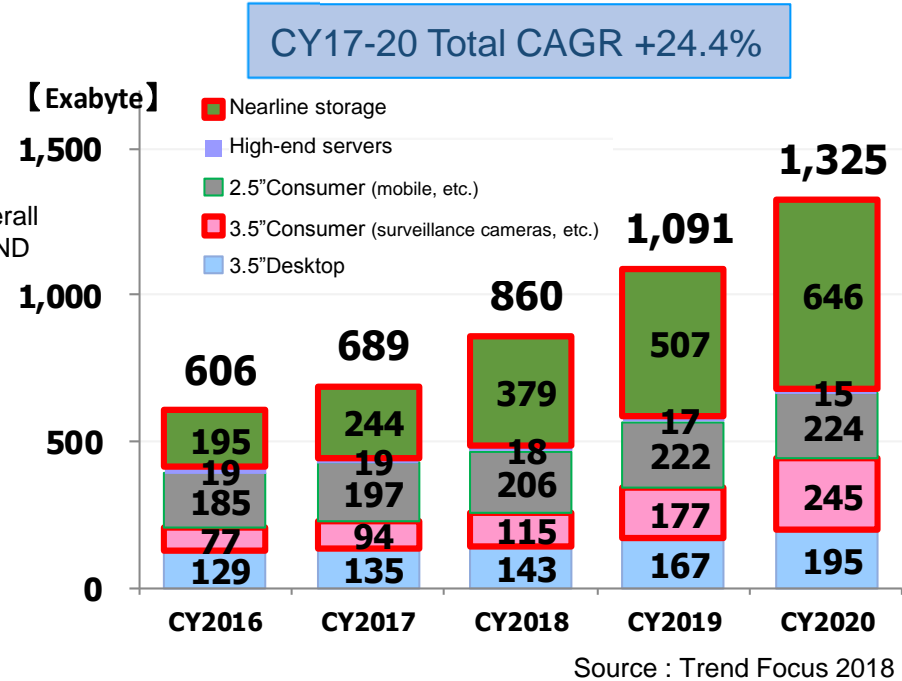
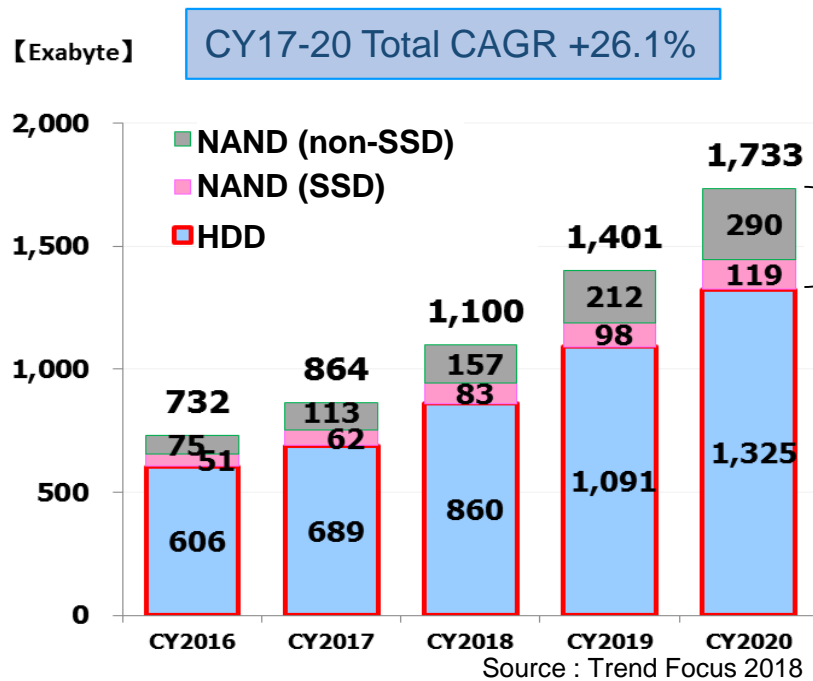
Large type
(50-75A)

Magnetic Disks

Total Shipped Data Volumes

- Overall data volume to continue to increase, HDD expected to cover majority of data demand
- Large growth in data volume from nearline storage models for cloud servers and models for surveillance cameras in HDD field

Data shipment volumes as HDD, SSD and NAND Memory HDD Data Shipment Volumes

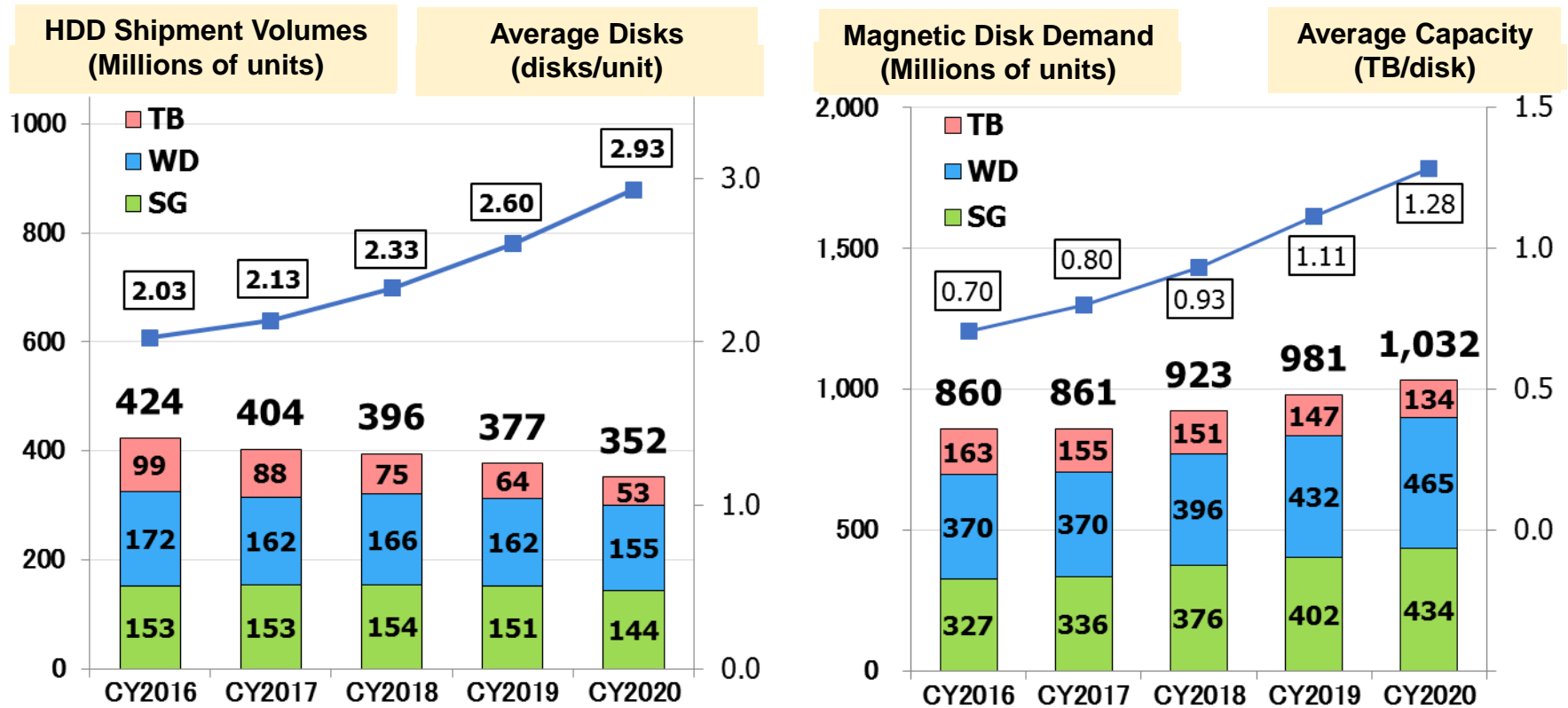


Volume of Data Per 1 HDD

TB/unit	1.4	1.7	2.2	2.9	3.8
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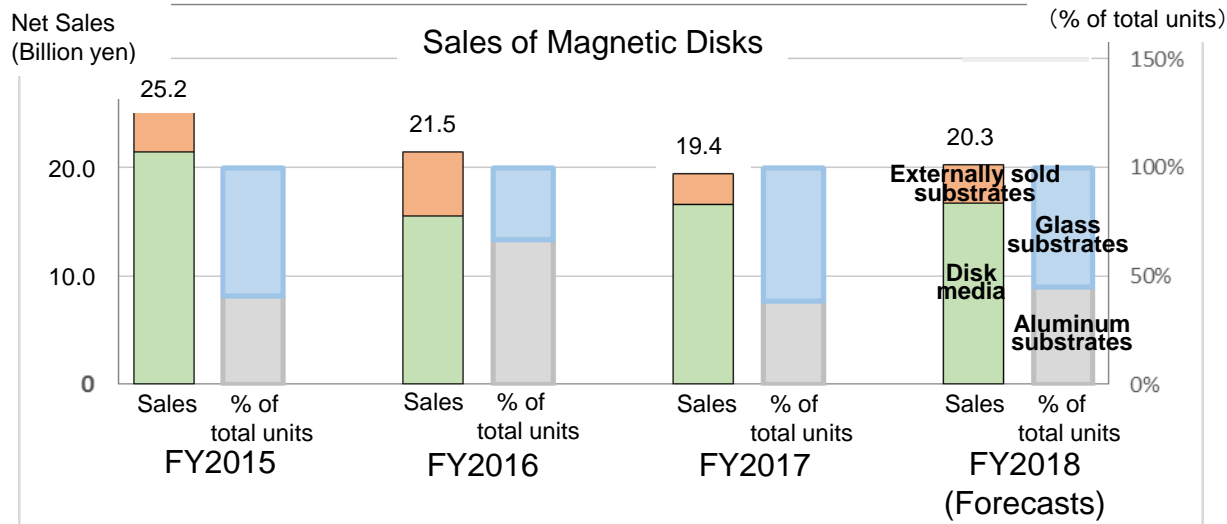
Magnetic Disks—Market Trends

- Lower HDD shipment volumes, but higher average capacity per unit
- Recovery of magnetic disk demand anticipated in conjunction with increase in number of disks used nearline storage models



※Trend Focus, 2018 and Company's estimation

● Secure profits by addressing increased demand for products for nearline storage models



● Priority Measures

◆ Secure sales and income

- Secure sales with new products for nearline storage models
- Step up efforts to reduce costs

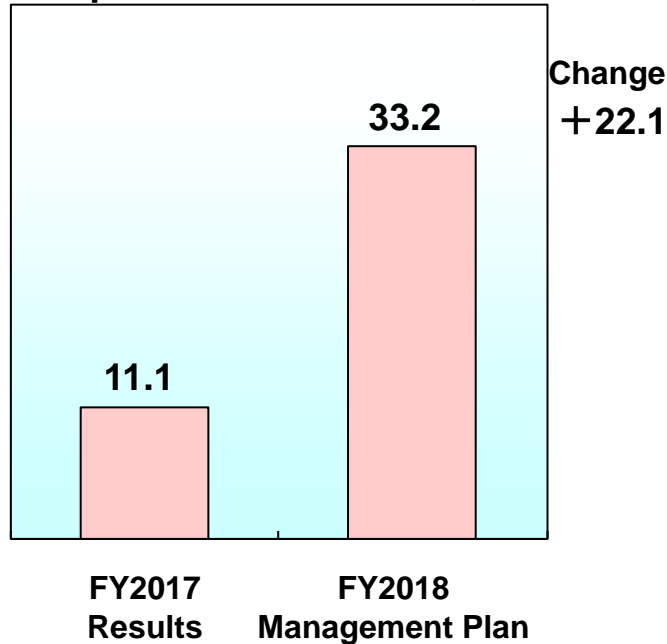
◆ Advance research and development

- Secure future sales by promoting joint-development with a customer

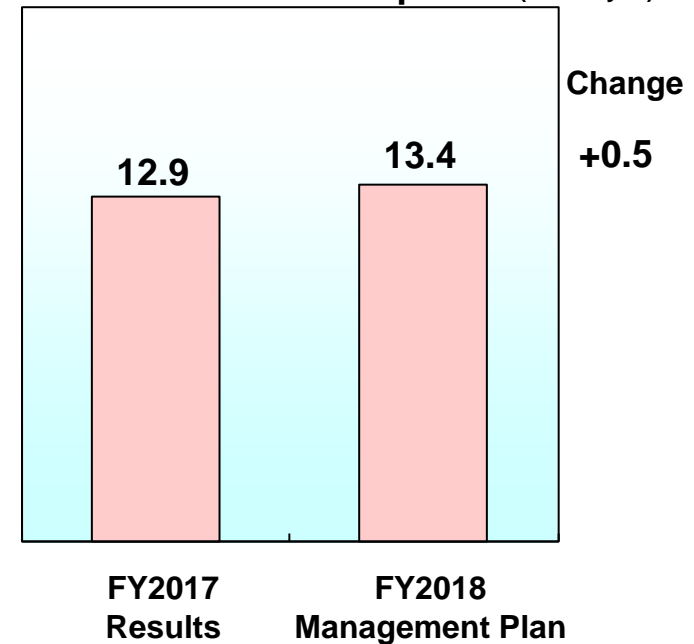
Capital Investment / Research and Development

Capital Investment / Research and Development

Capital Investment (Billion yen)



Research and Development (Billion yen)



Semiconductors

- Rationalization and production capacity increases
 - Front-end: Expansion of 8-inch wafer production
 - Back-end: Industrial and air-conditioning IPMs and automotive IGBTs and discrete devices
- Equipment for new products
 - Back-end: 4th-generation direct liquid-cooling automotive modules

Semiconductors

- SiC devices and modules
- Automotive IGBTs and discrete devices
- Expansion of 7th-generation IGBT series

* R&D expenditure figures above represent expenditures that have been allocated to segments based on theme and may therefore differ from figures contained in consolidated financial reports.

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