Fuji Electric
Innovating Energy Technology

FY2018 Medium-Term Management Plan
Electronic Devices Business

May 26, 2016

Fuji Electric Co., Ltd.

Electronic Devices Business Group

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Business Overview

Electronic Devices Business Overview

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Subsegments	Major products	Application	Production bases
Semi-conductors	Power semiconductors  	Inverters UPS PCS Air conditioners Automobiles Power supplies	**【Front-end processes】** ▪Fuji Electric Matsumoto Factory ▪Fuji Electric Yamanashi Factory ▪Fuji Electric Tsugaru Semiconductor Co., Ltd. ▪Fuji Electric (Malaysia) Sdn. Bhd. **【Back-end processes】** ▪Fuji Electric Power Semiconductor Co., Ltd. ▪Fuji Electric (Shenzhen) Co .,Ltd. ▪Fuji Electric Philippines, Inc. ▪Fuji Electric (Malaysia) Sdn. Bhd.
	Photoconductors 	Copiers Printers	▪Fuji Electric (Shenzhen) Co .,Ltd.
Magnetic disks	Aluminum substrate magnetic disks Glass substrate magnetic disks 	HDD	▪Fuji Electric (Malaysia) Sdn. Bhd.

* UPS：Uninterruptible power system

* PCS：Power conditioning sub-systems

Power Semiconductors Business Overview

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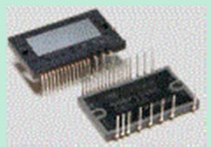
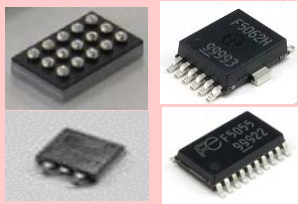
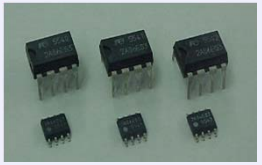
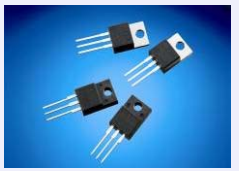
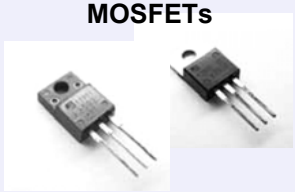
(FY2015)

	Industrial field (% of total sales: 53%)	Automotive field (% of total sales: 31%)	Power supply field (% of total sales: 16%)
Application	Inverters, NC machine tools, elevators, UPS, PCS (wind/solar power generation), air conditioners, etc.  Inverters  NC machine tools  PCS	HEV motor controls, Engine controls, transmission controls, brake controls, steering controls, etc.,  Automobiles	Industrial equipment, communication equipment, servers, PCs, flat-screen TVs, video game consoles , copiers, printers, etc.  Servers  Flat-screen TVs
Products	**Modules** IGBT modules    SiC modules  RB-IGBT modules 	Automotive IGBT IPMs  Pressure sensors  Igniters  Power ICs 	**Discrete products** Power supply control ICs  Diodes  MOSFETs 
Features	Unique devices that greatly improve power conversion efficiency (**SiC, RB-IGBT**) and packaging technologies that realize high reliability	Small, light-weight, and reliable devices critical for driving, turning, and stopping created by utilizing unique technologies (**direct water cooling technology, single chip power IC technology**)	High-voltage, low-loss **power supply IC and SJ-MOS* technologies** that respond to ever stricter energy saving standards for power supplies

* SJ-MOS: Superjunction MOSFET * RB-IGBT: Reverse Blocking IGBT

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Review of FY2015 Medium-Term Management Plan

Review of FY2015 Medium-Term Management Plan

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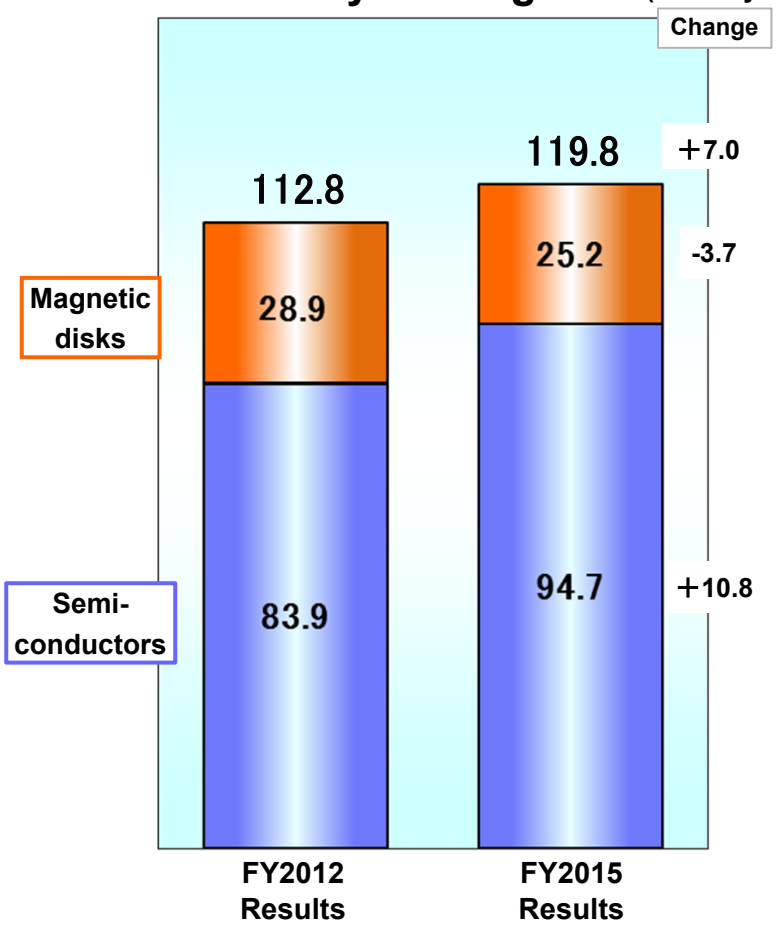
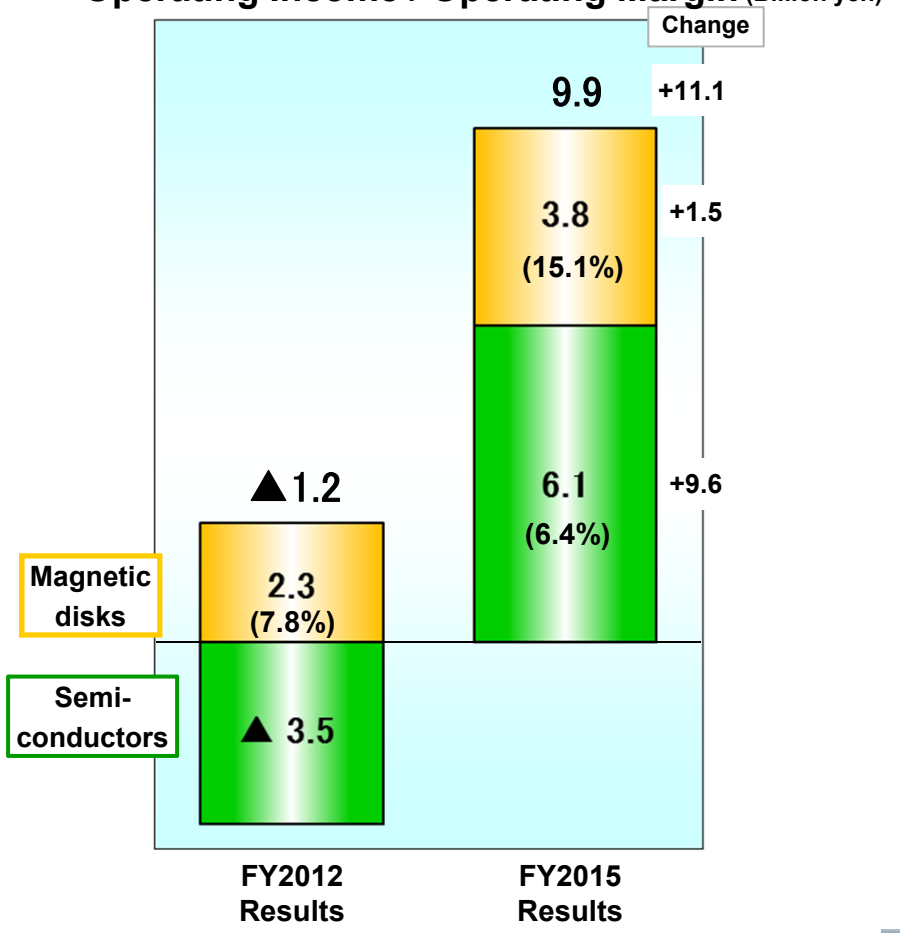
FY2015 operating income up due to further advancement of FY2012 business restructuring, reduction of depreciation and leases paid and other expenses, beneficial foreign exchange rates, and transference of solar cell business

Net Sales by Subsegment (Billion yen)



Operating Income / Operating Margin (Billion yen)



* Figures for FY2012 reflect the organizational restructuring conducted in FY2015.

Review of FY2015 Medium-Term Management Plan (Semiconductors)

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◆ Expanded overseas operations

- Increased ratio of overseas sales: FY2012: 46% → FY2015: 53%
- Expanded sales in rapidly growing new energy market
- Established overseas design centers

◆Reinforced profit structure

- Reorganized production bases

  Increased ratio of overseas production: FY2012: 38% → FY2015: 50%

  Commenced operation of 8-inch line at Yamanashi Factory and expanded range of power semiconductors produced at Fuji Electric Tsugaru Semiconductor Co.,Ltd
- Reduced ratio of fixed costs to net sales: FY2012: 54% → FY2015: 51%

Challenges

◆ Net sales significantly below targets

- Development of business portfolio that is resilient to market condition fluctuations
- Acceleration of new product development

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FY2018 Medium-Term Management Plan

Basic Policies of Medium-Term Management Plan

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◆ **Secure income through capable business operation against market fluctuation for stable earnings**

◆ **Contribute to customers and society, grow operations, and heighten industry position with world-leading technologies and products**

Semiconductors

● **Achieve sales growth in line with market growth and strengthen products development (R&D in advance)**

Magnetic disks

● **Secure stable sales volumes in shrinking HDD market**

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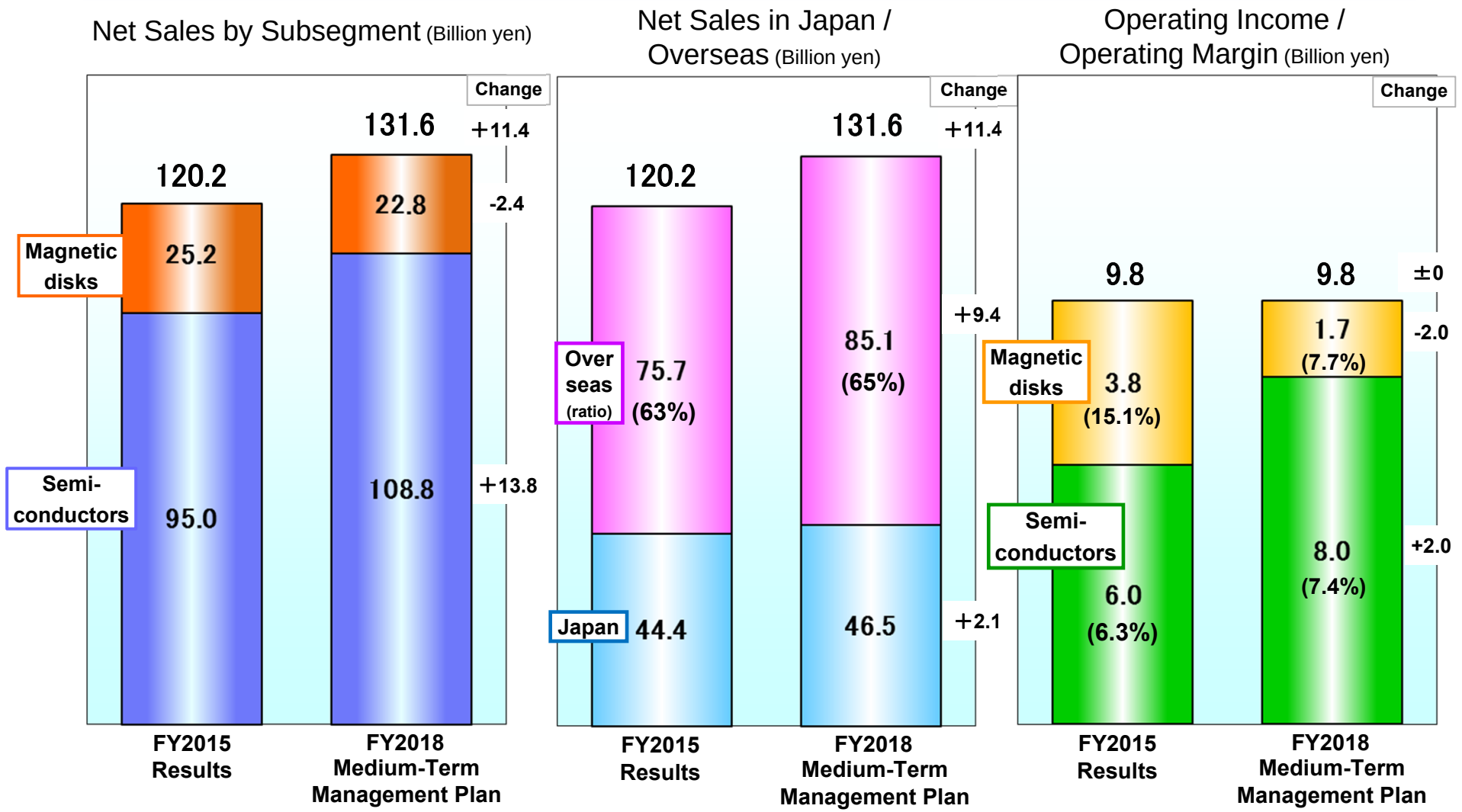
Continue to reinforce corporate constitution in order to grow semiconductor sales and income



Power Semiconductors

Power Semiconductors Market Trends

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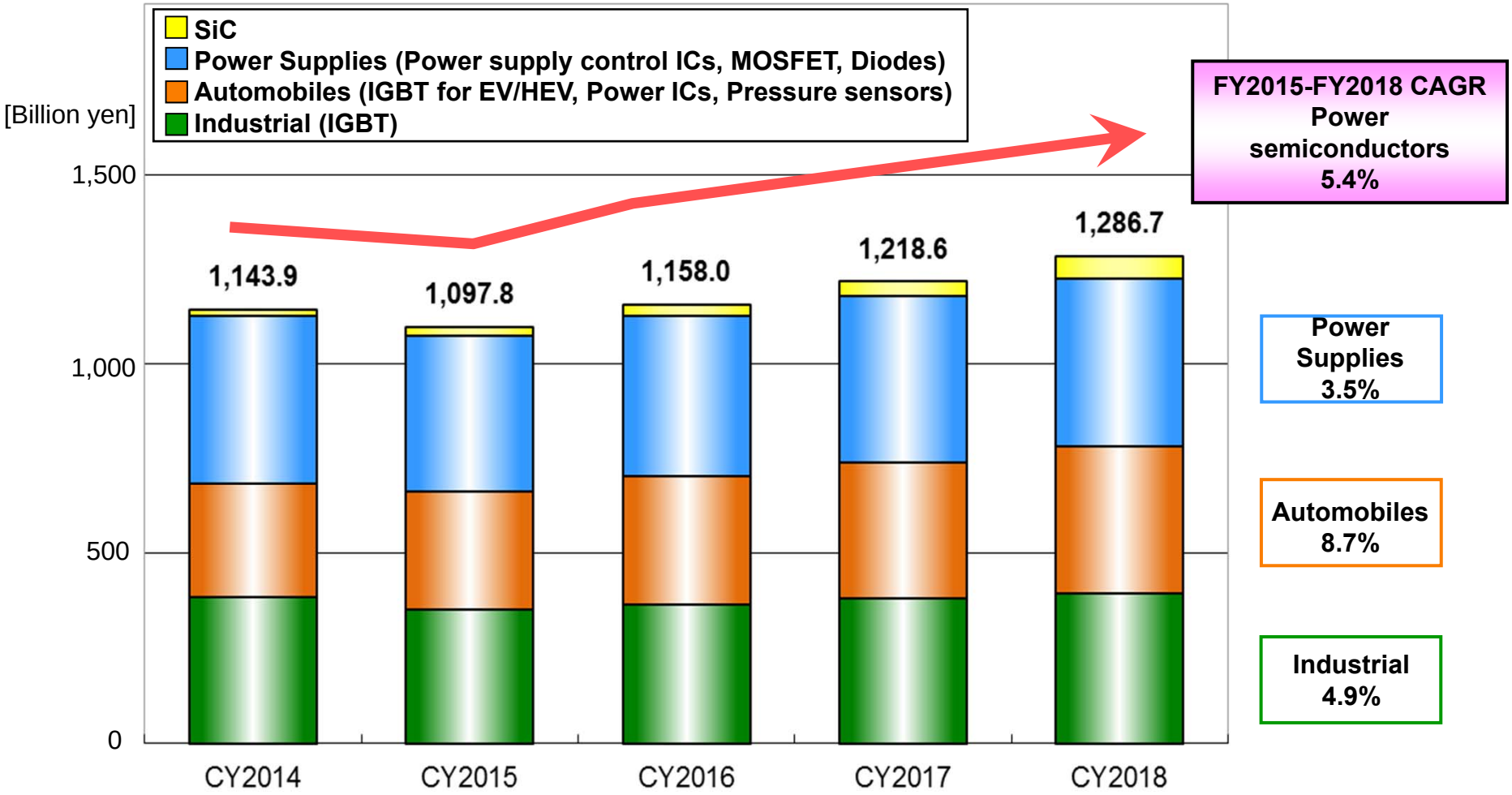
Steady growth in Fuji Electric target markets
(compound average growth rate of 5.4%) over period from FY2015–FY2018



* Company's estimation based on market data released by IHS, etc.

Power Semiconductors Business Plan

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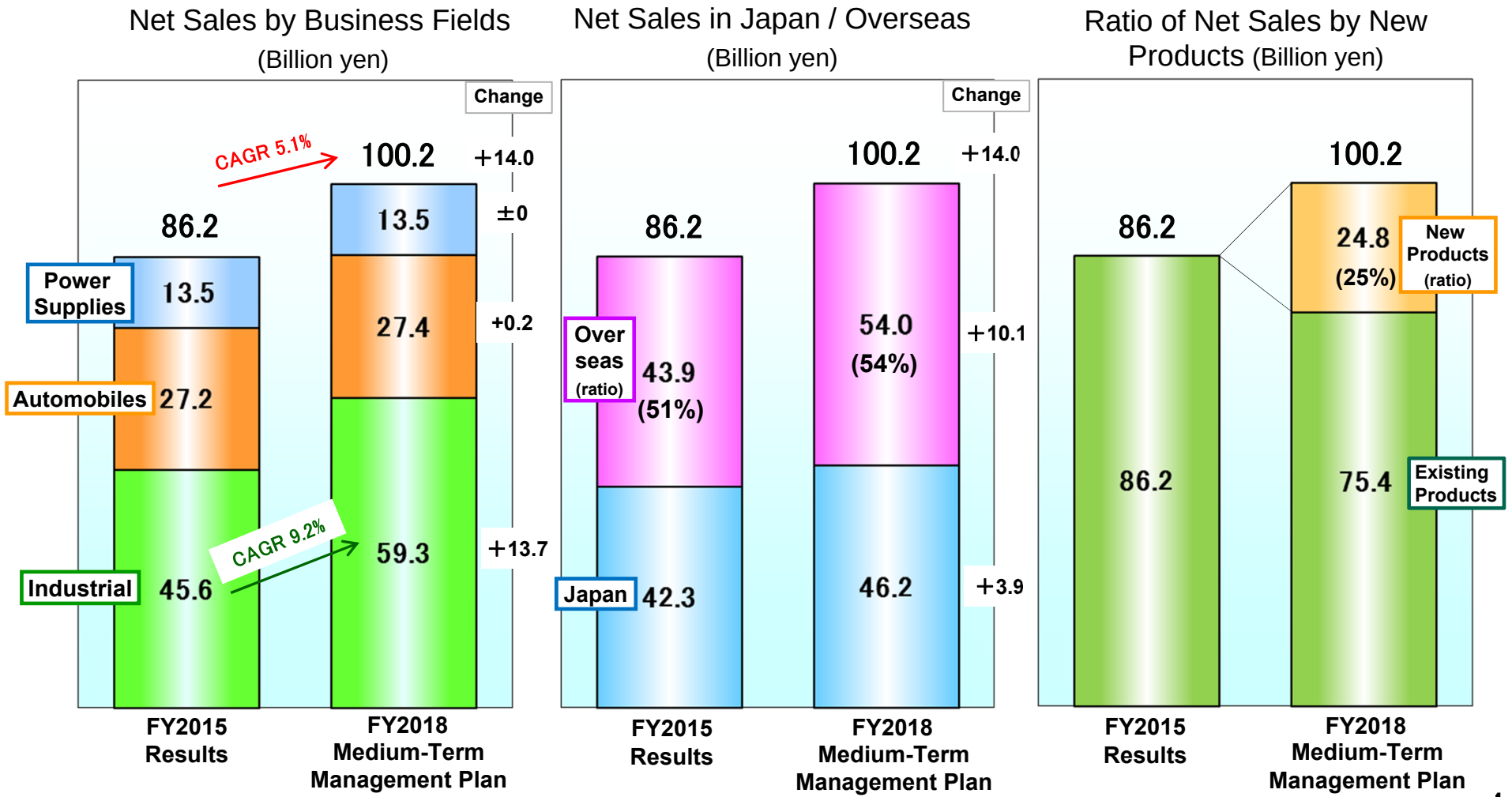
- Expand sales mainly in industrial field by launching 7th-generation IGBTs
- Increase overseas sales focused on new energy markets in Europe and China
- Reinforce development capabilities and create new products to win-out against global competition



Power Semiconductors Priority Measures

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◆ Accelerate new product development

- Strengthen development of SiC modules (industrial, railway, and automotive-use)
- Expand series of 7th-generation IGBTs
- Accelerate development of products for new fields and new customers
- Bolster development of automobile-use models targeting sales expansion in FY2019 and beyond

(Ratio of automotive field sales to total net sales: FY2015: 31% → FY2021: 40%)

◆ Increase net sales

- Boost share of 7th-generation IGBTs (industrial fields)
- Strengthen and utilize overseas design centers

◆ Advance ongoing cost reduction measures

- Accelerate local production and consumption
  (Ratio of overseas production: FY2015: 50% → FY2018: 56%)
- Strengthen design and production technology capabilities and collaborate with suppliers

Development History

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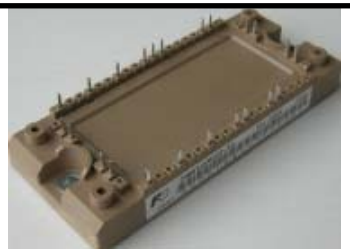
- Accelerate development of products for new applications and new customers by making use of the past R&D achievements

Applicable fiscal year	2010	2015	2018
7th-generation IGBT modules	6G	7G	
RC-IGBT modules	6G	7G	
All SiC modules		1G	

7th-generation IGBT modules



30% size reduction

RC-IGBT modules

30% size reduction

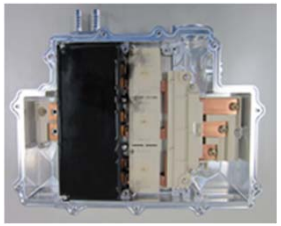
All SiC modules

50% loss reduction
4 times higher frequency
2 times higher output

General-purpose inverters

33% size reduction
Lower costs

Automotive inverters



Up to 50% size reduction
Lower costs

Solar PCS

0.4% increase in max efficiency
Size reductions 1.5–2.0 times higher output
Lower costs

* Above mentioned benefits are comparisons to prior models
* 6G: 6th generation * RC-IGBT: Reverse-conducting IGBT

Future Product Series Developments

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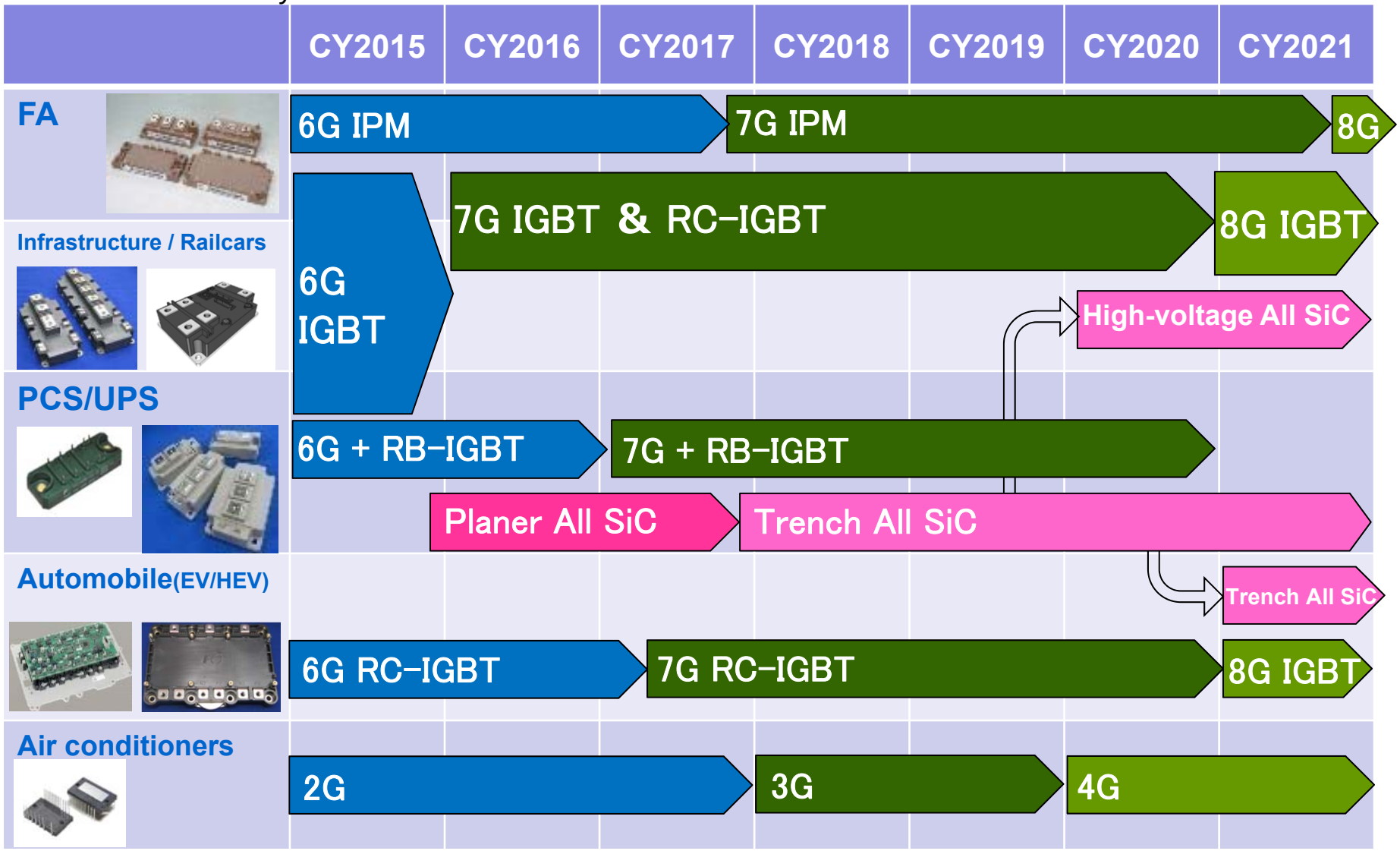
- Strengthen development of industrial-use, railway-use, and automobile-use modules in preparation for FY2019 and beyond



* FA: Factory Automation
* RB-IGBT: Reverse Blocking IGBT

The 7th-Generation X-Series IGBT Module Product Series

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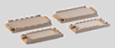
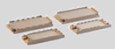
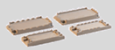
- Plan to establish broad lineup of products ranging from small capacity to large capacity with 650 V, 1200 V, and 1700 V

Voltage	Package	CY2016	CY2017	CY2018	Application
650V	 IPM : 10A–30A	☆			Air conditoner Inverters
	 PIM : 10A–150A	☆			
	 2in1 : 150A–600A		☆		Inverters Servo,UPS
1200V	 PIM : 10A–150A	☆			Air conditoner Inverters
	 6in1 : 100A–200A		☆		
	 2in1 : 100A–600A		☆		Inverters Servo,UPS
	 6in1 : 225A–600A			☆	Inverters
	 2in1 : 225A–800A		☆		Solar PCS Inverters Servo
	 2in1 : 900A–1800A		☆		
1700V	 2in1 : 75A–400A			☆	Inverters Servo,UPS
	 6in1 : 225A–600A			☆	Wind power Inverters
	 2in1 : 225A–600A			☆	
	 2in1 : 650A–1800A			☆	
	 2in1 : 1000A			☆	Railcars
3300V	 2in1 : 450A			☆	

X-Series features
1. Energy savings due to low losses
2. Small products with improved functionality contributing to more-compact equipment
3. Improved reliability
4. Broad lineup planned

X-Series expansion
1. PKG series ideal for various applications
2. Expansion of ratings for same PKGs
3. Sequential expansion from high-demand, low-capacity range (650 V and 1200 V)
4. Establishment of core chip and PKG technologies and application to product designs

☆Start Mass-Production

SiC Hybrid Product Series

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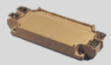
- Realize substantial reductions in loss by combining Si IGBT and SiC SBD*
- Plan to establish broad lineup of products ranging from small capacity to large capacity

Voltage	Package		CY2015 and before	CY2016	CY2017	CY2018	CY2019	Application
600V		Chopper : 30A			☆			PCS UPS
		PIM : 50A–100A	☆					Inverters
1200V		PIM : 35A–100A	☆					Inverters
		2in1 : 200A		☆				NC Servo Elevator
		2in1 : 300A	☆					NC Servo Inverters
		2in1 : 600A			☆			PCS UPS
1700V		2in1 : 400A	☆					Inverters
		2in1 : 550A			☆			PCS
		2in1 : 1200A		☆				Auxiliary power supplies for railcars
		2in1 : 1000A				☆		Auxiliary power supplies for railcars Railcar propulsion inverters
3300V		1in1 : 1200A				☆		
		2in1 : 450A					☆	

*SBD: Schottky Barrier Diode

☆Start Mass-Production

All-SiC Product Series

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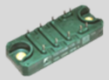
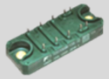
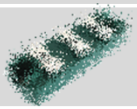
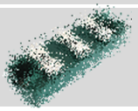
- Apply high-reliability new concept package
- Expand product series to cover 15 A to 320 A range

Voltage	Package		CY2015	CY2016	CY2017	CY2018	CY2019	CY2020	Application
1200V		Chopper: 100A	★						PCS, UPS
		2in1 : 15A, 35A		★		★			PCS, UPS Inverters
		2in1 : 35A–75A			★				
		2in1 : 75A–320A			★	★			Inverters Auxiliary power supplies for railcars
1700V		2in1 : 25A, 50A				★		★	
		2in1 : 50A–200A			★			★	

★ Start Mass-production of Planer All SiC

★ Start Mass-production of Trench All SiC

Industrial IGBT / SiC Loss Comparison

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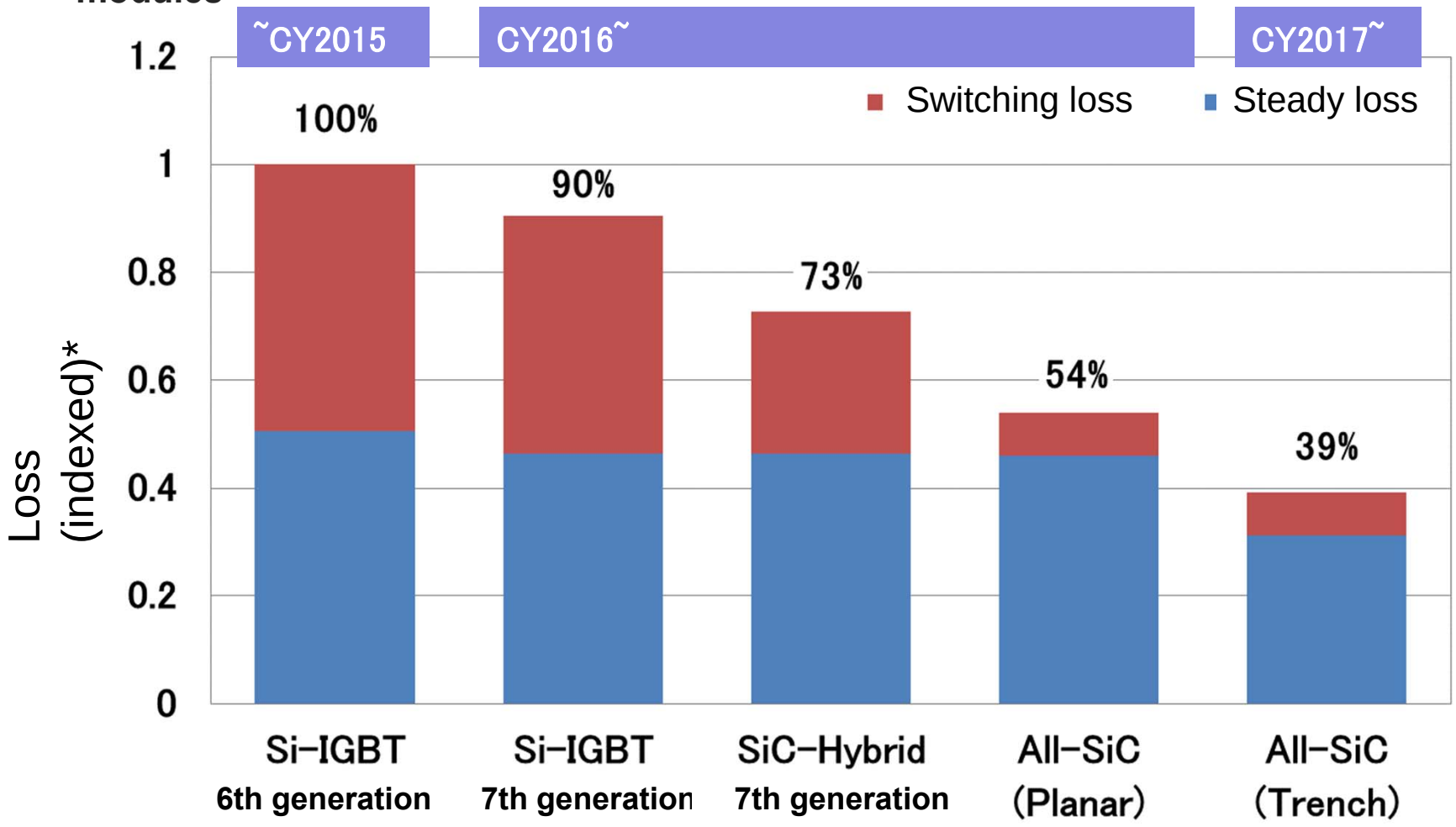
- Loss-low, high-reliability Fuji Electric 7th-generation IGBT modules
- Further loss reductions and contributions to more-compact equipment with SiC modules



* Loss (indexed): Loss of each generation with 6th-generation IGBT modules indexed to 100%

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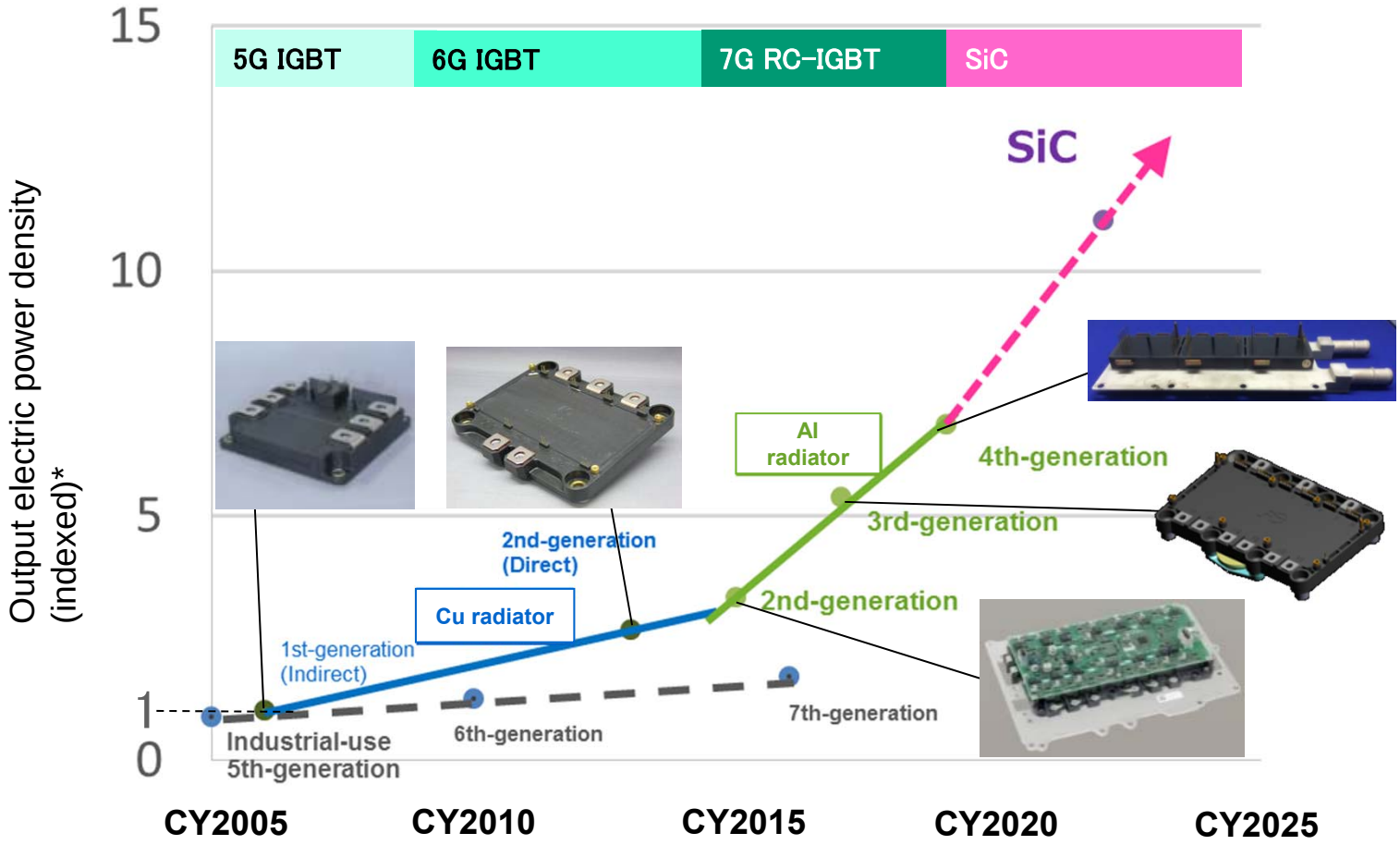
➢ Develop compact automotive modules with high electric power density by refining chips and module cooling structures



* Output electric power density (indexed): Output electric power density of each generation with 1st-generation Cu heat radiant (indirect water cooling) indexed to 1
Output electric power density (kVA/L) = Maximum power output (kVA) ÷ Module area (L)

Plans for Production Bases

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Front-end processes

Improve production efficiency at all bases and expand production of 8-inch devices

Japan (Matsumoto)

■ **Global mother base for front-end processes**
- ● SiC device production base
- ● Bolster 8-inch device production capacity
- ● Consolidate 5- and 6-inch lines (reorganize CRs)

Japan (Yamanashi)

■ Flagship 8-inch device production base
- ● Commence mass production of automobile-use IGBT modules
- ● Expand range of 7th-generation IGBT series produced

Japan (Tsugaru)

■ 6-inch device production base
- ● Increase power semiconductor production capacity

Malaysia

■ Production base for industrial-use IGBT modules for overseas
- ● Increase ratio of devices manufactured for overseas (60% → 90%)

Back-end processes

Increase overseas production by promoting local production and consumption

Japan (3 bases)

■ **Global mother bases for back-end processes**
■ Flagship production bases for automobile-use products for Japan
- ● Increase capacities through automation

Philippines

■ Flagship production base for compact packages
- ● Increase production of pressure sensors and small-capacity IPMs

China (Shenzhen)

■ Flagship production base for industrial products for China
- ● Expand production through transference of models to this factory

Malaysia

■ Flagship production base for industrial products for Europe, the United States, and Asia
- ● Increase production of large-capacity products

* CR: Clean room

Photoconductors

Photoconductors (OPCs) Market Trends

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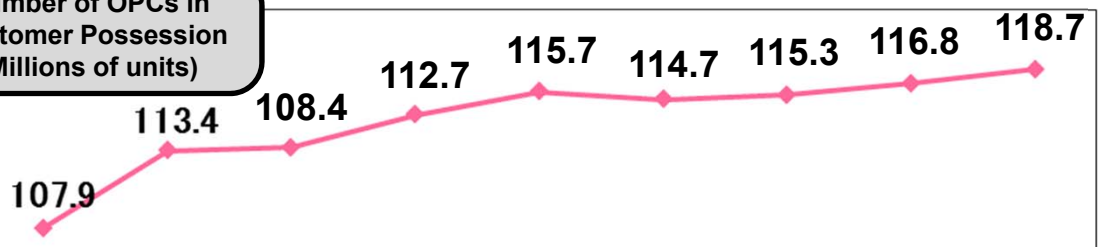
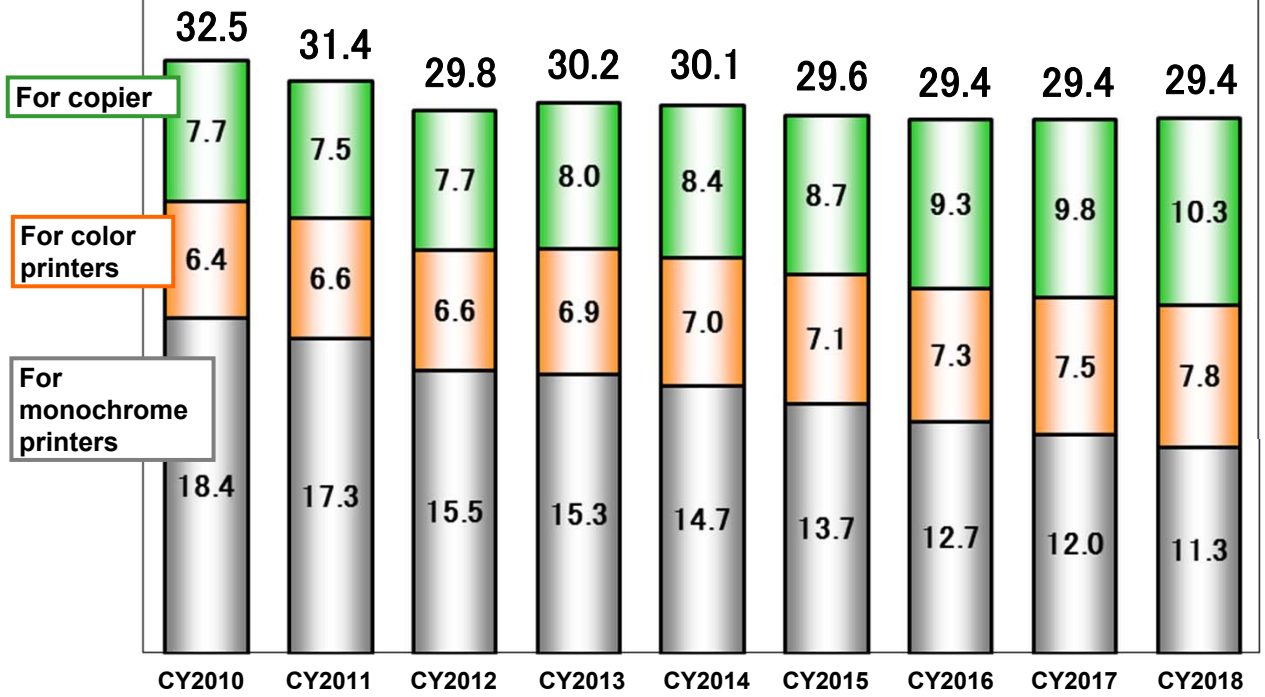
■ Demand shift from monochrome printers to multifunctional color printers and copier
■ Market scale expected to remain around ¥30.0 billion going forward, but number of OPCs in customer possession to rise each year

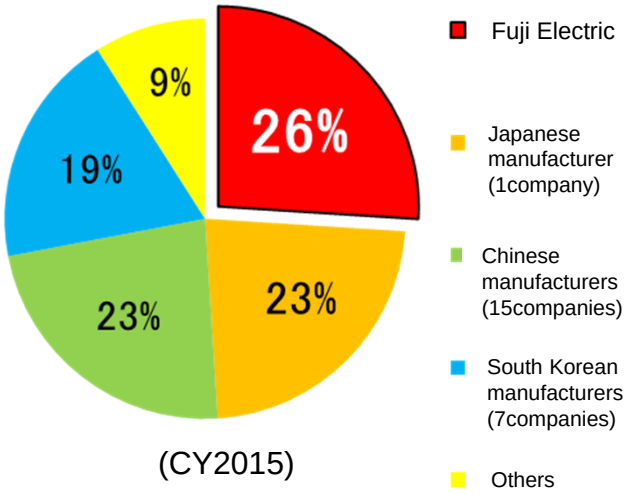
Number of OPCs in Customer Possession (Millions of units)



OPC Market Scale (Billion yen)



Global Market Shares of OPC Manufacturers and Dealers (Share of External Sales)



(CY2015)

* Combination of data released by Data Supply Inc. and Inter Watch Corporation and the Company's estimates

Photoconductors Business Plan

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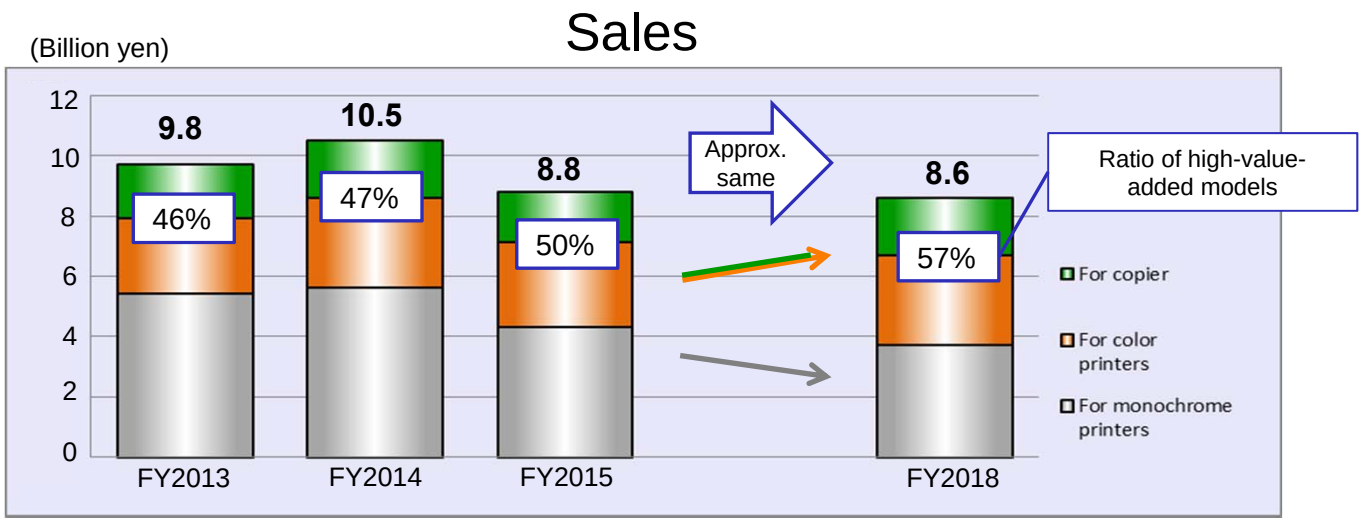
Maintain top market share with net sales of around ¥9.0 billion despite lack of market growth and share growth among Chinese manufacturers focused on low-price OPCs



■ Priority measures

Secure operating margin of more than 10% through increased orders of highly profitable products

- Focus on high-value-added OPC models for color printers, copier, high-speed devices, wide-format devices, etc.
- Maintain industry-leading performance levels by developing highly functional materials
  (Twofold improvement in durability, 150% improvement in photosensitivity stability)

Magnetic Disks

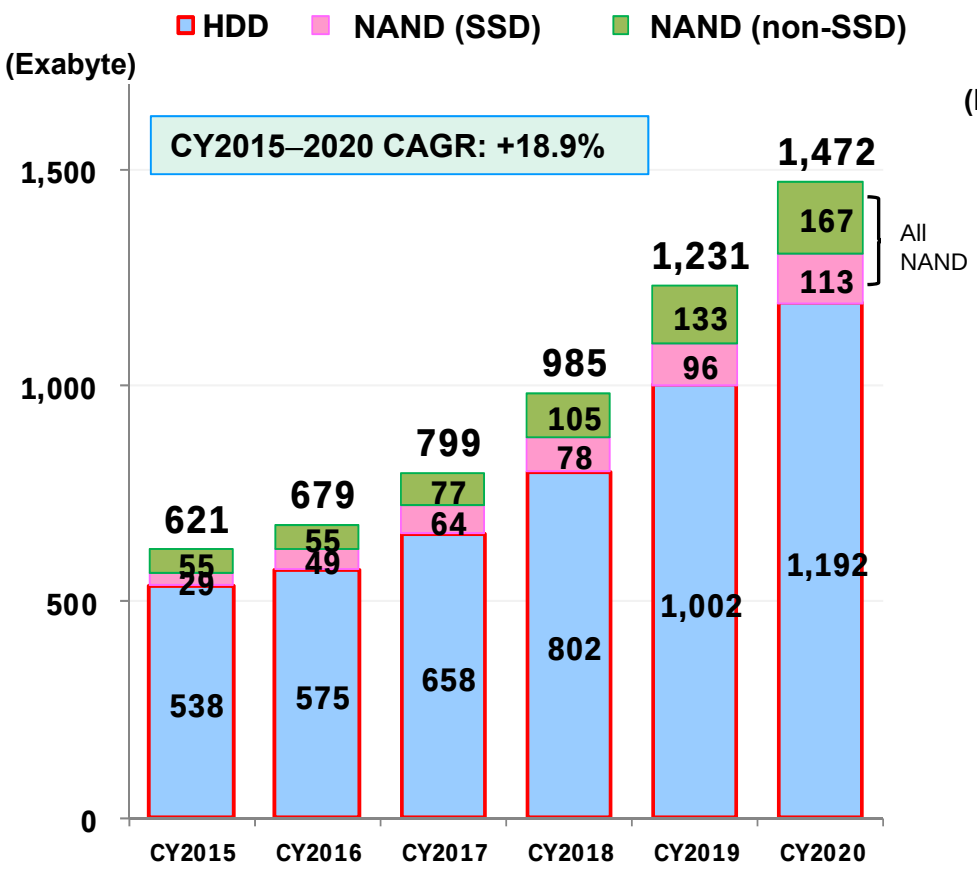
Total Shipped Data Volumes (Exabyte)

富士電機 Innovating Energy Technology

- Overall data volume will continually increase, HDD is expected to cover majority of data demand.
- HDD extend the data volume by nearline model for cloud server.
- NAND memory is insufficient to cover HDD data volume even if used all for SSD.

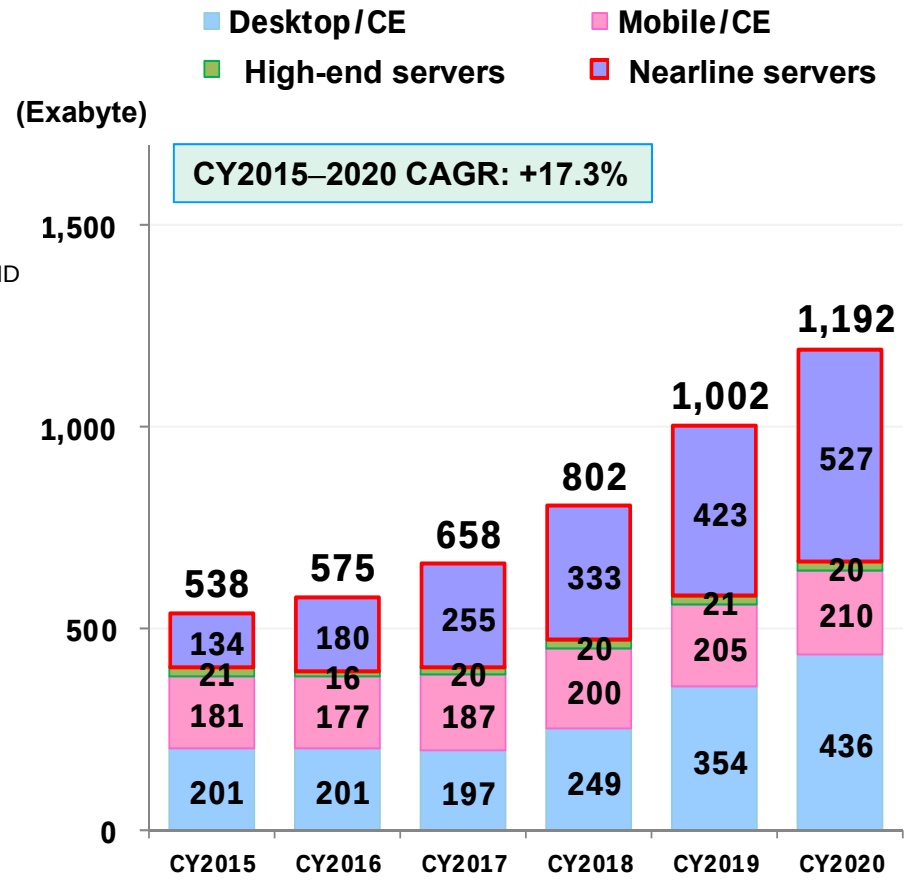
Source : Trend Focus

Data Shipment Volumes for HDD, SSD, and NAND Memory



Source : Trend Focus

HDD Data Shipment Volumes



Magnetic Disks Market Trends

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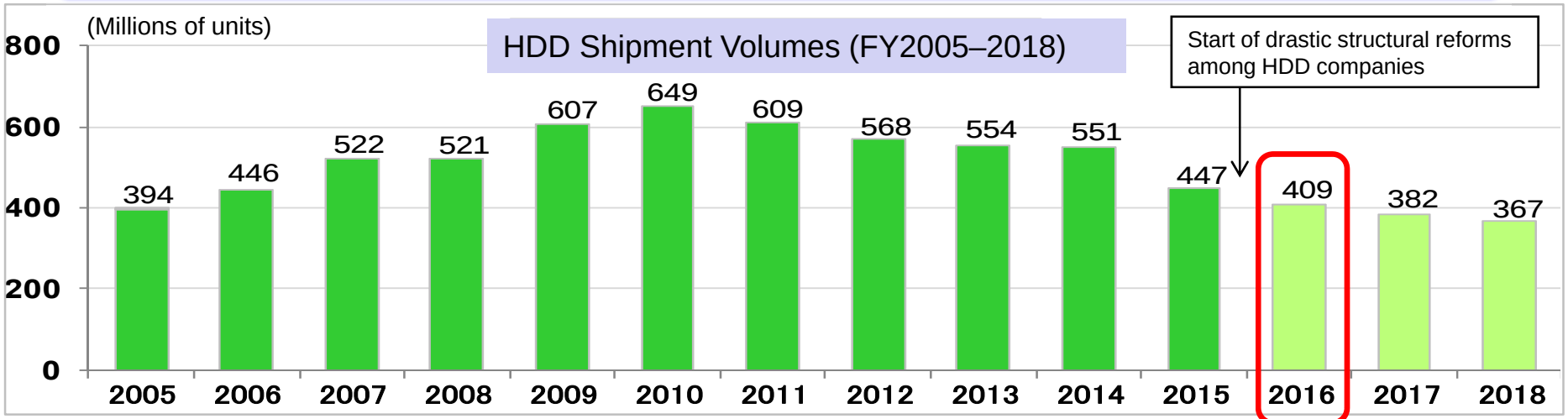
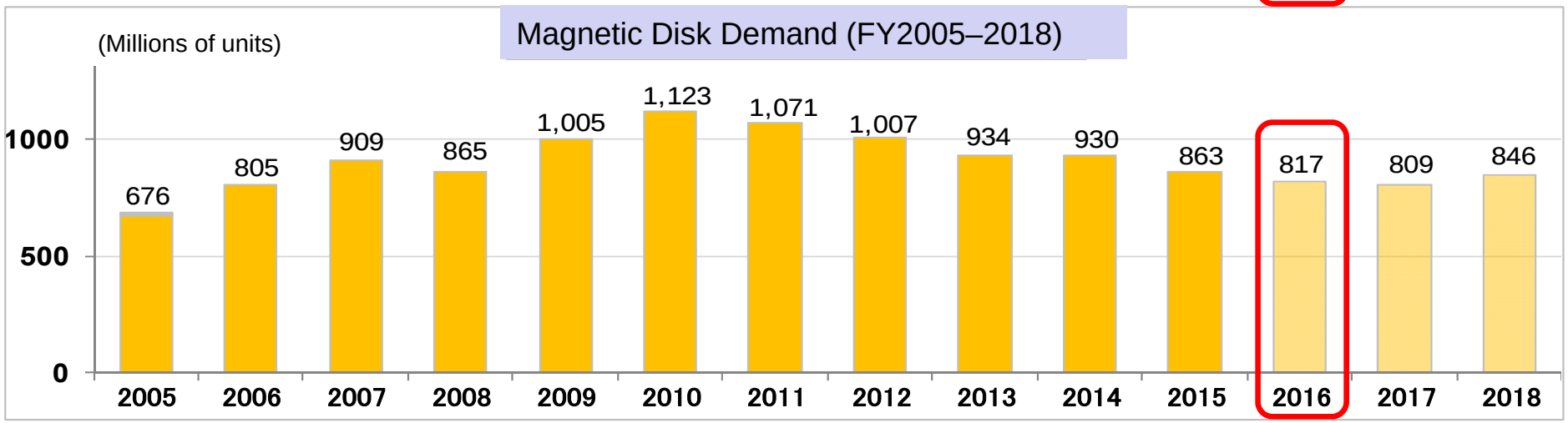
HDD shipment volumes decreasing every year after the peak at 2010, but magnetic disk demand expected to remain consistent due to increase of Disk to Drive Ratio.





* Combination of data released by Trend Focus and Company's estimation

Magnetic Disks Business Plan

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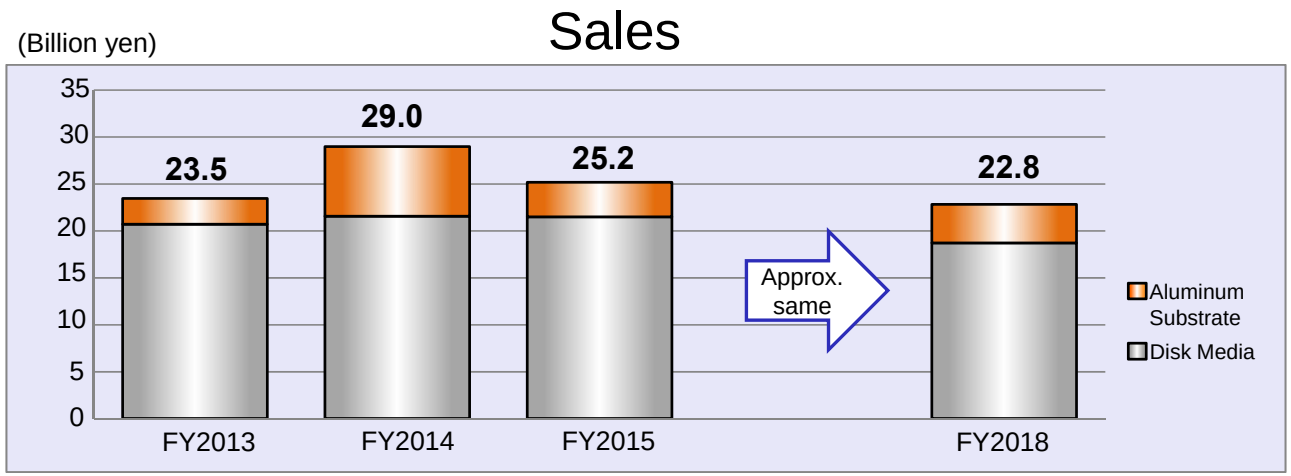
Secure sales of approx. ¥23.0 billion amidst gradual contraction of HDD market.



■ Priority measures

◆ Secure sales and income

- Secure sales volumes by strengthening partnerships with customers leveraging technological capabilities
- Boost cost competitiveness by reducing costs which surpass selling price reductions

◆ Advanced R&D

- Commence development of next-generation HAMR products aiming to start mass-production in FY2020

Capital Investment / Research and Development

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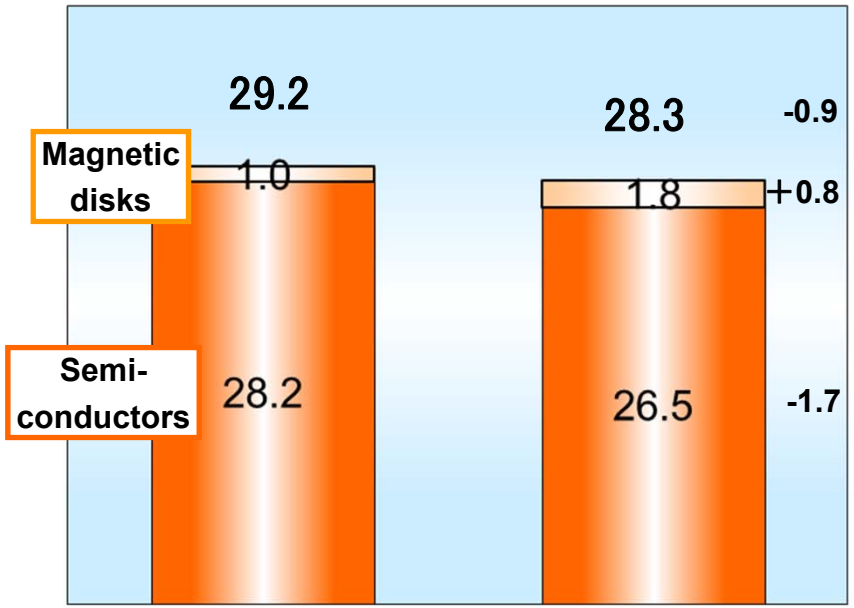
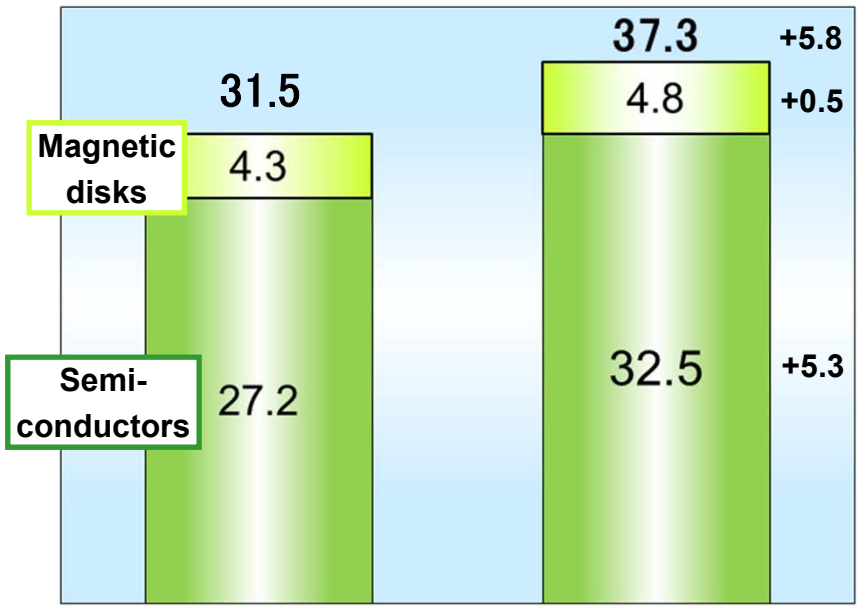
■ Capital investment: Shift from investing in production increases to conducting upfront investments in next-generation products and new products
■ R&D: Step up development of SiC modules, 7th-generation IGBT modules, and automobile-use modules

Capital Investment (Billion yen)



Research and Development (Billion yen)



・Production equipment of 7th generation IGBT (Yamanashi/Malaysia)

・SiC devices, modules
・Automobile-use devices, modules

* 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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