

Mitsubishi Electric Key Growth Businesses

< Power Semiconductor Devices >

November 9, 2021

Mitsubishi Electric Corporation

- 1 Formulate a medium-term management plan that targets revenue of ¥240 billion or more and operating profit margin of 10% or more in FY2025 (P13)**
- 2 Focus on the automotive and consumer product fields, expand business by utilizing IGBT and SiC (P13~14)**
- 3 Enhance production capacity of 200/300mm, promote productivity improvement, and maintain capital investment in response to fluctuation in demand (P23~24)**
- 4 Provide products as core components of each solution, contribute to realize a decarbonized society, which is a global issue (P26)**

*1 IGBT: Insulated Gate Bipolar Transistor/ Insulated gate type bipolar transistor

*2 SiC: Silicon Carbide / Compared to conventional Si, power loss can be significantly reduced, enabling high efficiency and compact design of inverter equipment.

1. Business Overview

1-1. Business Structure

1-2. Business Details

1-3. Our Strengths

1-4. Business Management Policy

2. Medium-term Management Plan of Key Growth Businesses

2-1. Market Environment

2-2. Growth Strategy

2-2-1. Overall overview

2-2-2. Consumer Segment

2-2-3. Automotive Segment

2-2-4. Investment Plan

2-3. Initiatives on Social Challenges

Note

FY2018 : April 1, 2018 -March 31, 2019

FY2019 : April 1, 2019 -March 31, 2020

FY2020 : April 1, 2020 -March 31, 2021

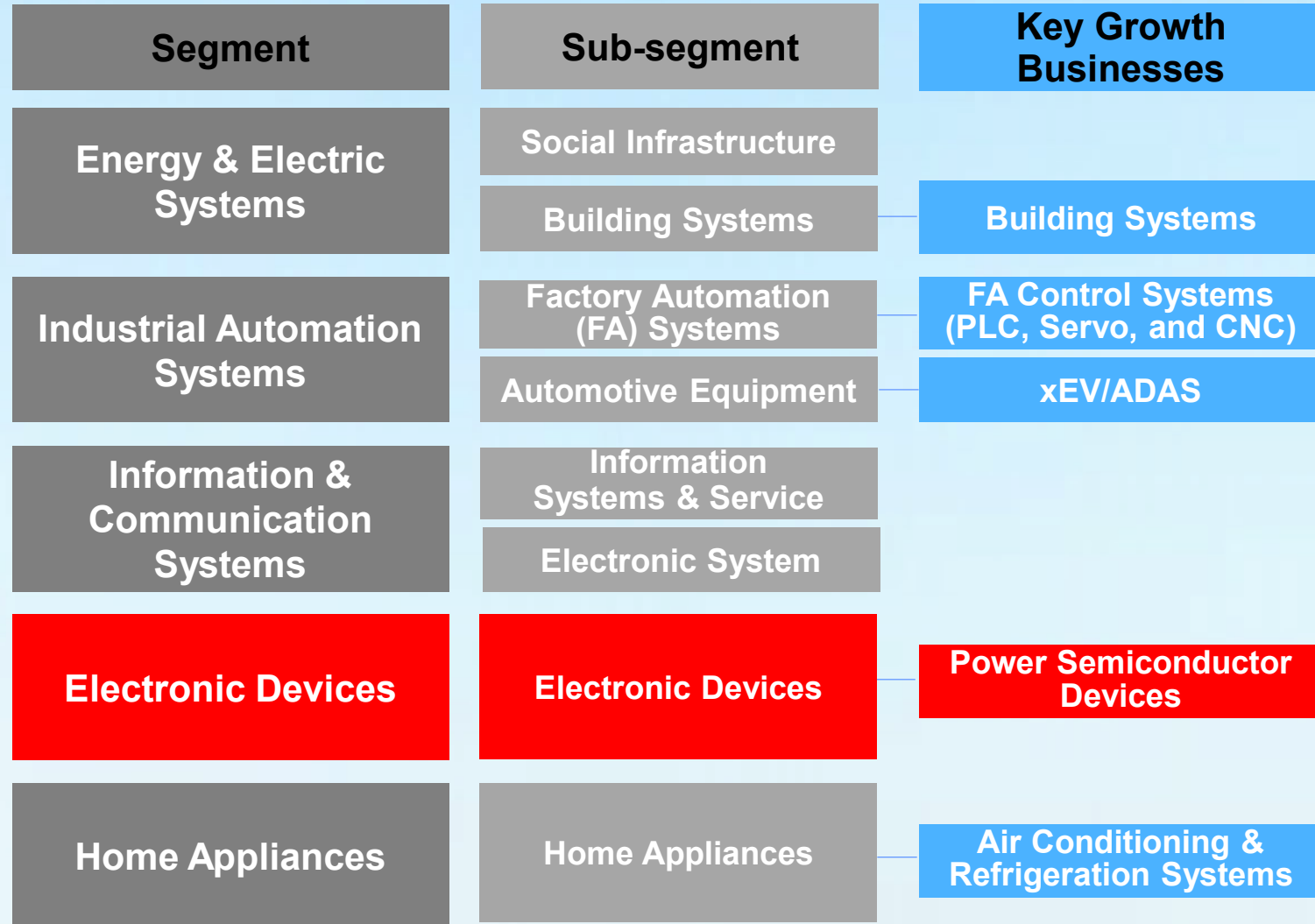
FY2021 : April 1, 2021 -March 31, 2022

FY2025 : April 1, 2025 -March 31, 2026

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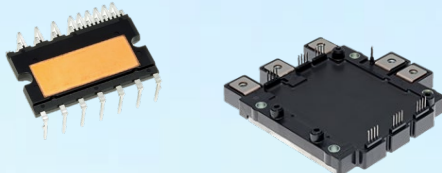
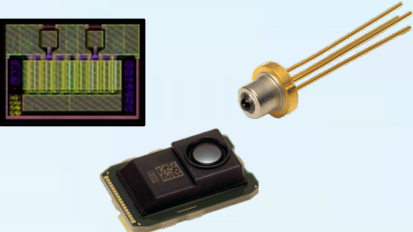
Business Overview

Business Structure



Constituent of Electronic Device Business

Provide key devices that meet social issues such as the after COVID-19 digital revolution and overcoming energy and environmental constraints.

Business	Overview	Ratio (FY2020 actual)
<p>Power Device Business</p> 	<p>Devices used for AC⇔DC, Voltage/frequency conversion, motor control, power converter</p> <p>Applications : Home appliances(air conditioners, etc.), industrial equipment(inverters, servos, etc.), motor controls(xEV*), traction, wind/photovoltaic power generations, etc.</p>	<p>Approx. 75%</p>
<p>High-frequency and Optical Device Business</p> 	<p>High-frequency Device : wireless communication devices</p> <p>Optical Device : Optical fiber communication devices</p> <p>Infrared Sensor Device : Thermal diode infrared sensor devices</p> <p>Applications : Various communication systems, data centers, etc.</p>	<p>Approx. 15%</p>

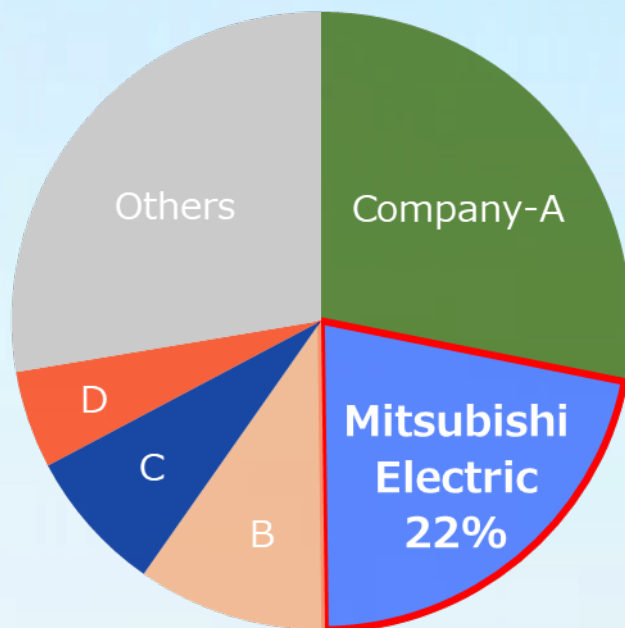
※TFT-LCD Module Business will end production and business by June 2022.

The composition rate is approx. 10%. (actual result in FY2020)

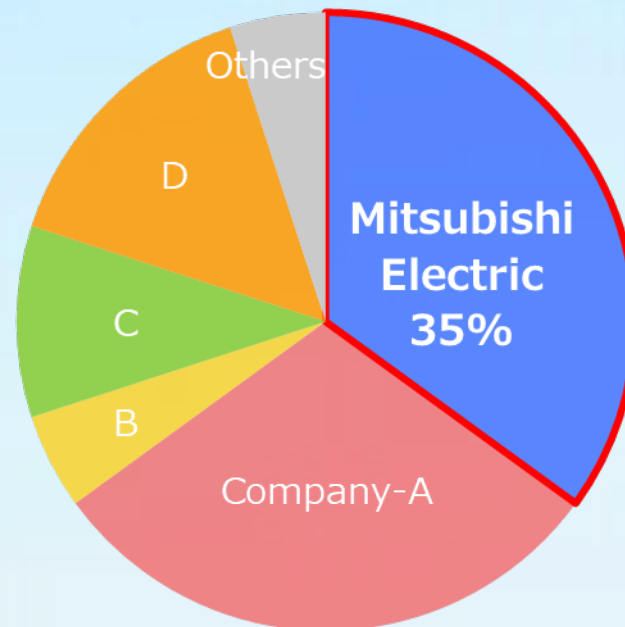
*EV: Electric Vehicle

Strengths of Electronic Device Business

Have the strengths of high efficiency, long life and high reliability. Make use of abundant field knowledge cultivated over many years, such as optimization with customer's equipment to improve its global position, especially in IGBT modules and optical devices for data centers.



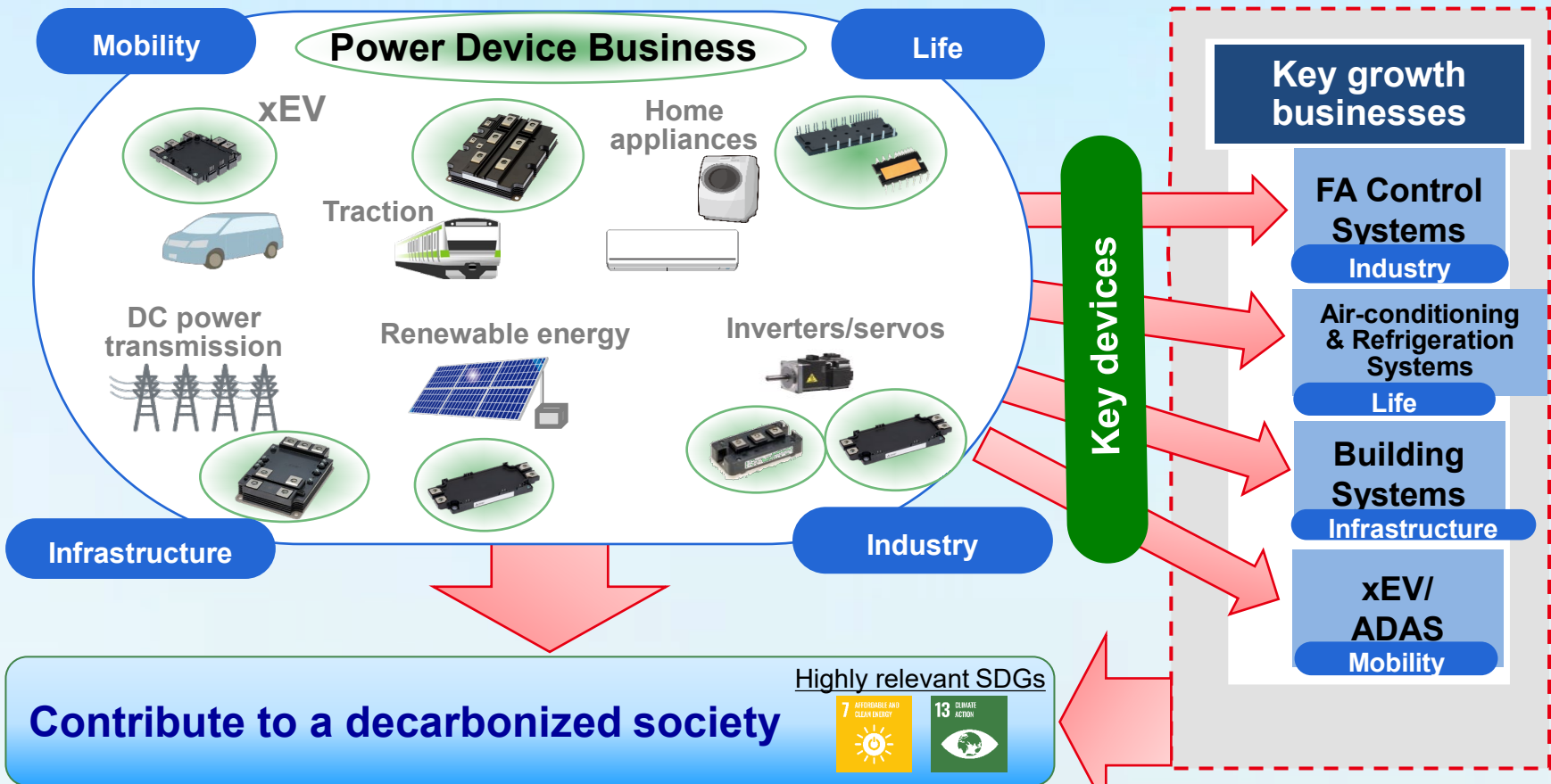
Power module(IGBT module) share
(Our estimate, FY2019)



Optical devices share for data centers
(Our estimate, FY2019)

Reasons and Background for Focusing on Power Device Business as a Key Growth Business

Key devices contribute to a decarbonized society.
 Have the top-tier in the IGBT field and expect high growth globally.
 Key devices for other key growth businesses.



2

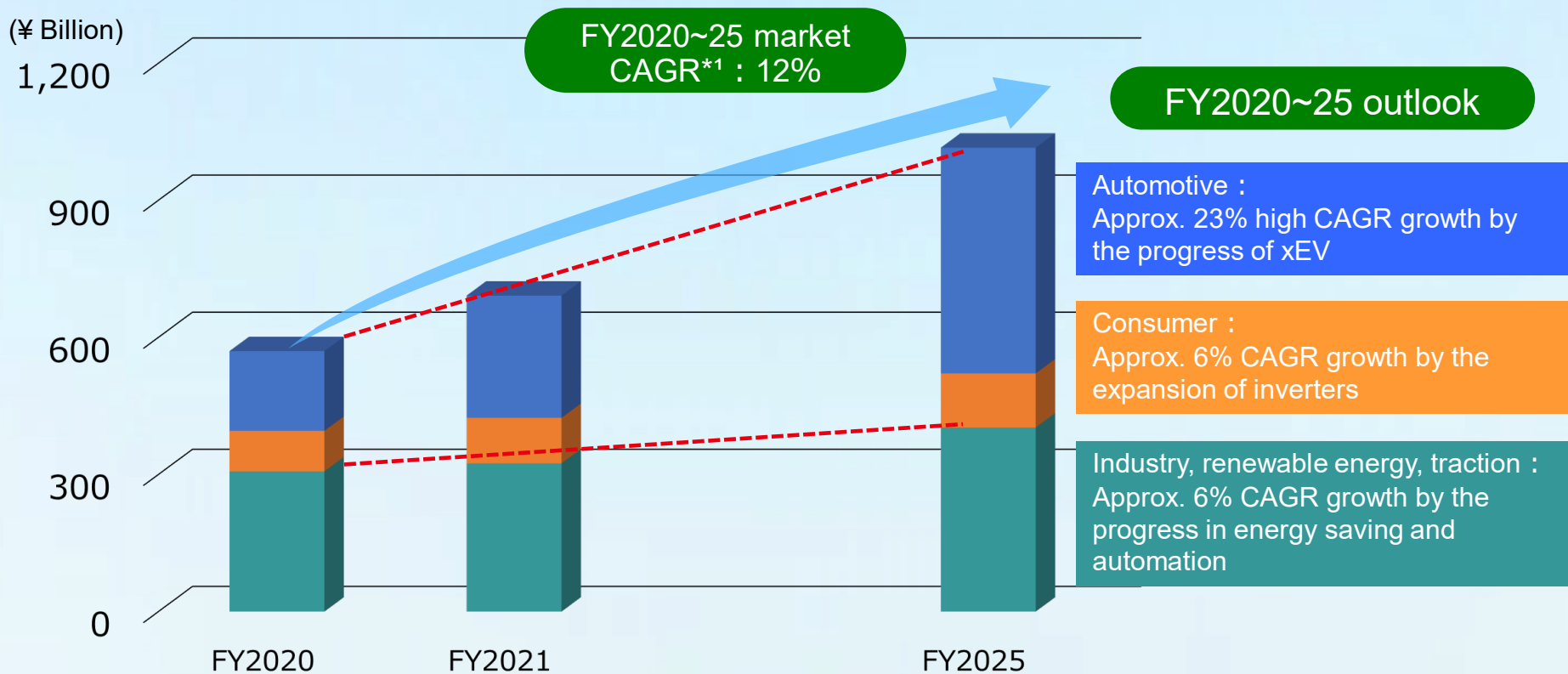
Medium-term Management Plan of Key Growth Businesses

2-1

Market Environment

Power Device Market Outlook

Approx. 12% CAGR in FY2020-2025 growth is expected with the progress of xEVs for automotive and inverters for consumer equipment.



Market size of IGBT modules by field (our estimate)

2-2

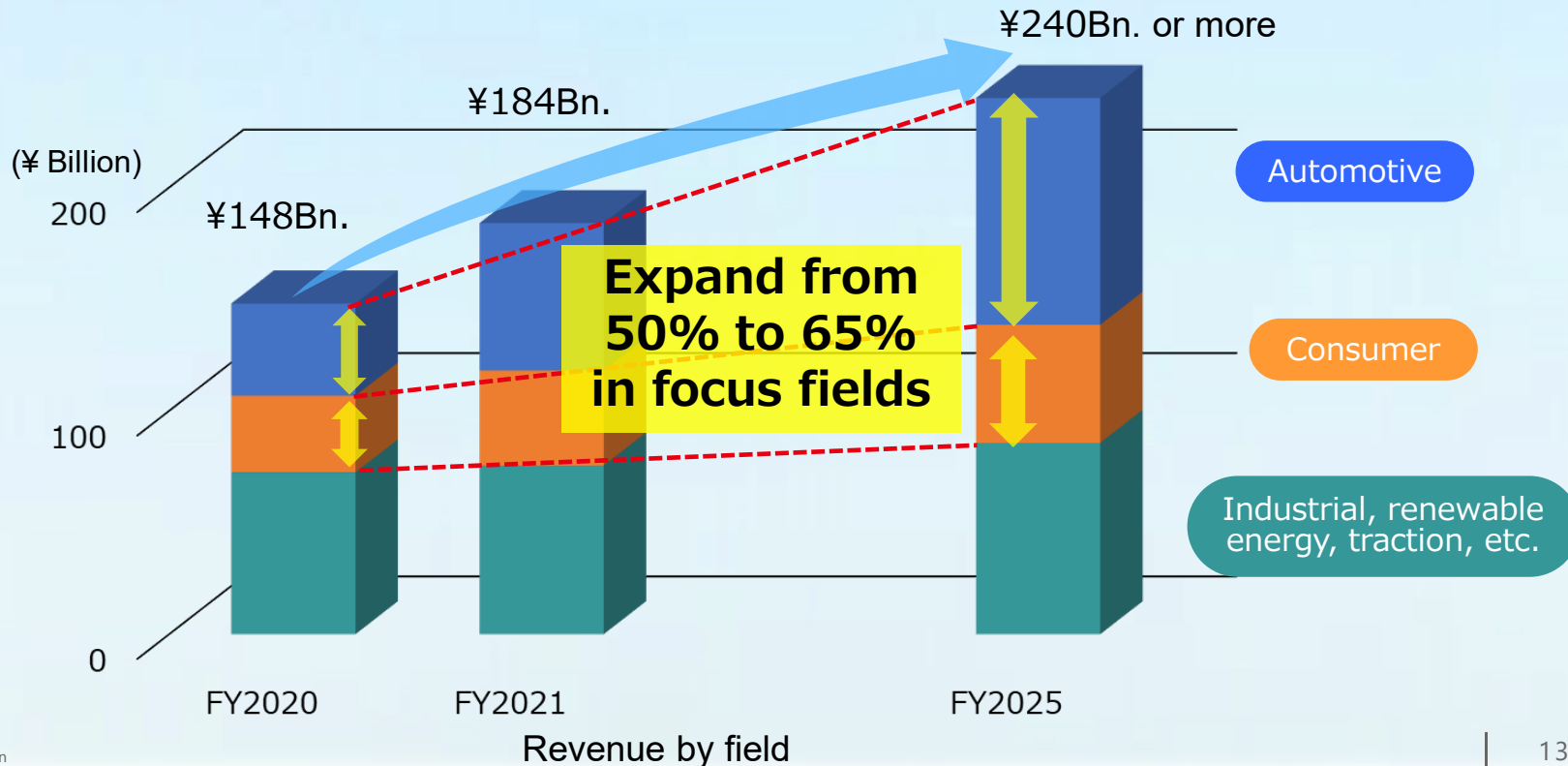
Growth Strategy

Growth Targets

	FY2020 Actual	FY2021 Plan	FY2025 Target
Revenue	¥148Bn.	¥184Bn.	¥240Bn. or more
OPM	0.4%	5%	10% or more

Business Strategy

Expected to expand in the medium term in each field. **Focusing on the automotive field, where high growth is expected, and the consumer field where we are strong,** while using the industrial, renewable energy and traction fields as base roads.



Market Outlook by Field and Our Measures

Automotive



<Business environment>

- Expected to grow rapidly due to xEV

<Our Measures >

- Capture with strategic products achieved significant size and mass reduction
- Accelerate and strengthen SiC to meet diversifying customer needs

Consumer



<Business environment>

- Inverters for home appliances continue to grow and strong demand continues

<Our Measures >

- Strengthen product performance and maintain top position in the air conditioner market
- De facto standardization with strategic products for new markets such as air conditioner fans, washing machine fans and refrigerators

Industrial, renewable energy



<Business environment>

- Demand for capital investment for automation etc., currently strong, will maintain over the medium to long term
- Renewable energy market also expands significantly

<Our Measures >

- Strengthen large and medium capacity lineup we are good at
- Strengthen small capacity lineup mainly by Vincotech*1

Traction, electric power



<Business environment>

- Strong demand for traction continues in the medium to long term
- High voltage direct current(HVDC) market is activating for electric power

<Our Measures >

- Strengthen mainly large capacity lineup we are good at, including SiC

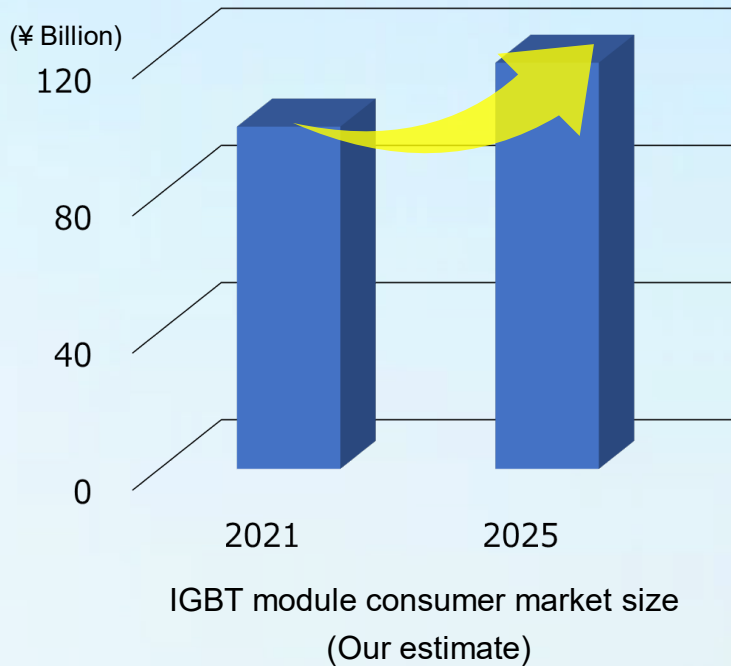
*1 Vincotech : Our affiliated company

Market Trend

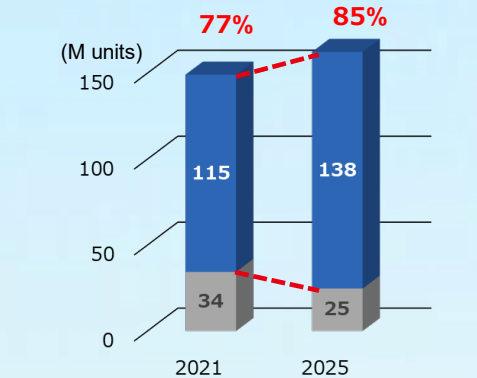
Existing room air conditioner market(for compressors), the core, is **steadily expanding** due to tightening of energy saving regulations.

Applications with small current capacity, such as air conditioner fans, washing machine fans and refrigerators, are **expanding as a new market, as inverters are expected to be used for.**

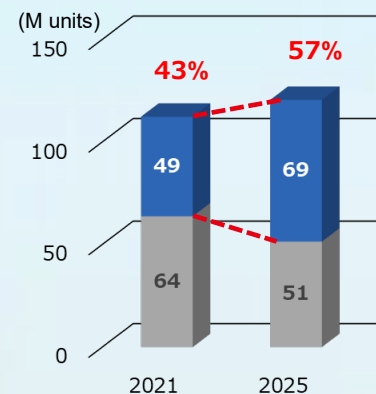
Consumer market FY2021~25 outlook



Sales quantity and inverter rate transition of room air conditioners and washing machines



Room air conditioner sales quantity



Washing machine sales quantity

Red : Inverter conversion rate

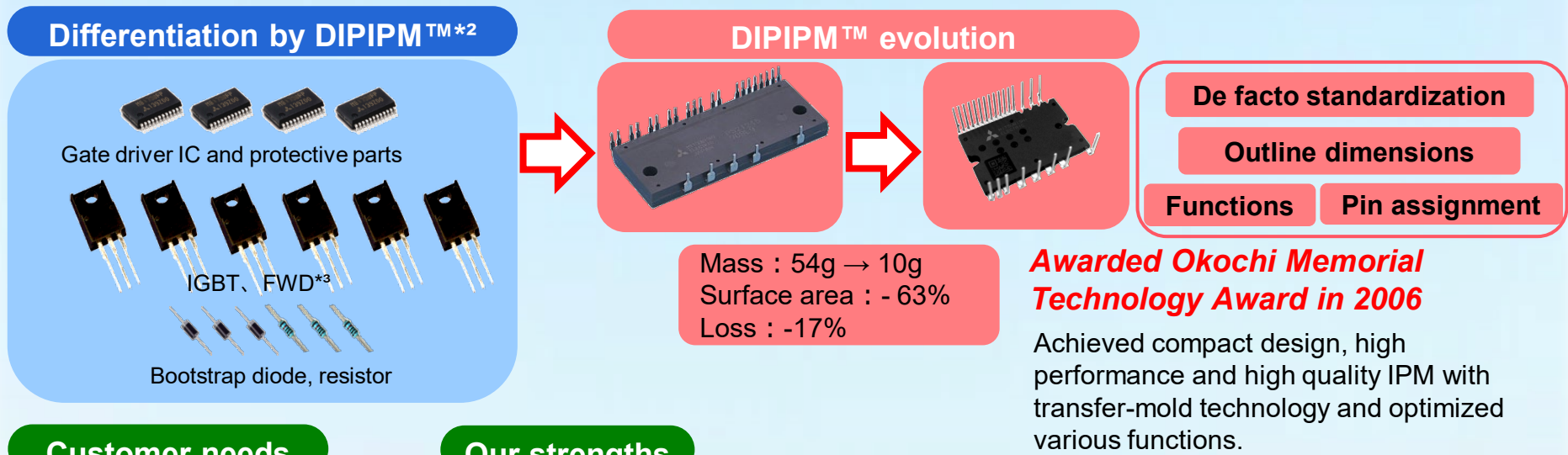
Blue : with inverter

Grey : others

Source : Fuji Keizai CO.,LTD., February 2021
(Global Home Appliance Market Research 2021)

Our Achievements

In early days, introduced market compact design high performance, high quality transfer-molded IPM. Optimal package, implements peripheral parts, realized easier and more compact customer design. **De facto standardization** by being adopted by many customers. Since then, continued to evolve and have **market leading IPM products**.



Customer needs

- Compact design
- Low power consumption
- Improved durability

Our strengths

- Small size** : Thinner chip, optimized package
- High performance(low loss)**: High chip efficiency(improvement in loss)
Optimized driving(fine control by built-in driver IC)
- High quality** : Countermeasures to temperature(high heat dissipation material, high heat resistant resin)

*1IPM : Intelligent Power Module
©Mitsubishi Electric Corporation

*2DIIPM™ : High performance module with built-in drive circuit and protection circuit in IGBT


*3FWD : Free Wheeling Diode

Initiatives for FY2025(Air Conditioner Compressor Market)

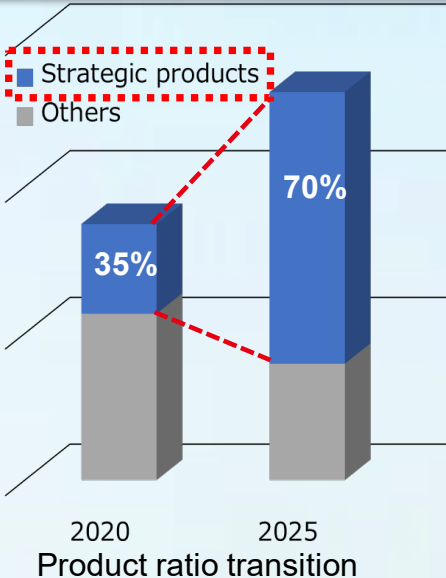
In the existing market(air conditioner compressors), **maintain position and improve commercial growth by strategic products** with further compact design, while keeping higher performance and high quality.

RC-IGBT*1 has approx. 30% low loss*2 compared to competitor due to our unique chip performance improvement technology. Continue to evolve products and lead the industry.

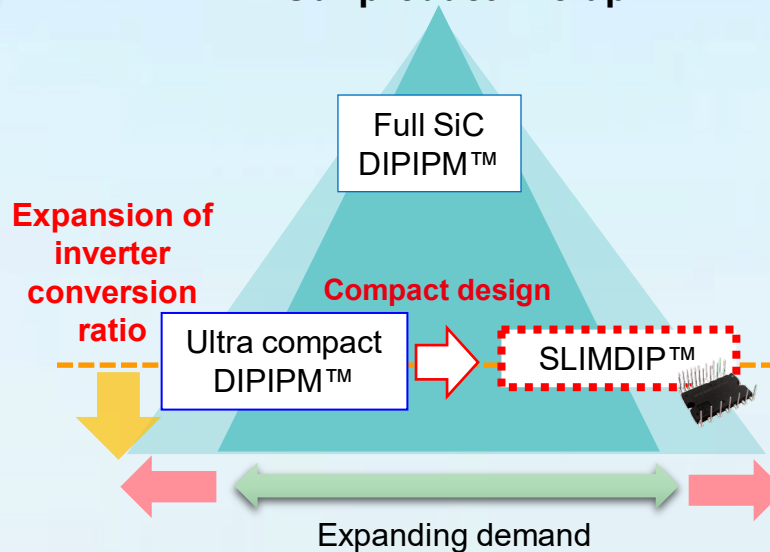
Compact design

Strategic product	Target market	Key technology	Providing distinctive products
SLIMDIP™ 	Air conditioner compressor (existing)	Adopt our unique RC-IGBT structure, insulating material	<ul style="list-style-type: none"> • Compact design(surface area : -33% to conventional product) • Low loss(approx. -30% to competitor products)

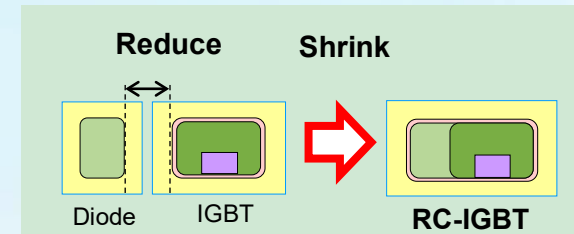
Ratio of strategic products :
FY2020:35% ⇒ FY2025:70%



<Existing market(Air Conditioner Compressor) > Our product line-up



What is RC-IGBT?




IGBT and diode are within 1 chip. More compact design possible while maintaining performance such as heat dissipation.

*1RC-IGBT: Reverse Conducting Insulated Gate Bipolar Transistor
*2Our estimate

Initiatives for FY2025(New Market)

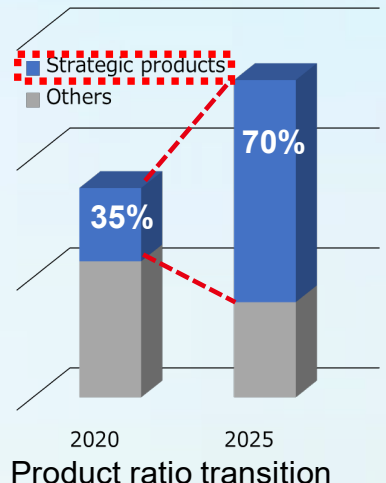
For new markets such as air conditioner fans, washing machine fans and refrigerators, etc., we have already introduced surface mount type strategic product, easier for customers to handle.

Customer board surface area can be **reduced by around 10% compared to other company's products**. It has also been decided to be **adopted by major customers, aiming to create another de facto standard**.

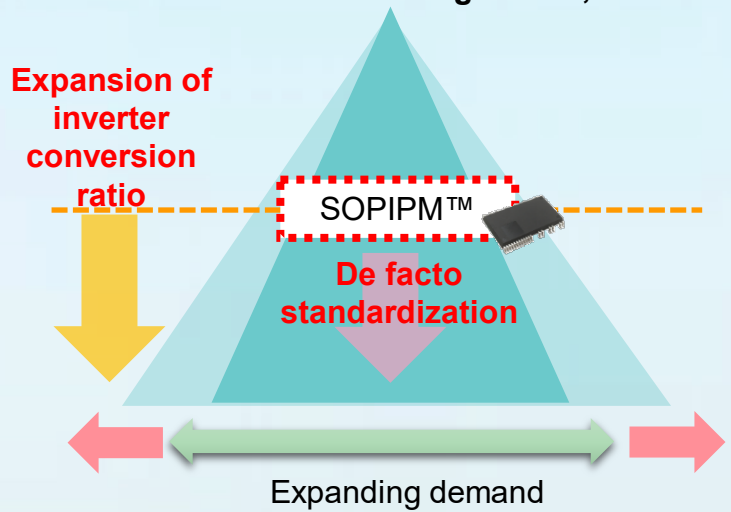
Strategic product	Target market	Key technology	Providing distinctive products
 <p>SOPIPM™</p>	Air conditioner fans, washing machine fans and refrigerators, etc., (new market)	<ul style="list-style-type: none"> • Surface mount while maintaining SLIMDIP™ functions • Differentiation by optimally implementing peripheral parts 	Surface mount type while implementing peripheral functions

Surface mount type

Ratio of strategic products :
FY2020:35% ⇒ FY2025:70%



<New market>
Air conditioner fans, washing machine fans and refrigerators, etc.



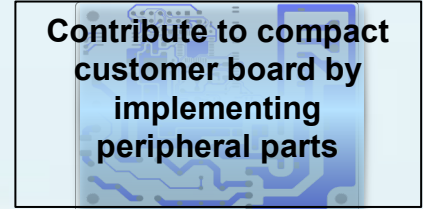
Customer board image with SOPIPM™ (image)



With other company's product

Approx. 10% smaller

*Our estimate



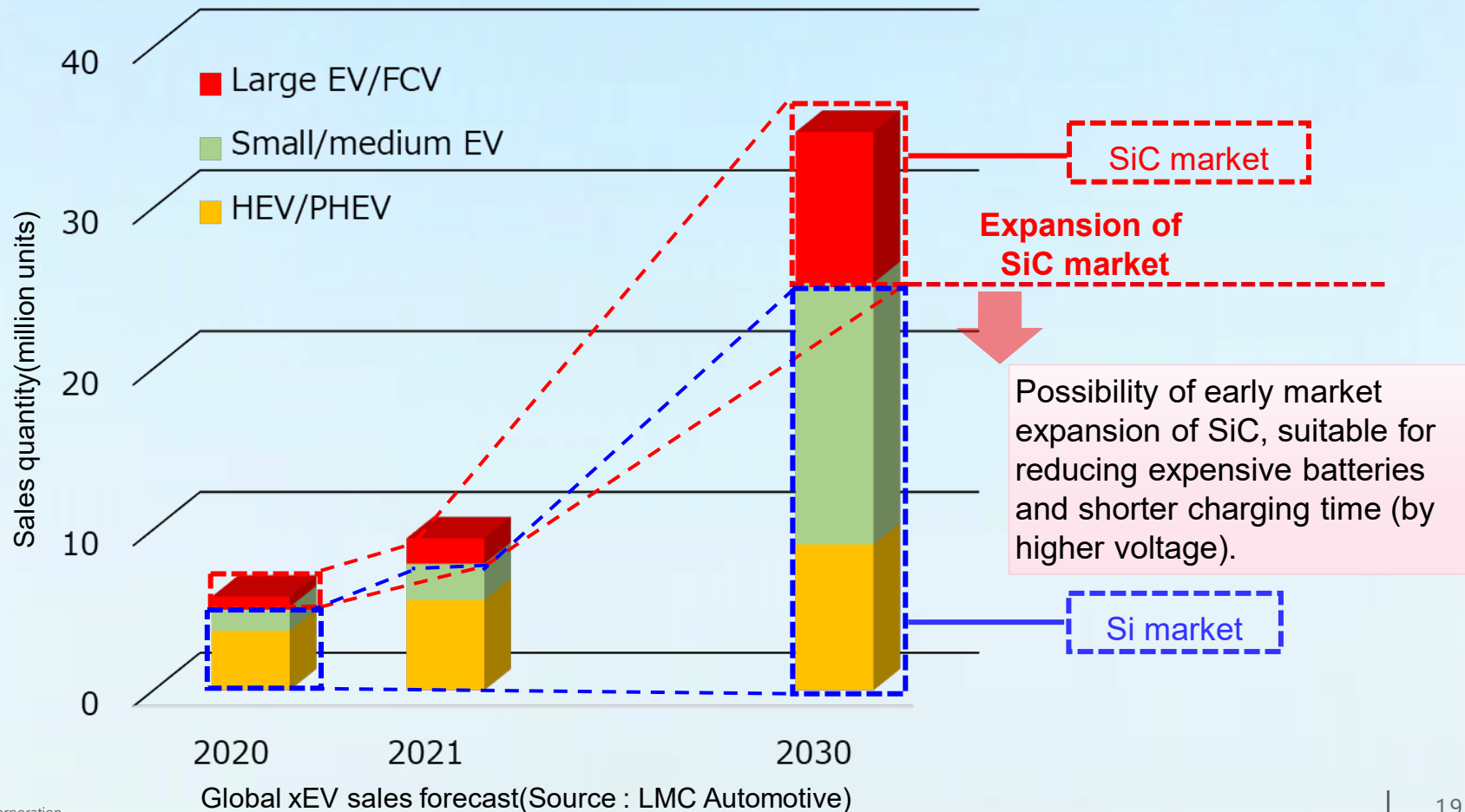
Contribute to compact customer board by implementing peripheral parts

Market Trend

High growth can be expected in the automotive field(xEV) due to energy saving trend.

Market, will grow particularly by 2030, is for small/medium size EVs.

As for power devices, the use of Si and SiC will be promoted, according to diversifying customer needs(motor output capacities).



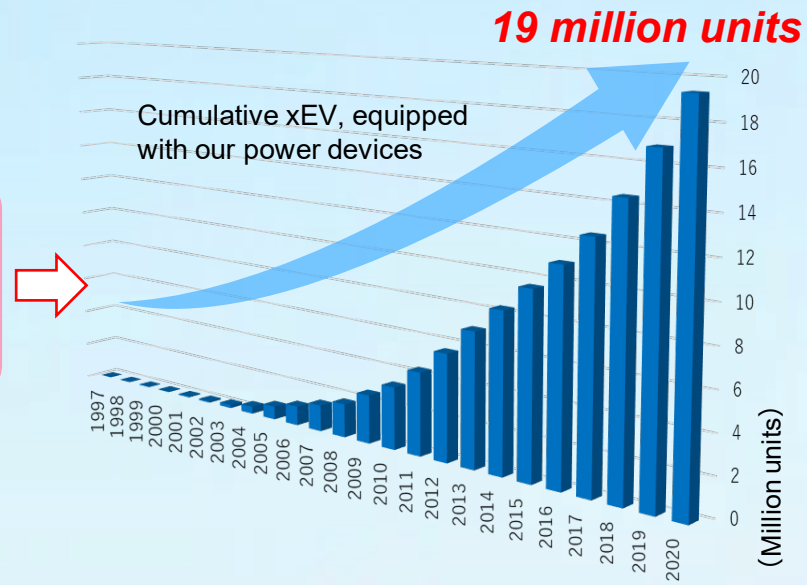
Our Achievements

Realized earlier mass production of IPM for the automotive field by applying chips and packaging technology cultivated in other fields. Continue to meet the needs of customers in the automotive field with compact design, high performance utilizing SiC, and high quality and **cumulative xEV equipped with our power devices have become 19 million units.**

Develop products, further refined with the knowhow gained from our achievement.

Major achievements in our power devices(automotive field)

- FY1997 : Mass production(MP) of IPM for automotive
- FY2015 : MP of cooling fin integrated type
- FY2016 : Commercialization of SiC power device
- FY2020 : Started MP of SiC products for automotive



Customer needs

- Compact design of engine room(power unit)
- Extension of cruising range
- Improved durability

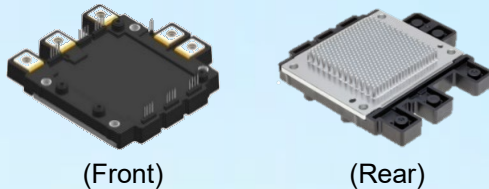
Our strengths

- Smaller size** : Improved heat dissipation by our unique insulating material and resin sealing
- High performance(low loss)** : High chip efficiency(Si loss improvement, SiC)
- High quality** : Industry's first DLB* adoption, and resin sealing

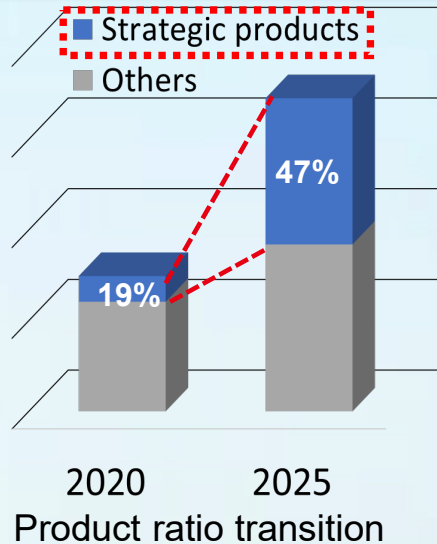
Initiatives for FY2025

Introducing strategic products **significantly smaller and lighter**, while maintaining high performance and high quality. Superiority of our products has already been recognized, **sales expands due to increased number of adopted models from multiple customers**. Also **working on new business negotiations** for further expansion.

Strategic products : J1*1 Series



Ratio of strategic products :
FY2020:19% ⇒ FY2025:47%



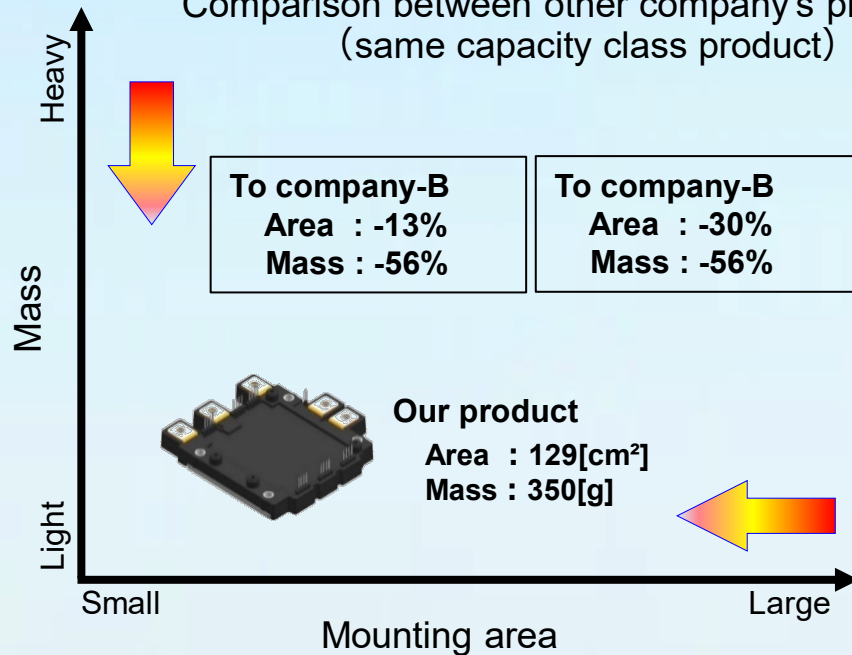
Key advantages of strategic products

Newly adopted,

**Smaller
Lighter**

- Latest generation thinned IGBT chip
- Case with integrated cooling fin structure

Comparison between other company's products*2
(same capacity class product)



Initiatives for Further Growth

Strengthen and accelerate initiatives for SiC to popularize xEV.

Strengthen business by properly using Si and SiC according to customer needs.

Strengths of our SiC

- Since the launch of the SiC power module in 2013, we have accumulated **high-performance and high-reliability built-in technology (screening technology, etc.)**, cultivated over many years in the consumer, industrial, and especially traction fields.

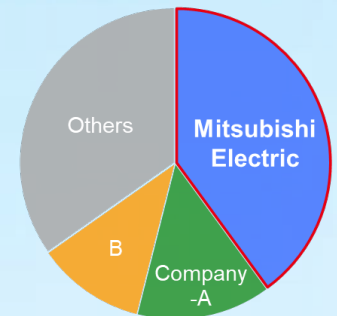
Example: In case of inverter equipment for traction, while ensuring reliability, achieved from conventional products, about **"55% reduction in generation loss"** and **"65% reduction in volume and mass"**.

- Realized further compact design by **SBD*1 built-in MOSFET*2**

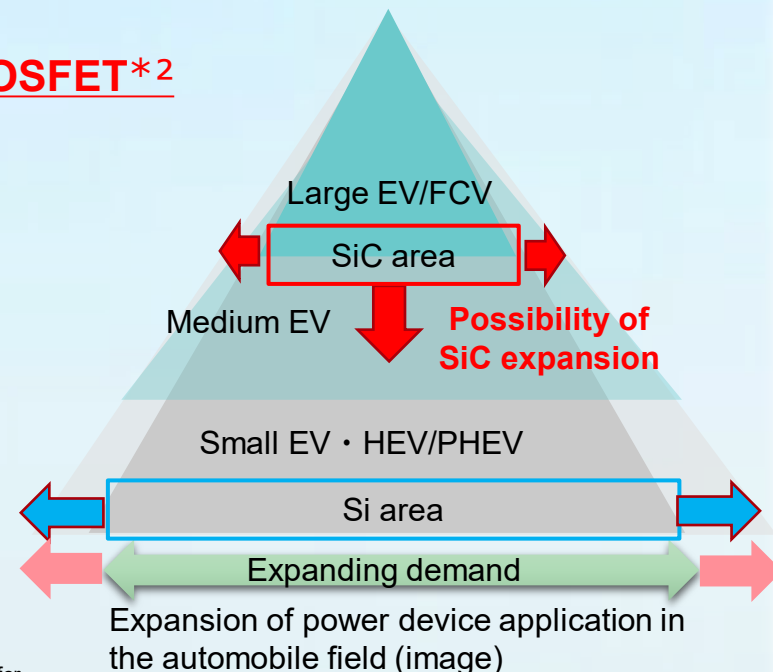
Initiatives on SiC

- Achieve further performance and productivity improvement by applying a unique manufacturing process to **Trench MOSFET*3**
- Considering **200mm wafers** to improve productivity

By offering lineup of modules implement Si chips / SiC chips, we can meet the diverse customer needs from small to large size.



Full SiC power module share
(Our estimate FY2019)



*1 SBD : Schottky Barrier Diode *2 MOSFET: metal-oxide-semiconductor field-effect transistor

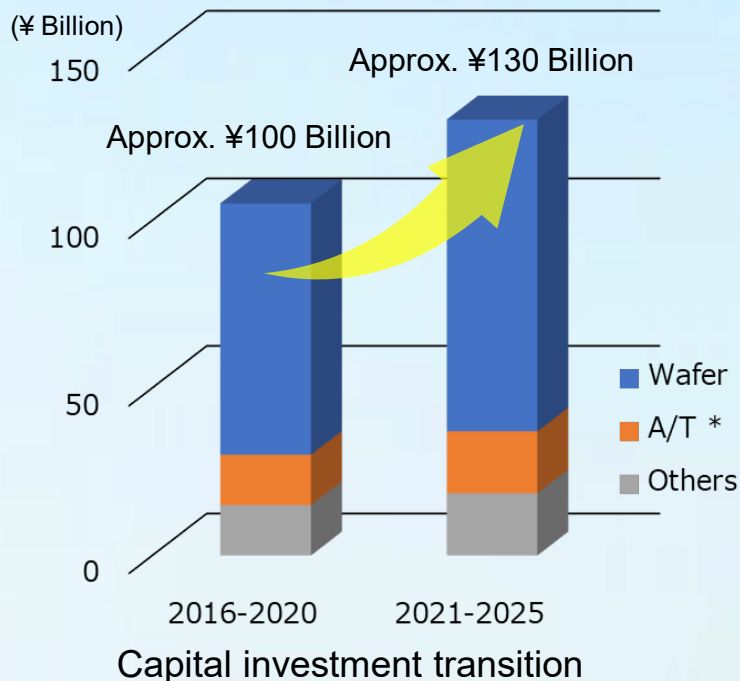
*3 Trench MOSFET: MOSFET in which gate electrodes are embedded in trenches, dug from the surface of the wafer

Capital Investment Plan

Wafer process capacity will be doubled by FY2025 compared to FY2020.

Also, invest on assembly and test process in a timely and appropriate manner to meet future demand.

Capital investment (actual, plan)



Manufacturing factory (example: wafer process)



Constructed 200mm line with improved production efficiency at Fukuyama Factory.

Test run starts in November and production capacity will be gradually expanded.

Started construction of 300mm line.

* A/T : Assembly and test

Production Capacity Enhancement (300mm Line)

In response to increasing demand for power devices due to xEV growth and tightening of energy-saving regulations, we enhance wafer production capacity.

In addition to the expansion of the 200mm line, 300mm line production is also planned.

By improving the microfabrication technology, considering the 300mm line, we have further evolved **our unique CSTBT™* cell structure** to **develop high-performance products and realize production line with high productivity.**

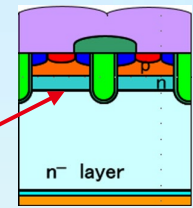
About our 300mm line

Mass production timing : FY2024 (target)

Location : Fukuyama Factory

Si IGBT by CSTBT™
Wafer cross section (image)

Achieves low loss by adding a carrier storage layer in the wafer



Benefits of 300mm line

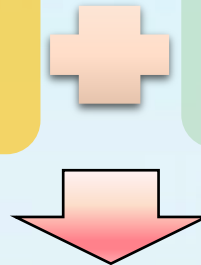
More chips per wafer by larger wafer diameter (more than double)

Realize highly productive line by automation

Furthermore, our unique differentiation (CSTBT™ cell structure)

We have uniquely evolved CSTBT™ structure to reduce loss and improve productivity

RC-IGBT is to be produced in 300mm line



Apply especially from the growing automobile and consumer fields, achieve enhanced production capacity and productivity.

2-3

Initiatives on Social Challenges

Contribute to Solve Social Issues Toward the Realization of Sustainability

Utilize IGBT / SiC cultivated through business synergies, we will contribute to a decarbonized society by providing key devices that save energy in equipment.

Materiality to realize sustainability

Provide solutions to social challenges through our business

Realize a sustainable global environment

Realize a safe, secure, and comfortable society

Provide solutions to social challenges through our business	Realize a sustainable global environment
	Realize a safe, secure, and comfortable society
Strengthen our business foundation to enable our sustainable growth	Respect for all people
	Strengthen corporate governance and compliance on a sustainable basis
	Create a sustainability-oriented corporate culture

Power Device Business

In addition to develop SiC, suitable for compact design, high-speed and high-temperature operation, we will leverage business synergies to supply power devices as core components of each solution in four areas.

By providing products with better energy efficiency, we will contribute to the realization of a decarbonized society, which is a global issue.

Mobility


Life

Infrastructure


Industry

Highly relevant SDGs

7 AFFORDABLE AND CLEAN ENERGY



13 CLIMATE ACTION



Social Challenges

Mobility

Life

Zero traffic accidents Comfortable transport Eliminate regional disparities Enrich leisure time Comfortable life Health

Eliminate traffic congestion Reduce air pollution Improve QOL of mobility impaired people Build communities Prepare for infectious diseases

Measures for deteriorating infrastructure Prevent global warming Preserve the ecosystem

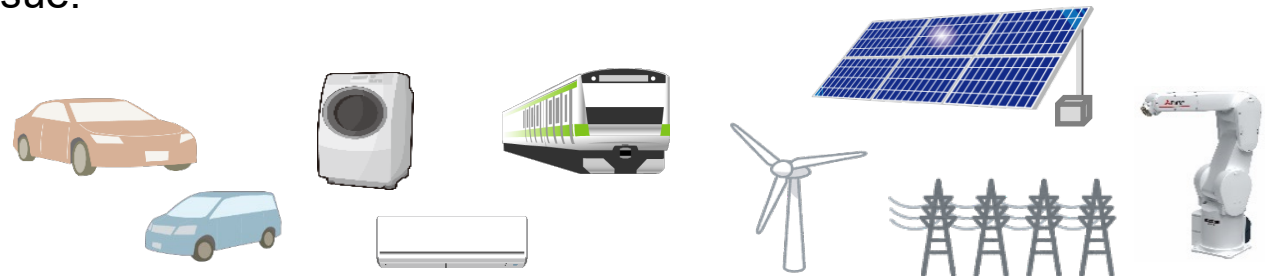
Prepare for natural disasters Avoid water shortage/ food shortage Industry and technological innovation etc.

Eliminate poverty/ inequalities Clean water Address labor shortage Prepare for man-made threats Response to uneven distribution and depletion of resources

Infrastructure

Industry

Sustainable society



Cautionary Statement

While the statements herein including the forecast of the Mitsubishi Electric Group are based on assumptions the Group considers to be reasonable under the circumstances on the date of announcement, actual results may differ significantly from forecasts. Such factors materially affecting the expectations expressed herein shall include but are not limited to the following:

1. Any change in worldwide economic and social conditions, as well as laws, regulations, taxation and other legislation
2. Changes in foreign currency exchange rates, especially JPY/dollar rates
3. Changes in stock markets, especially in Japan
4. Changes in balance of supply and demand of products that may affect prices and volume, as well as material procurement conditions
5. Changes in the ability to fund raising, especially in Japan
6. Uncertainties relating to patents, licenses and other intellectual property, including disputes involving patent infringement
7. New environmental regulations or the arising of environmental issues
8. Defects in products or services
9. Litigation and legal proceedings brought and contemplated against the Company or its subsidiaries and affiliates that may adversely affect operations or finances
10. Technological change, the development of products using new technology, manufacturing and time-to-market
11. Business restructuring
12. Incidents related to information security
13. Large-scale disasters including earthquakes, typhoons, tsunami, fires and others
14. Social or political upheaval caused by terrorism, war, pandemics, or other factors
15. Important matters related to the directors and executive officers, major shareholders and affiliated companies of Mitsubishi Electric Corporation

