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Toyo Tanso
Second R&D Strategy Briefing

Held on December 14, 2020

Toyo Tanso Co., Ltd.

1. Outlook for R&D

Naotaka Kondo,
Representative Director,
Chairman & President, CEO

Staying True to Our Reputation as a Technologically Innovative Company

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Our Aims

Establish a de facto standard globally and become the

"Quality Leader on carbon"

✓ **Achieve good quality/cost from a customer standpoint**

✓ **Provide inspiring new products**

Medium-Term Management Plan

Key initiatives

Enhancement and innovation of production technology

Reinforcement of overseas expansion efforts

R&D activities

Learn customer needs in each region ▶ **Use small starts to develop with speed**

- Globalize R&D centers
- Utilize/collaborate with academia overseas

Structural Enhancements to Become the Company We Strive To Be

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2019 — **2020**

Build a cross-functional system on a global scale in addition to organizations set up by function

2021

Concentrate the development capabilities spread across different departments into the development division

Attempt to become the "Quality Leader on carbon"

Integrate the strategies of each business to accelerate deployment of a consistent technology strategy both upstream and downstream

- ✓ Speed up process from development to commercialization
- ✓ Anticipate market needs and introduce developed products in a timely manner
  - ✓ Enhance developmental ability on a global scale
  - ✓ Nurture global development personnel

FY2020 Research & Development Achievements

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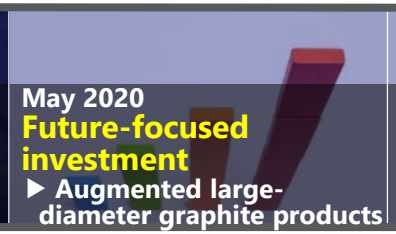
May 2020
Approach to raw materials
▶ Established joint venture



May 2020
Future-focused investment
▶ Augmented large-diameter graphite products

September 2020
Implement integration strategy
▶ Integrated development departments

October 2020
Actively disseminate information about developed materials
▶ Press release about developed C/C composites for oil quenching

Priority growth areas	Key themes
Energy	・C/C components for solar panel manufacturing ・Porous carbon
Electronics	・Graphite materials for power semiconductor manufacturing ・Hybrid TaC/SiC-coated graphite material
Mobility	・High-density C/C composites for oil quenching ・Resin material for injection molding ・New sliders
Social infrastructure	・Low-noise slider material
Life science	・Carbon brushes for cleaners ・C/C composites for home appliances

■ Bring in technologies from outside the company
Examples of joint research / commissioned research

- Exit-focused application research

Joint research into the use of catalysts
National Institute of Advanced Industrial Science and Technology

Commissioned development on recycled water purification
Toyo University

- Basic research

Joint research into porous carbon
Oita University

Joint research into carbon brushes
Nippon Institute of Technology

Commissioned research into isotropic graphite
Fraunhofer Society (Germany)

Toward the Realization of a Sustainable Society

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Advance research and development to handle energy and environmental challenges faced by customers in each business sector. And be sure to seize the business opportunities that are expected to arrive.

Energy

[Power generation]
Grounding brushes for power generation
Components for manufacturing solar power generators
Next-generation nuclear power reactor core materials
[Fuel cells]
Jigs for manufacturing electronic components

Electronics

[Semiconductors]
Components for crystal growth
Components for wafer processing
[Electrical parts]
Jigs for manufacturing electronic components

Social infrastructure

[Communications]
Components for manufacturing fiber optics
Components for manufacturing cables
[General industry]
Packings
Seal ring bearings

Mobility

[Train] Pantograph sliders
[Aircraft] Engine parts manufacturing
[Automotive] Carbon brushes for fuel pumps
Gaskets

Life science

[Medical care]
Target materials for CT scan systems
Chromatographic column fillers
[Home appliance]
Components for manufacturing LEDs
Carbon brushes for cleaners

2. Prospects for Product Development
— Energy Control —

Dr. Takahiro Morishita,
Executive officer, Director of Global R&D Division,

April 2006	Joined Toyo Tanso Co., Ltd. Fundamental R&D Group, Technology Development Division
April 2008	Leader of Advanced Technology Development Group, Technology Development Division
June 2014	Manager of Porous Carbon Business Unit
July 2015	General Manager of Performance Chemicals Division
March 2017	Executive Officer, Director of Technical Development Division, and General Manager of Performance Chemicals Division
September 2018	Executive Officer, Director of Global R&D Division

New Products That Made It to Commercialization This Year

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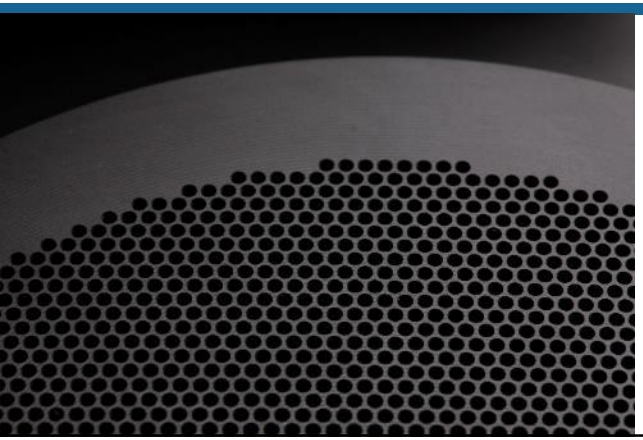
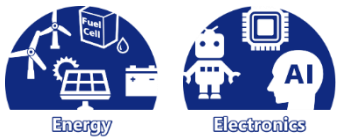


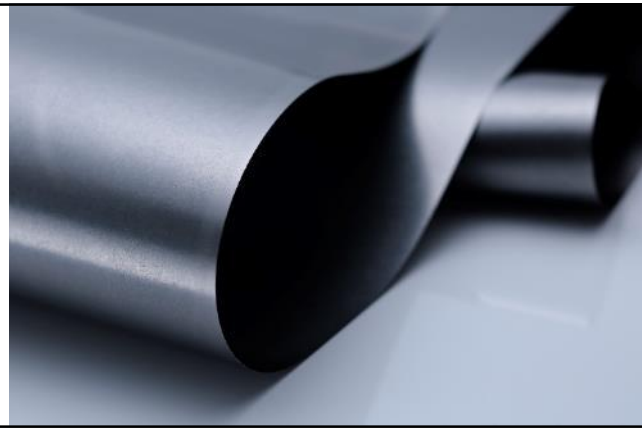
Copper-impregnated graphite material for electrical discharge machining

Cemented carbide used in the manufacture of components for automobiles, smartphones, etc. Electrode material for electrical discharge machining that is excellent for producing metal molds

High-purity graphite sheets

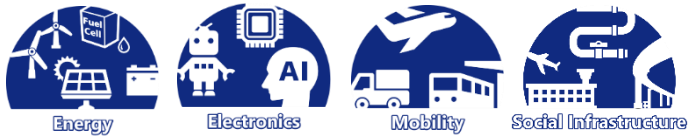
A grade that delivers great cost performance





TaC/SiC Susceptors for SiC Epitaxy

Has the characteristics of both materials of our EVEREDKOTE®-B and PERMA-KOTE® products helping to improve SiC wafer quality



Develop Carbon Materials for Use in Energy Infrastructure

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Habitation, environment, industry

Efficient energy use
Environmentally friendly materials
Sensor technology

Carbon materials

Materials indispensable for supporting society's energy infrastructure

Electrical energy

- Power generation (solar / wind / nuclear power)
- Power storage (batteries / capacitors)
- Conversion (power semiconductors / sensors)

Transportation, information, electronic materials

Non-internal combustion engine components

Automated, safe, high-performance communication products

Thermal energy

- Heat dissipation (energy saving / sensors)
- Heat storage (air conditioning / power generation)
- Heat generation (heater / furnace materials)
- Unused heat utilization (cogeneration / power generation)

Chemical / optical / mechanical energy

- Transportation / storage (material handling / tanks)
- Movement (motors)
- Power generation / conversion (chemical catalysts)
- Combustion / abrasion (members)

Principal Technological Development Road Map

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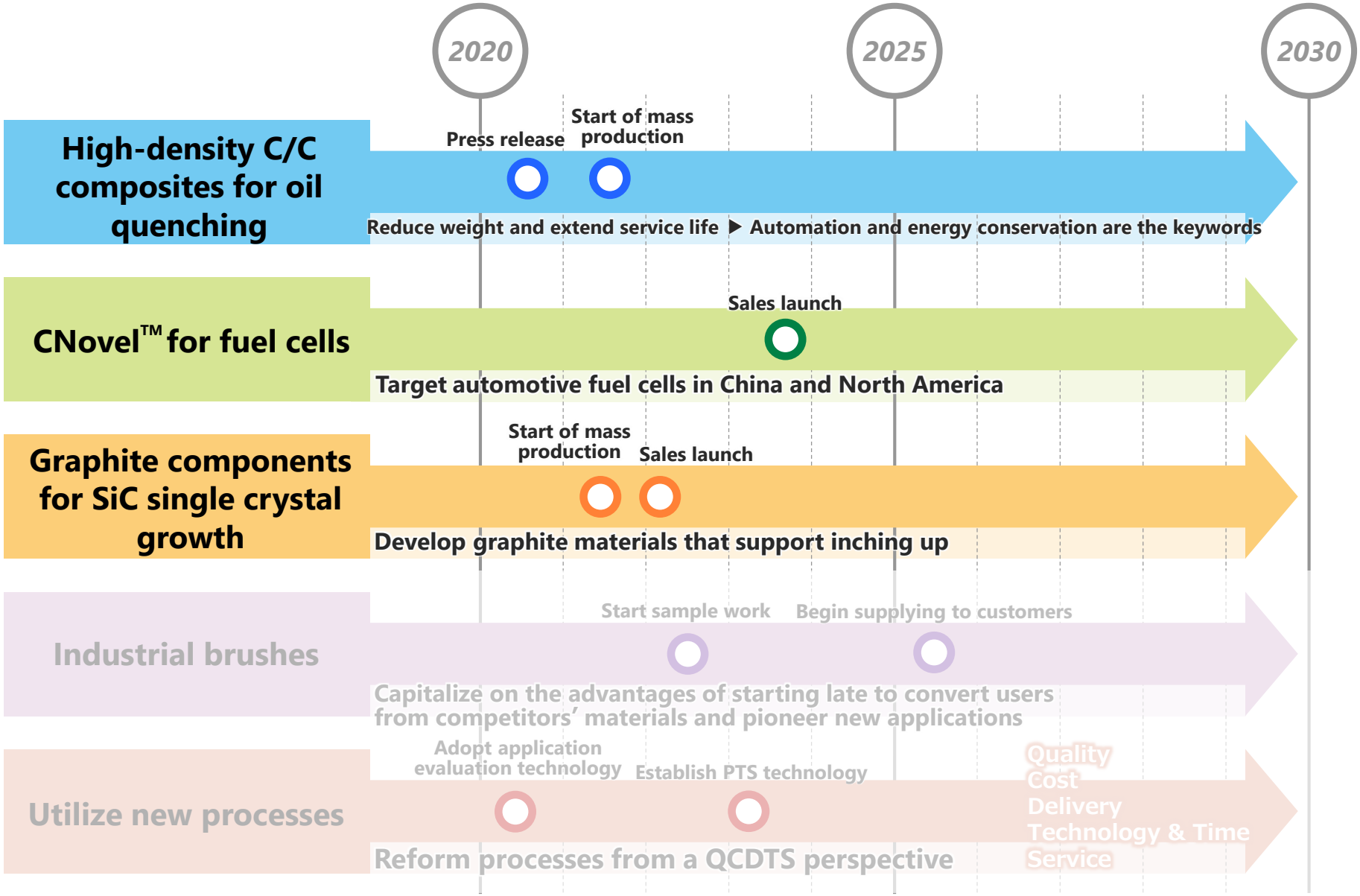

C/C Composite From Metal to Carbon

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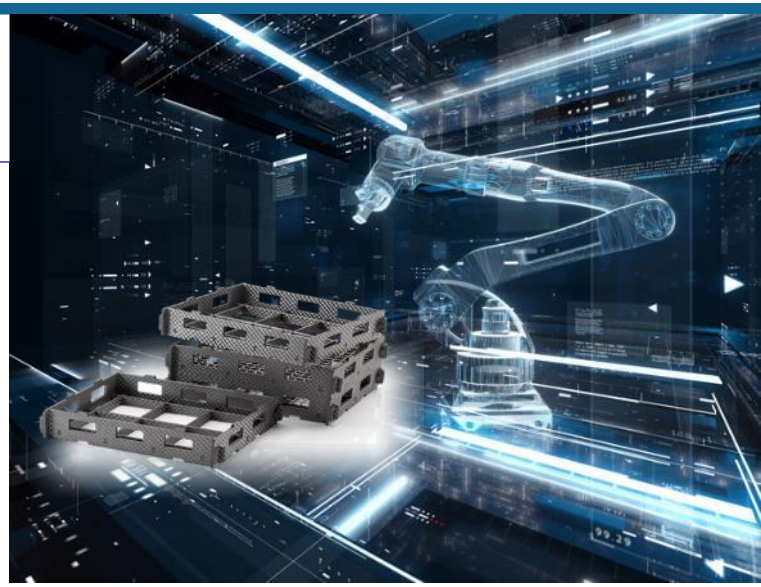
Corresponding Toyo Tanso targets:

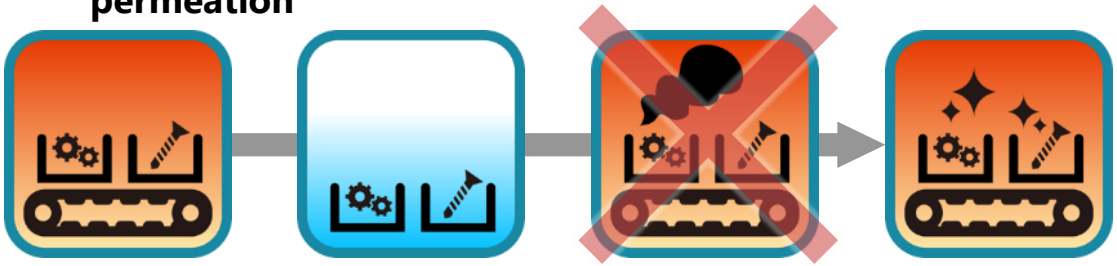


Striving for energy conservation

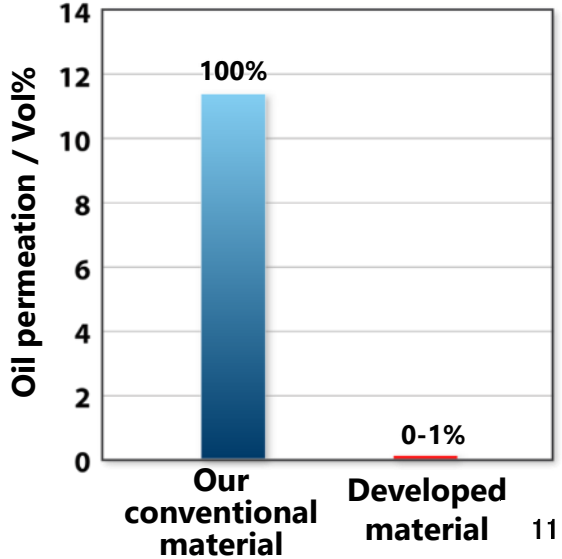
- Reduce weight
  - ➡ Promote low energy consumption and automation
- Extend service life
  - ➡ Lessen environmental burden by reducing waste

■ Develop materials for oil quenching during the heat treatment process

- If oil seeps into the C/C composite during the oil quench, then oil smoke will be produced during reheating and adversely affect the quality of the processed item
- Our developed material exhibits virtually zero oil permeation



Oil permeation ratio



CNovel™ Fuel Cell Market Trends

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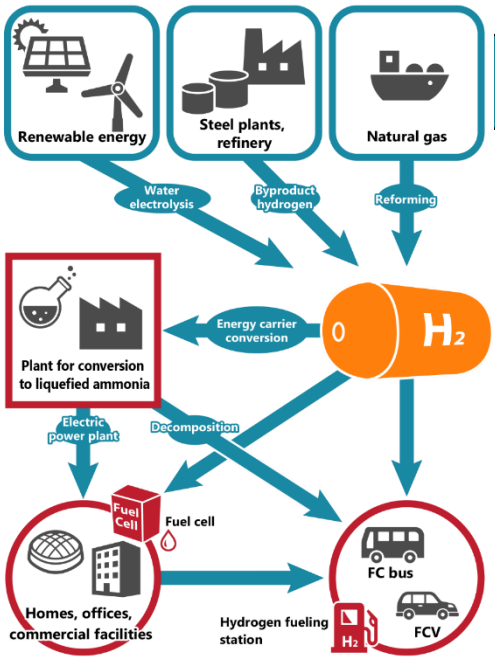
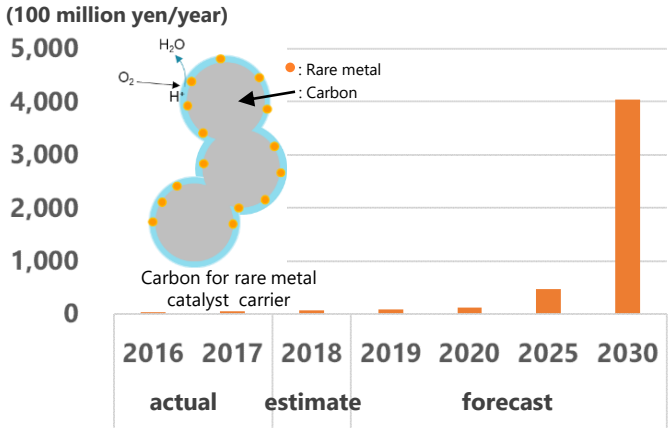
Corresponding Toyo Tanso targets:

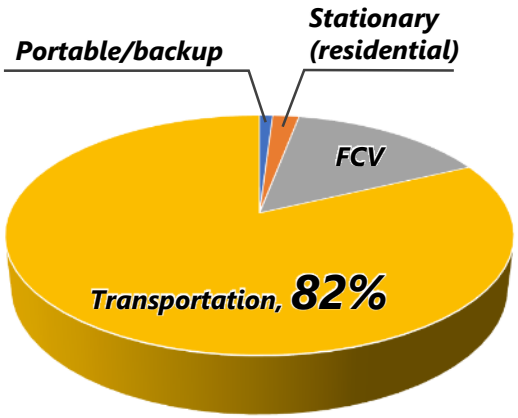


Projected demand for carbon as a catalyst (rare metal) carrier



(Source: Estimation by Toyo Tanso)

Projected demand by application in 2030



(Reference: Fuji Keizai report)

- **The market for Fuel Cell Vehicles (FCV) will ramp up during the 2020s and become a mature market in the 2030s**
- **The market for transport applications such as forklifts in North America, and buses/trucks in China is rapidly expanding**
- **In particular, there is potential for the shift away from gasoline and fossil fuels to accelerate demand for use of hydrogen produced using renewable energy**

Global Deployment of CNovel™ for Fuel Cells

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CNovel™  **for fuel cells**

- **Target the market for automotive fuel cells**
- **We are currently deploying this chiefly to customers in China and North America as a catalyst carrier for next-generation models from 2025 onward**
- **Presently, we are evaluating samples at the implementation level, and they have received high praise for their high output and increased service life**

Projected change in technical requirements for the fuel cell market

Reduced platinum + Increased durability

Reduced platinum +
Even higher durability
+ Higher output

Developing Isotropic Graphite Material for SiC Power Semiconductors

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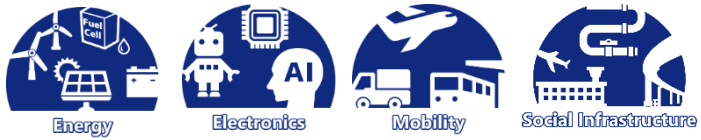
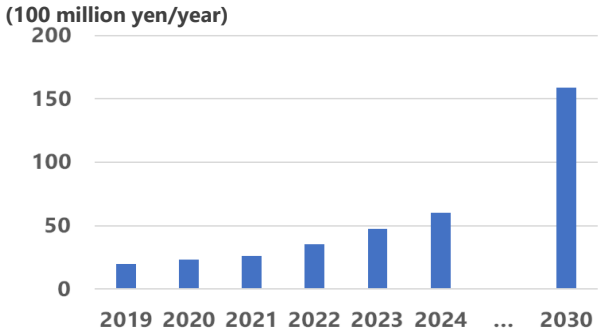
Corresponding Toyo Tanso targets:



■ Developing graphite components for SiC single crystal growth

Metal-coated graphite material:
Development phase expected to finish within the year
New dedicated graphite material:
Mass production evaluation by SiC wafer manufacturer expected from next year
We are also considering designing graphite material that supports inching up
Designing and machining crucibles and structural components is one of our strengths

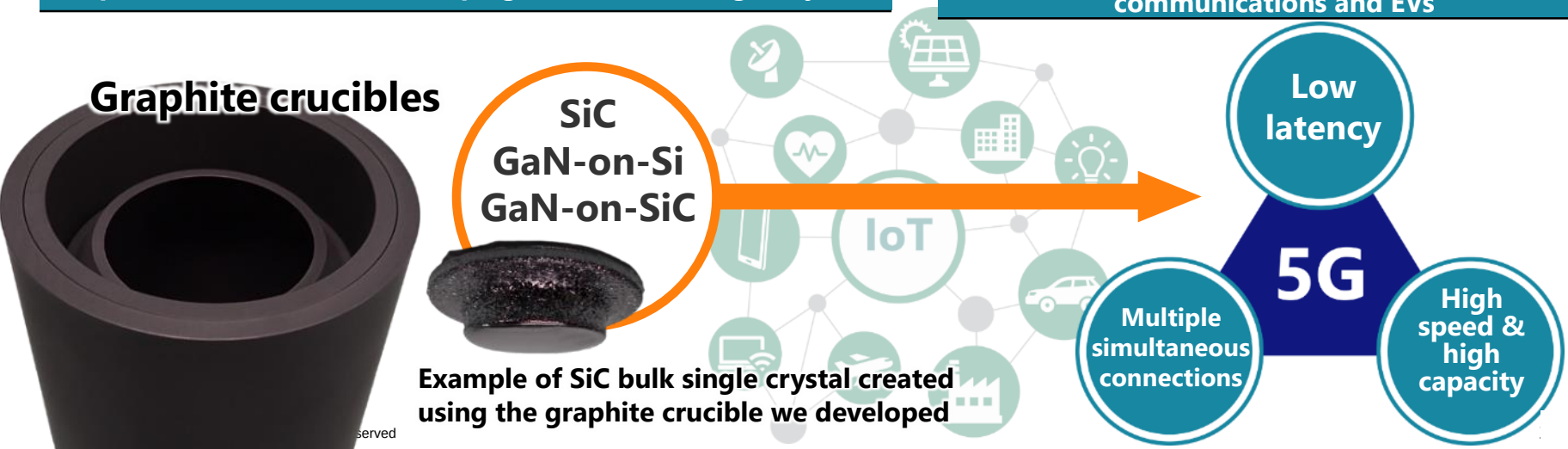
Projected market for components in the power semiconductor market



(Source: Estimation by Toyo Tanso)

Graphite crucible we are developing to create SiC single crystals

Expanding the market for high-efficiency electric power use in applications such as high-speed communications and EVs



Example of SiC bulk single crystal created using the graphite crucible we developed

3. Medium- to Long-term Development Outlook

Principal Technological Development Road Map

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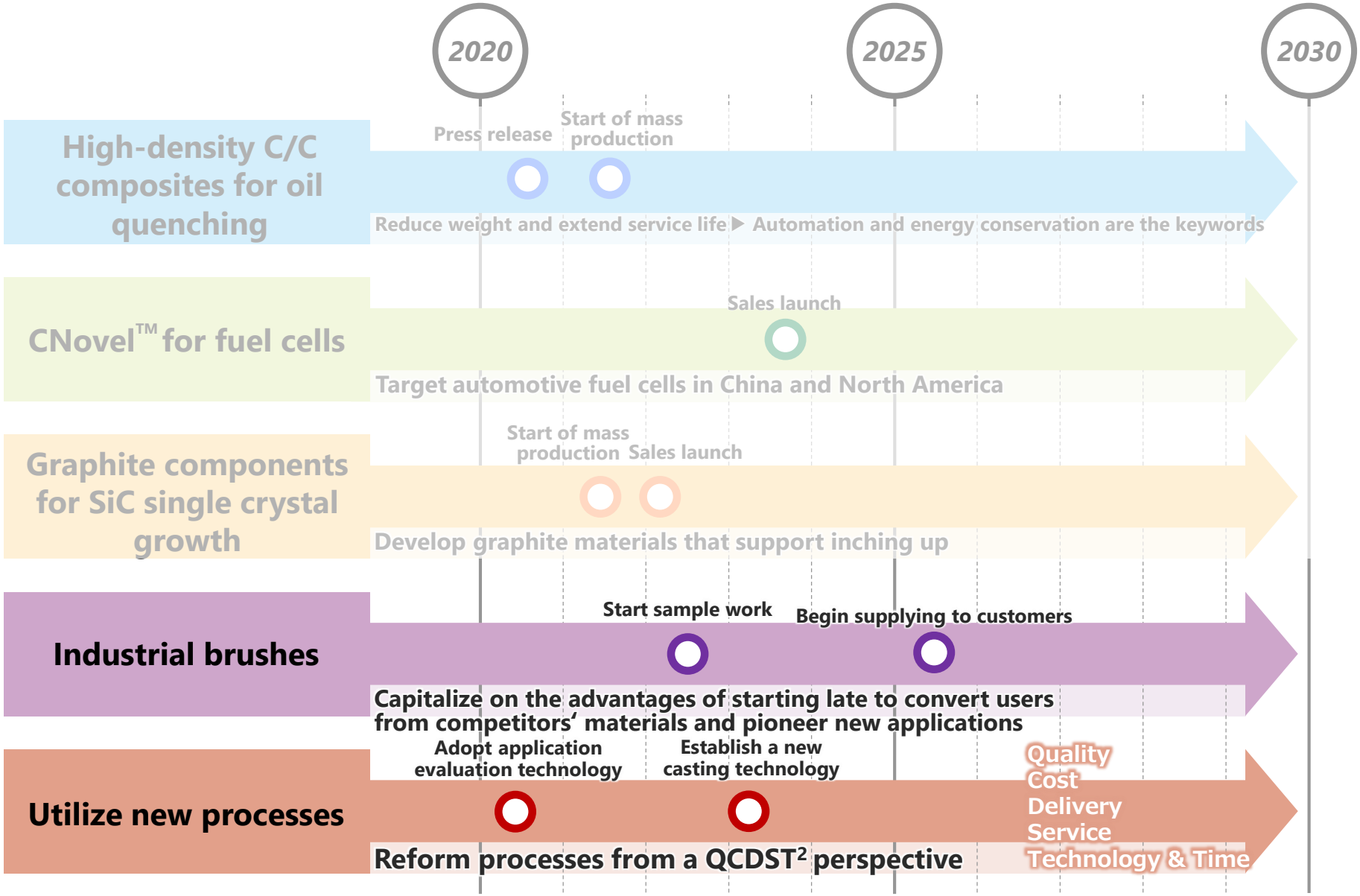

Process Reform — Further Enhancing QCDST² —

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■ Establishing new graphite fabrication technology — Precision tooling and injection molding —

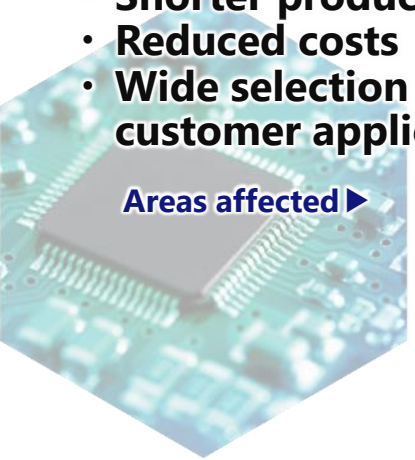
- Shorter production times
- Reduced costs
- Wide selection of grades depending on customer application

Areas affected ▶
- Cost
- Delivery
- Technology & Time

■ Anticipating customer needs

- Cooperation with outside institutions to incorporate user application technology
- Shorter time to commercialization
- Provision of services related to use

Areas affected ▶
- Quality
- Technology & Time
- Service



■ Establishing raw material control technology

- Skillful use of coke
- Quality improvement
- Supply chain stabilization

Areas affected ▶
- Quality
- Cost
- Delivery
- Technology & Time

Expanding the Brush Business Striving for a Sustainable Society

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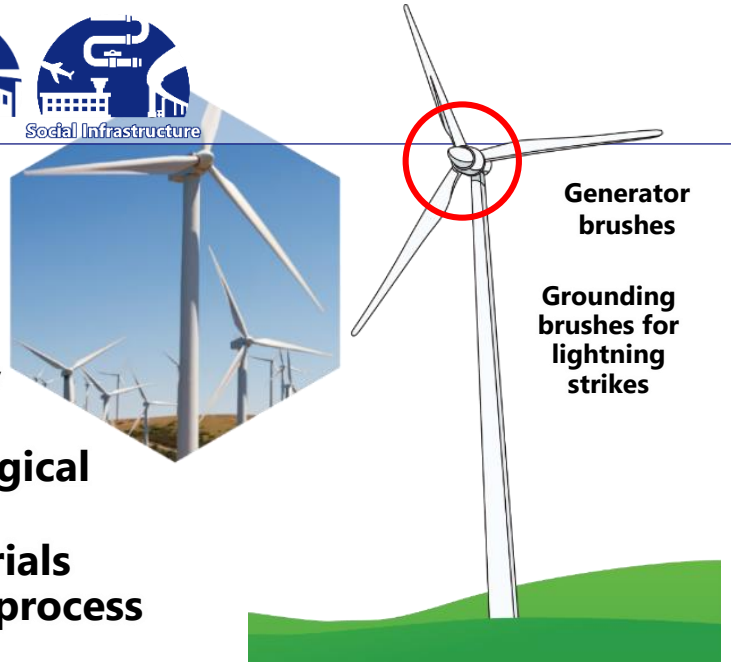
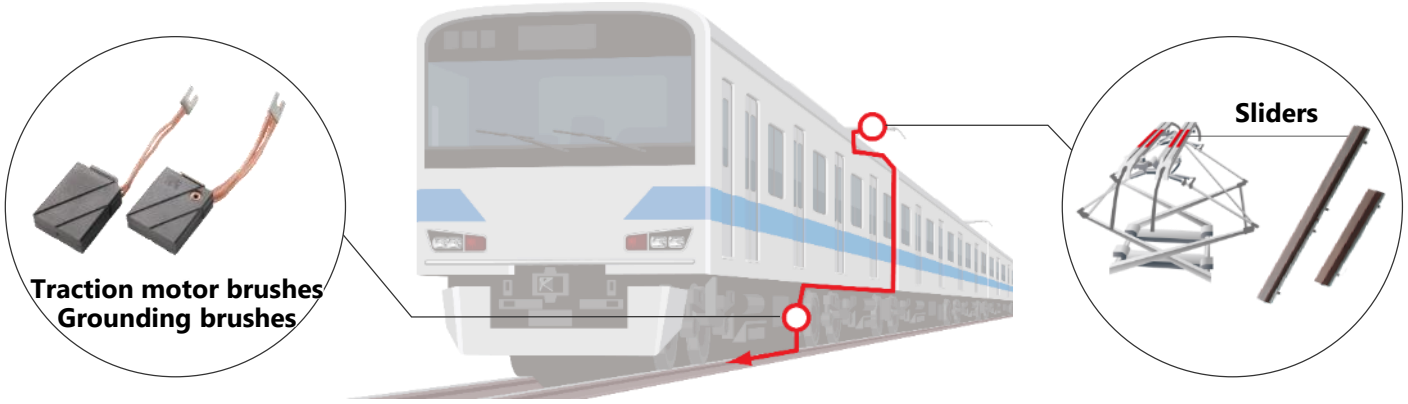
Corresponding Toyo Tanso targets: Energy, Mobility, Social Infrastructure

Carbon brushes for use in energy infrastructure

- Accelerate development toward entry into the industrial brush market
  - ➡ Contribute to renewable energy and the stability of society through high-quality materials
- Respect environmental regulations during technological development
  - ➡ Trials to develop environmentally friendly materials have the potential to birth innovation and new process technologies



Flow of electricity in electric trains



Toward Carbon Materials Aimed at Creating a Recycling-oriented Society

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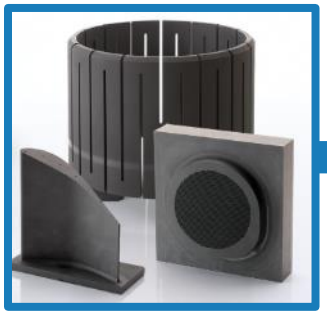
Corresponding Toyo Tanso targets: Energy, Social Infrastructure

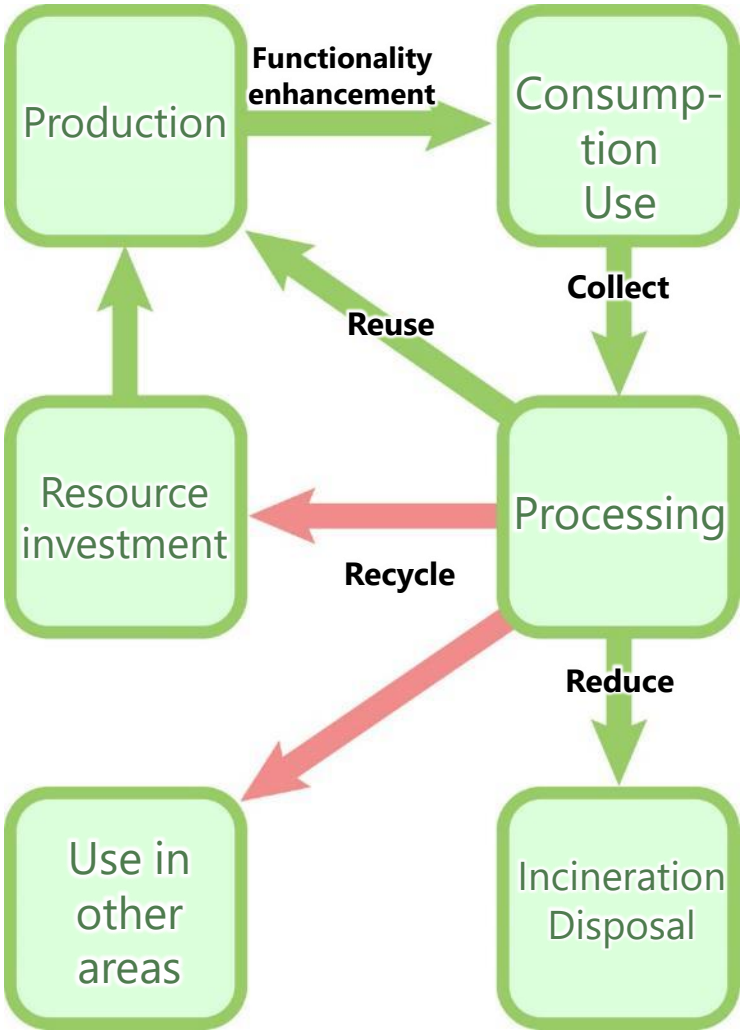
Building a recycling-oriented society Striving to Become a Sustainable Carbon Manufacturer

- **We are promoting research, development, and infrastructure improvement built on cooperation between all stakeholders involved in carbon materials**

Examples of carbon material recycling



- **Waste/end-of-life graphite products**
- **Carbon shavings generated during machining**
- **Re-pulverized powder**



APPENDIX
Contribution to Sustainable Development Goals (SDGs)

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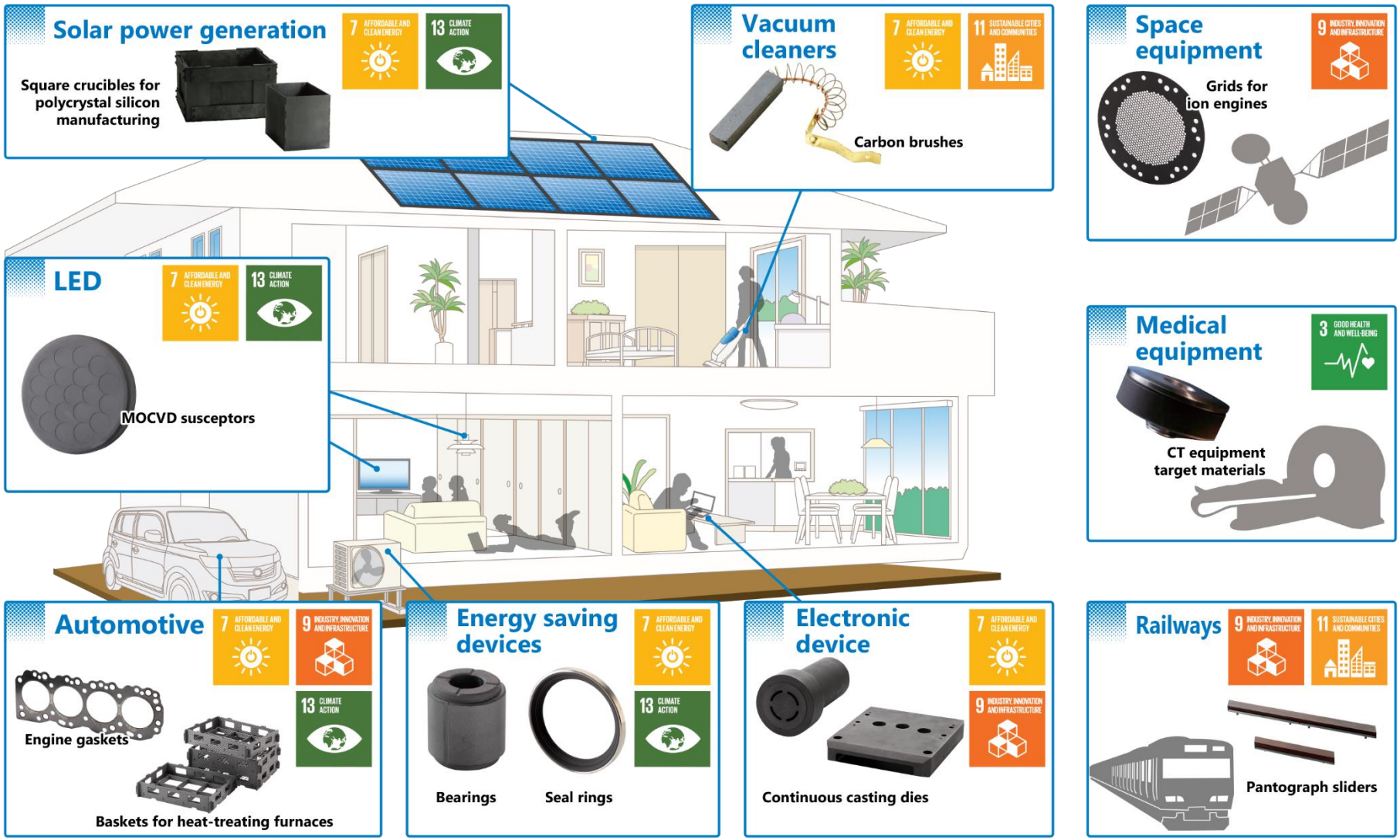

APPENDIX
Product Range Special Graphite Products

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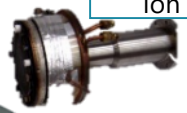
	Products	Applications	Related markets	Percentage of sales (FY2020 forecast)
Special graphite products	**Electronics applications**  Crucibles  Heaters	・Parts for single-crystal silicon manufacturing furnaces (crucibles, heaters) ・Parts for compound semiconductor manufacturing equipment (crystal pulling devices, susceptors for MOCVD equipment)	Semiconductors Solar cells LED Next-generation semiconductors	**17.3%**
	General industries applications  Continuous casting dies EDM electrodes   Hot press molds (cut models)	・Metal casting furnace components (continuous casting dice) ・Die manufacturing equipment components (electrical discharge machining electrodes) ・Industrial furnace components (heaters, trays) ・Optical fiber manufacturing components (heaters, furnace core pipes)	Automotive Aircraft Semiconductors Home electronics Industrial machines Optical fibers	**23.3%**
	Other Ion engine parts    CT device parts High-temperature gas reactor core materials	・Silicon semiconductor manufacturing equipment components (ion implanter electrodes, glass sealing jigs) ・High-temperature gas-cooled reactor structural components (furnace core materials) ・Nuclear fusion reactor structural components (furnace wall materials) ・CT scanning components (target materials)	Semiconductors Nuclear power Aerospace Medical care	**5.7%**

APPENDIX
Product Range Carbon Products for General Industries

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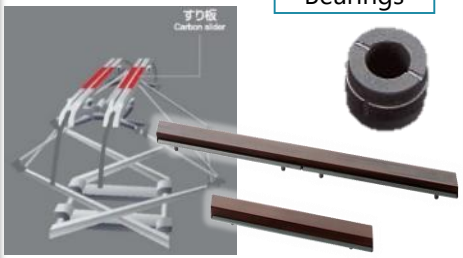
	Products	Applications	Related markets	Percentage of sales (FY2020 forecast)
Carbon products for general industries (mechanical applications)	Mechanical seal  Bearings  Pantograph sliders	・Parts for pumps and compressors (bearings, piston rings, mechanical seals) ・Pantograph parts (sliders)	Industrial machines Railways Ships Automotive Home electronics	**11.8%**
Carbon products for general industries (electrical applications)	 Small brushes  Industrial brushes	・Small motor components (vacuum cleaners, washing machines, electric tools) ・Large motor components (general industrial, power supply, electrical equipment)	Home electronics Power tools Railways Automotive Industrial machines Wind-power generation	**13.8%**

APPENDIX
Product Range Compound Materials and Other Products

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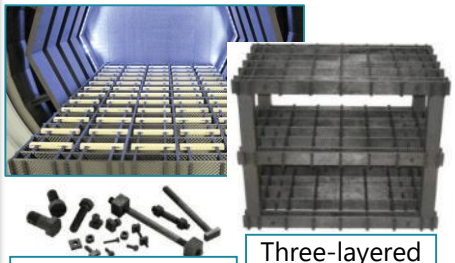
	Products	Applications	Related markets	Percentage of sales (FY2020 forecast)
Compound materials and other products [three major products]	**SiC-coated graphite products**  MOCVD susceptors	・Silicon, compound semiconductor thin film manufacturing equipment components (susceptors for MOCVD equipment) ・Parts for Si-Epi equipment (susceptors) ・Parts for SiC-Epi equipment (susceptors)	Semiconductors LED Next-generation semiconductors	**21.7%**
	C/C composite products  Bolts, nuts Three-layered trays	・Parts for single-crystal silicon manufacturing equipment (crucibles, inner shields) ・Parts for polycrystal silicon manufacturing equipment (crucibles, trays) ・Parts for industrial furnaces (trays, baskets, bolts, nuts) ・Nuclear fusion reactor structural components (furnace wall materials) ・Small probe engine parts	Semiconductors Solar cells Automotive Aircraft Nuclear power Aerospace	
	Graphitic sheet products 	・Automotive parts (gaskets) ・Parts for synthetic quarts manufacturing (release agent) ・Parts for single-crystal silicon manufacturing (protective layer) ・Heatsink ・Packings for general industries	Automotive Semiconductors Industrial machines	

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Note: This presentation contains "forward-looking statements" and forecasts of business results. These statements are not historical facts but instead represent the Company's beliefs regarding future events, many of which, by their nature, are inherently uncertain and beyond the Company's control. It is possible that the Company's actual results may differ, possibly materially, from the anticipated results and financial condition indicated in these forward-looking statements.

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