

Next-Generation Digital Infrastructure Construction (Amount covered by the government: Up to 141.0 billion yen)

[Next-Generation Green Power Semiconductors]

- Power semiconductors are used to control various electrical products related to everyday life, such as automobiles and industrial equipment, electric power generation and railways, and home appliances. For example, about 20% of the power loss of electric vehicles is said to be caused by power semiconductors. That means they have significant implications for the energy efficiency of various electrical devices.
- This project will work toward reducing the power loss of next-generation power semiconductors (SiC, GaN, etc.) by more than 50% and reducing their cost to achieve similar cost levels to those of Si power semiconductors, in order to promote their social implementation in the fields where innovative improvements in energy efficiency are required toward carbon neutrality, such as electric vehicles, electric power generation (e.g., by renewable energy) and server power supplies.

[Next-Generation Green Data Centers]

- In response to the surge in power consumption by data centers due to social and industrial digitalization, international efforts are ongoing to achieve ultra-low power consumption and ultra-fast processing by introducing photonics-electronics convergence technology.
- This project aims to significantly improve the energy efficiency of data centers (i.e., data aggregation hubs) by over 40% through innovative photonics-electronics convergence technology that replaces electrical wiring inside servers with optical wiring.

◎ Next-generation green-power semiconductors

- In order to **improve performance and reliability**, develop **technologies that are closely related to defect rate reduction**, and **that are closely related to control technologies**.
- In order to **reduce costs**, **develop manufacturing technologies to increase the wafers' diameters (from 150 mm to 200 mm)** and **improve their quality, while also making use of AI**.

○ Expected approaches (examples)

NB: Assuming SiC for the medium- and large-power ranges and GaN for the small-power range

Small-power range
(For server power supplies, etc.)

- High-efficiency, compact power supplies**
- 750-V class or lower
 - Improved performance and reliability
 - High-quality crystal growth technology
 - High-efficiency control functions (e.g., measures against electromagnetic noise)
 - Developing circuit technology (e.g., high-efficiency power sources)

Medium-power range
(For xEVs / industrial equipment)

- Inverters for electric vehicles**
- 1.2-kV class
 - Improved performance and reliability
 - High-quality wafers with larger diameters
 - High-efficiency control functions (e.g., high-efficiency motor drives)
- Inverters for industrial equipment**
- 1.7-kV class
 - Improved performance and reliability
 - High-quality wafers with larger diameters
 - High power density (e.g., rapid charging)
 - Module technology (e.g., improved heat dissipation)

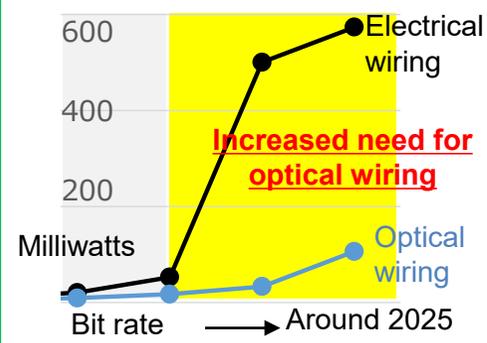
Large-power range
(Electric power generation such as by renewable energy)

- Electric power systems**
- 3.3-kV class
 - Improved performance and reliability
 - High-quality wafers with larger diameters
 - Module technology (e.g., reliability in the event of a failure)
 - High breakdown voltage (e.g., high power conversion for grid networks)

◎ Next-generation green data centers

- Photonics-electronics convergence technology has emerged as a game changer for innovative improvements in the energy efficiency of data centers.**
- Photonics-electronics convergence technology **combines optoelectronics** with electronic devices, replacing electrical wiring with optical wiring. This **results in improved energy efficiency, higher capacity, and lower latency (with the power consumption of the entire network system reduced to 1/100)**.

○ Power consumption of chip-to-chip wiring



○ Photonics-electronics convergence within a server

