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## Estimating Data Center Power Demand and Challenges for Future Power Supply Development in Japan

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### Abstract

This presentation addresses the critical challenge of forecasting and securing the power supply in Japan amid rapidly increasing demand driven by Digital Transformation (DX) and electrification. The presentation focuses specifically on data center (DC) power needs. Japan's historical power demand outlooks, including those from the Organization for Cross-regional Coordination of Transmission Operators (OCCTO), have shifted from projected decline to increase. Since the 2024 outlook, these outlooks have explicitly incorporated demand from data centers and semiconductor fabrication facilities. OCCTO's 2025 outlook projects that total power demand will reach 852 TWh by 2034, with data centers accounting for 44 TWh (approximately 5%).

We estimate the long-term DC power demand by 2050 using a bottom-up approach that aggregates technological factors, such as the number of installed servers and power usage effectiveness (PUE). Although this method is favored in "high"-rated global studies for its narrower estimate range, its long-term accuracy is limited by rapid technological progress and the short five-year server lifetime. Based on the OCCTO 2024 outlook, CRIEPI's mid-scenario projected DC power demand at 107 TWh in 2050. However, updating the assumptions using the OCCTO 2025 annual outlook resulted in a substantial increase to 197 TWh by 2050, underscoring the significant uncertainty and volatility in DC demand forecasting.

A key challenge for the development of the future power supply stems from the location trend of hyperscale data centers (DCs), which are concentrated in areas such as Inzai in Chiba Prefecture (Greater Tokyo). Additionally, although new grid connection applications provide visibility, they only extend five years into the future, which is insufficient for power generation planning. This unreliability is exacerbated by observations of "stagnant actual usage" and "revisions to contracted power" in connection applications. This is partly because operators face no penalties for plan changes. Improving forecast accuracy is essential for avoiding both supply shortages and power oversupply. To this end, the government must take the lead in collecting and publishing official statistics on DC power consumption. Additionally, policy intervention is necessary to ensure that DC development aligns with the national goal of achieving carbon neutrality rather than promoting an uncontrolled "DC attraction race."