
Hyperscale Disruptors

Don't Point that Disruptor at Me!

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Hyperscale Disruptors Unique to Japan's Market



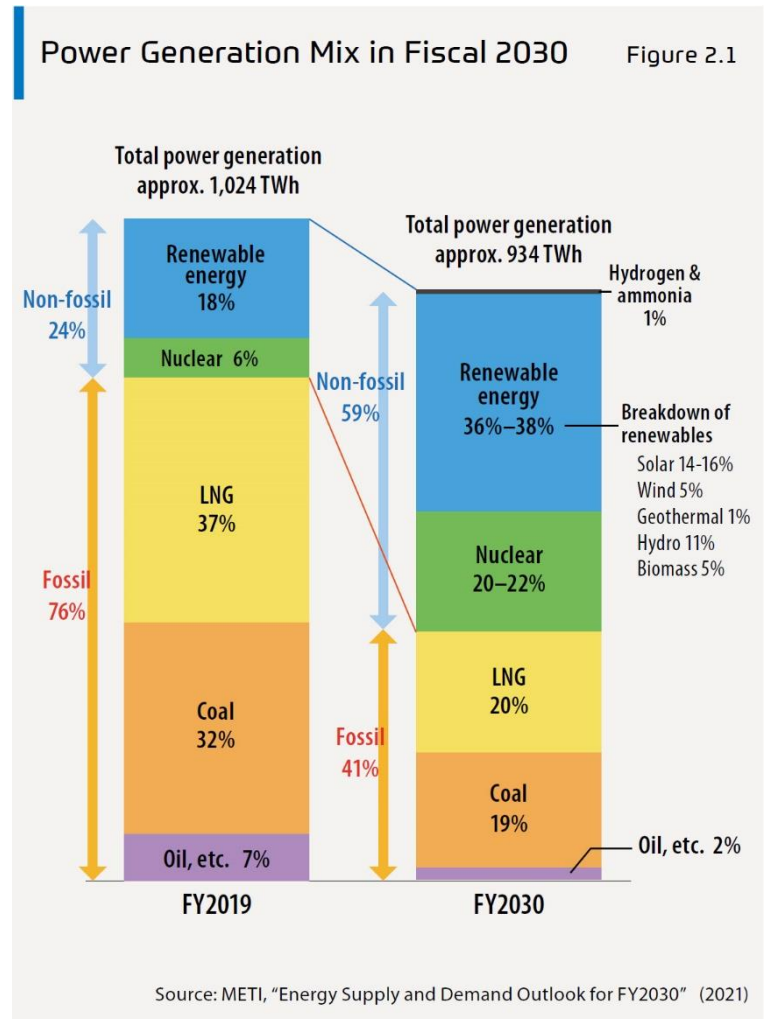
Hyperscale Disruptors Unique to Japan's Market

- Power remains a significant challenge and it will get worse
 - Impact of climate change and committed sustainability goals in power generation
 - Climbing cost of electricity
- Significant growth in constructed facilities across Japan
 - Major construction projects around Japan
- Scarcity of Suitable Land
 - Multiple Hyperscale Data Center builds in Osaka, Tokyo, Saitama City, Chiba
 - Many attempting to enter the data center market in Japan
- Covid Recovery
 - Lack of availability of construction labor

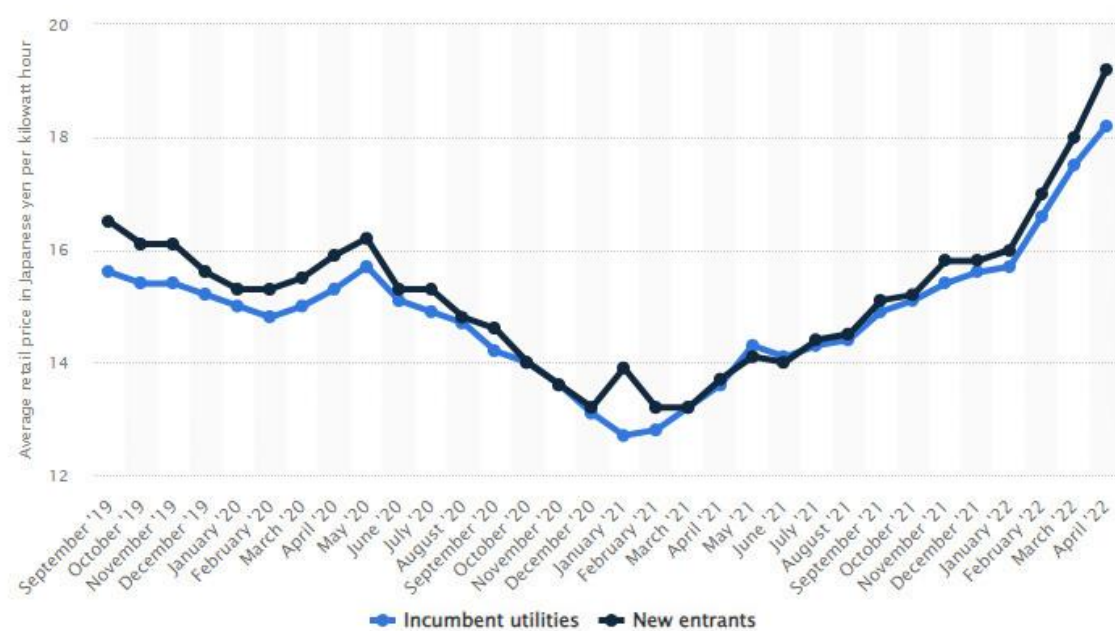


Curbing the Current to Sustain the Future

- Japan plans to keep temperature rise below 1.5°C by 2030 and below 2°C by 2050 → means a 10% reduction in available power by 2030 (from 1,024TWh to 934TWh)
 - Increase in renewables from 24% to 59% of total power generated
 - Reduction of fossil fuels from 76% to 41% of total power generated
 - Increase in nuclear supply from 6% to 22%
- The road to 2050 Carbon Neutrality
 - 45GW wind generation capacity by 2040
 - Target of 50% renewable energy by 2050 is feasible maximum due to land shortages



Rising Cost of Electricity



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- Energy crisis fueled by the war in Ukraine as well as supply chain issues from Covid knock-on effects
 - Japan imports more than 70% of the fuel used to run power plants
 - Electricity prices have been approved to increase by as much as 42% in Japan
 - Inflation and a weak yen compound this issue further



Renewable Energy is Constantly Exposed to Risk



Heavy snow destroys panels

- Snow and Ice
- High Winds



High winds destroy panels

Solar farms face many natural threats



Hail stones destroy panels

- Hailstones
- Wildfire



Wildfire destroys panels



Wind farms susceptible to damage from -- wind



- Windfarms face natural threats
 - High winds from thunderstorms and typhoons
 - Lightning strikes
 - Landslides and quakes



A Surge in Construction Projects Across Japan

- Japan is experiencing a country-wide development
 - Tokyo’s “Once in a Century Redevelopment” including waterfront redevelopment
 - Osaka 2025 World Expo
 - Multi-purpose tower complexes – examples most recently in the news
 - › Azabudai Hills Development
 - › Tokyo Kabukicho Tower
- Unprecedented number of Data Center Build Projects Underway
 - New data center builds taking place across the country
 - › Locations with multiple hyperscale DCs under construction in 2023
 - Chiba, Fuchu, Inzai, Osaka, Tokyo, Yokohama
 - › Locations with developing data center markets with new builds in 2023
 - Akashi, Ginoza, Kitakyushu, Kobe, Matsue, Nago, Oyama, Saitama, Sanda, Shirakawa, Shiroy, Takamatsu, Tatebayashi, Okinawa
 - › Locations proposing subsidies to attract more data centers
 - Hokkaido and Kyushu



Pre-Data Center Growth - Somewhere in Japan - 2014



And 9 Years Later – The View in 2023



Impact of Japan's Construction Rise

- New build in Japan has general contractors occupied
 - Lead time to engage a general contractor for new build is currently 2+ years
 - The absence of data center construction expertise among general contractors is hindering new participants from entering this specific type of construction
- Land suitable for data center construction is highly sought after, not only for data centers, but for other purposes
 - New power plant (Solar, wind, nuclear)
 - Logistics centers
 - Residential towers
 - Farmland retention
- Couple this with the “Perfect Storm” of Covid which saw a drop in foreign construction labor availability



Hyperscale Disruptors Effecting the Industry



Hyperscale Disruptors Effecting the Industry

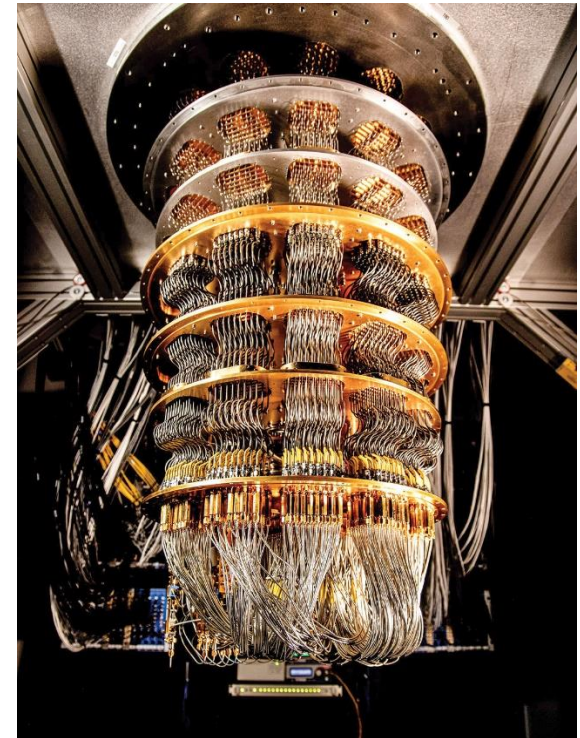
- Entrance and expansion of Quantum Computing
 - Implication of Quantum Computing on data center design
- Immersion Cooling
 - Gimmick or Game-Changer?
- Potential power solutions for a greener world
 - Fusion reactors vs Fission reactors
- Other threats to Hyperscale expansion
 - Increase resistance to “Not in My Back Yard”
- The inevitable unsustainability of growth
 - Technology “refresh” cycles, which generate massive waste
 - Technology advancements that render previous solutions obsolete
 - › Then what do we do with all these disused data centers?



Quantum Computing's Future in the Data Center



- Dramatic change in the requirements for a facility (transformation from server-based requirements to Quantum based requirements)
- Their need to operate in temperatures near absolute 0
- Changes in refrigeration and cooling methods to allow quantum operation
- Changes in vibration isolation to enable quantum operation

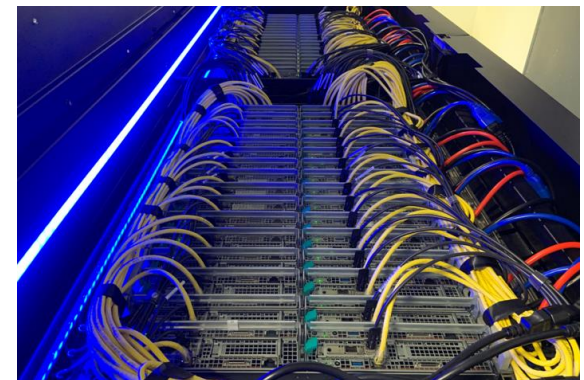


Immersion Cooling – Gimmick or Game-Changer?



- Capacities
 - Claims of up to 200kW in a “single unit”
 - More typical 30kW capacity
- Most utilize a horizontal formfactor
 - Trade-off to floor space versus traditional vertical racks
 - Difficult to do vertical racks, though some OCP racks are exploring this

- Immersion Liquids
 - Dielectric engineered liquids
 - › Hydrofluoroethers (HFEs)
 - › Fluorocarbons (Like NOVEC)
 - Mineral and Silicone based oils
- Oils bring some increased fire risk
- Dielectric liquids have no long-term studies on effects of vapor



The Future of Power - Two Types of Nuclear Power

- Traditional Fission Reactors
 - Very long planning and development cycles, sometimes taking decades for approval
 - Solve a greater overall power need
 - Have accepted standards and regulatory measures established
- Small fusion reactors
 - Advantages of Fusion Reactors
 - › Does not produce long-lived radioactive waste (can be recycled within 100 years)
 - › A near infinite fuel supply (can utilize lithium found in sea water)
 - › No risk of meltdown, inherent in Fission Reactors
 - Still in the developmental stages
 - › In late 2022, Lawrence Livermore National Laboratory successfully produced a controlled nuclear fusion reaction



And One More Thing...

- Other threats to Hyperscale expansion
 - Increased resistance to “Not in My Back Yard”
- The inevitable unsustainability of growth
 - Eventually, the market will be saturated
 - Technology “refresh” cycles, which generate massive waste
 - Technology advancements that render previous solutions obsolete
 - › What do we do with all these disused data centers?



Thank you

