

FUTURE OF NUCLEAR ENERGY

*CRITERIA TO FIT TO THE EMERGING DEMAND
OF NEXT GENERATION SOCIETY*

OCTOBER 2024

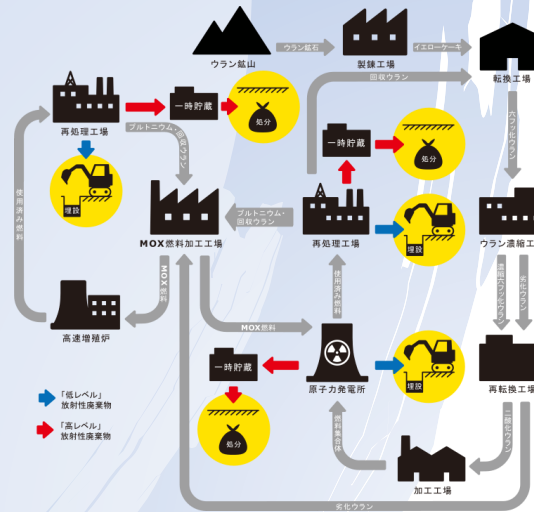
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Meeting changing user needs in the next generation society is another essential criteria for future nuclear energy
→ Even nuclear needs to take 'Market-In' approach

Enhanced
Operational
Safety



Establishing
Nuclear
Fuel Cycle

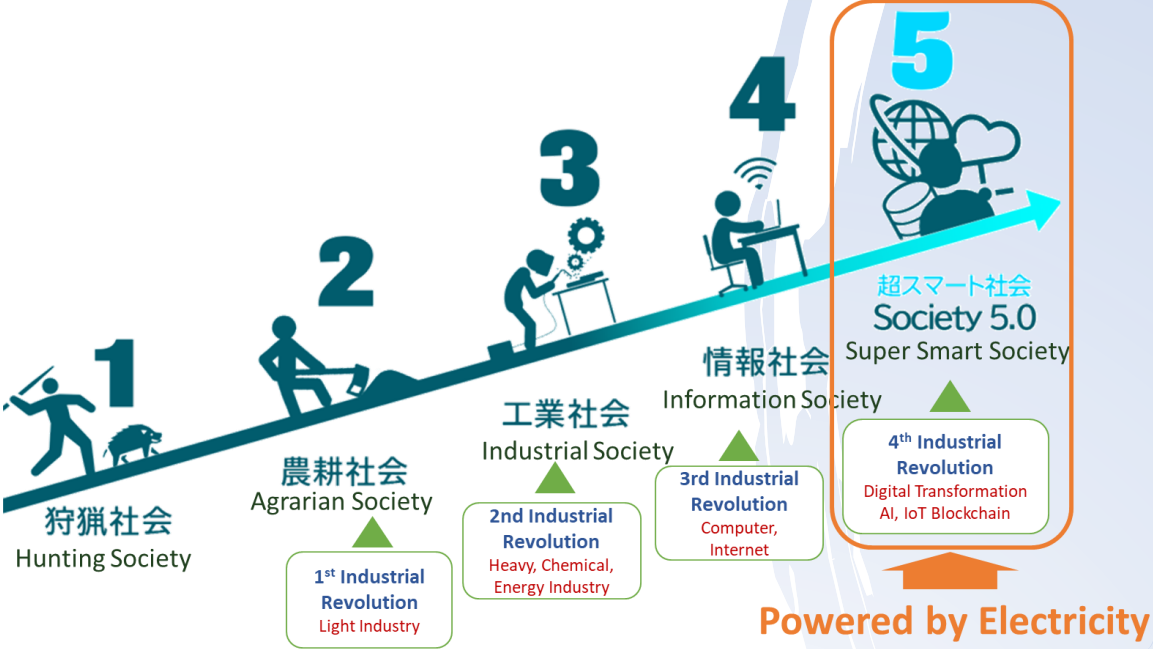


Meeting
Emerging
User Needs
in the Next
Generation
Society



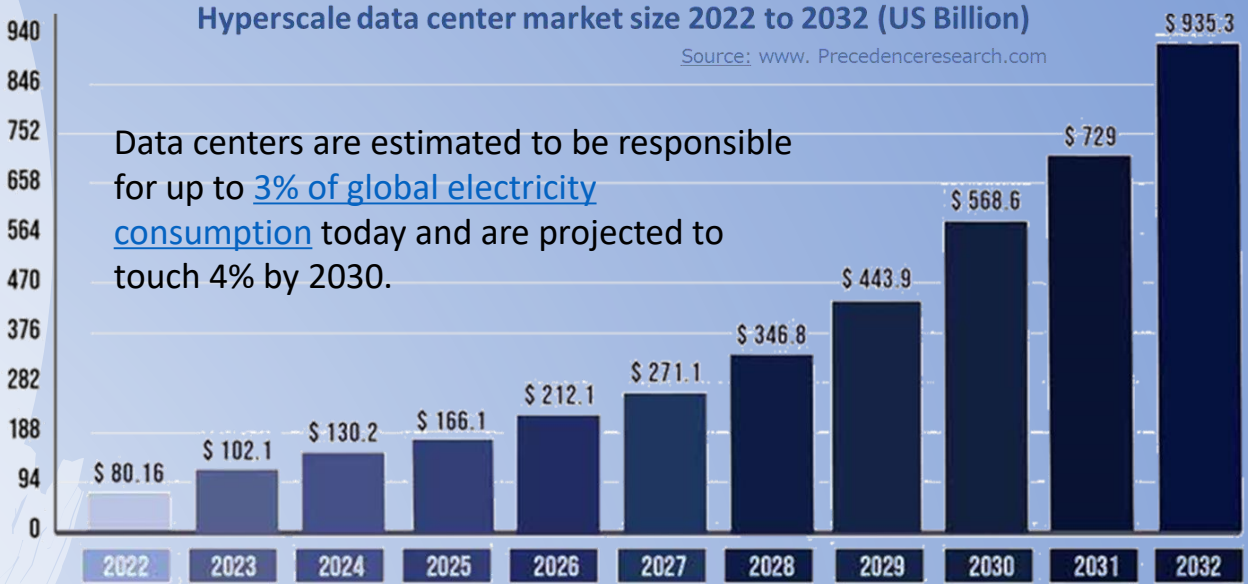
As the world is evolving into Society 5.0, i.e., Super Smart Society, power demand will increase. Such power needs to be CO2 free

Evolution of Society



Source: Society5.0 (ソサエティ5.0) の目的をわかりやすく解説 | 【テックストックMAGAZINE】エンジニア向けスキル・キャリア情報 (tech-stock.com)

Data Centers are expected to be powered with CO2 Free Power i.e., Renewable or Nuclear generation



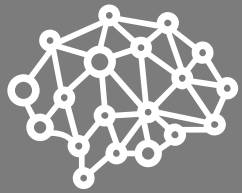
Source: Energy efficiency predictions for data centres in 2023 | Data Centre Magazine

DX and GX require nuclear to play an important role

Demand for nuclear energy in non-power sector. Some examples are....

Emerging new market for nuclear energy

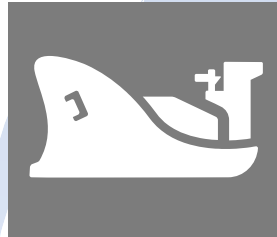
Data Center



- GAFAs and alike have ambitions to eliminate their carbon emissions by 2030 while growing cloud computing and AI pose a huge challenge.

- They have their eyes on nuclear as a way to reconcile the data center growth with their commitments to hit net-zero
- Some development of SMRs are specifically for data centers, ie., Last Energy, Okulo
- Growing investment into nuclear from technology players such as Google, Microsoft.
(Additional information on Appendix 1 & 2)

Maritime Vessel



- Shipping accounts for 3% of global CO2 emissions.
- In the past, nuclear energy has been used to power military submarines and icebreakers.
- However, its use by merchant ships has been constrained by the cost, but more over, due to wariness by insurers of providing cover for ships going into commercial ports without more understanding of the risks involved.
- Japan used to develop and sailed a nuclear-powered ship 'Mutsu' which sailed 88,000Km (with nuclear power 82,000Km)

Steel and Chemical Industries



- Industries such as Steel and Chemical accounts for 25% of Japan's CO2 emission which needs to be reduced. For this purpose, large amount of hydrogen is required at lower cost
- The high operating temperatures (800-950°C by HTTR JAEA) of High Temperature Gas Reactor (HTGR) is expected to be an applications to process heat or hydrogen
- Japan Atomic Energy Agency (JAEA) has developed and tested its Testing Reactor with support from Japanese Gov't GX strategy
- UK is exploring the HTGR at Hartlepool Power Station which locates in the middle of industrial area (Appendix 3)

Other uses of nuclear technology are also being explored

Other uses of nuclear technology being explored

Medical Radio-isotope for Cancer Treatment using fast reactor

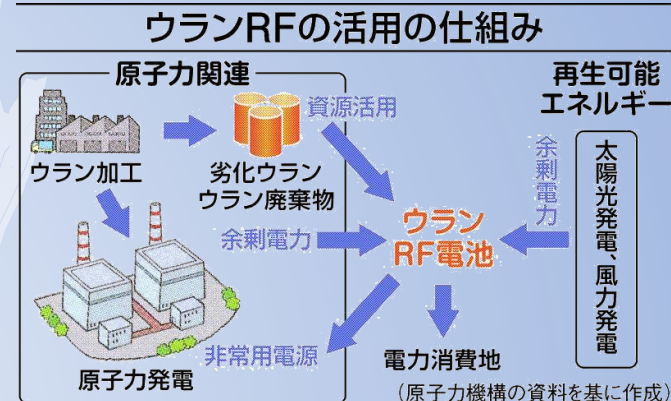
- Utilizing fast neutrons, actinium 225 (Ac-225) is produced which can be used in cancer treatments
- Treatments using Ac-225—which involve irradiation by alpha particles from inside a tumor—are seen as highly effective. They are also advantageous in that they require no shielding, allowing the relaxation of restrictions on entry into the hospital room.
- On the other hand, Ac-225 is in short supply globally because it has a half-life of only ten days. As there are currently no high-energy neutron irradiation facilities, the global trend is to produce neutrons using accelerators.



[「常陽」の多目的利用の可能性 | 特設サイト 高速実験炉「常陽」 | 高速炉・新型炉に関する研究開発について | 国立研究開発法人日本原子力研究開発機構 高速炉・新型炉に関する研究開発 \(jaea.go.jp\)](#)

Uranium Redox Flow Battery from remaining after producing enriched uranium

- JAEA is developing Uranium Redox Flow Battery which utilizes the remaining after producing enriched uranium for power generation. Commercial use is expected by 2035.
- Compared to material which is currently used (Vanadium), electricity loss is lower. Also material is quasi domestically supplied, therefore cost is also lower.
- This is another way to recycle one of the nuclear fuel waste. Hence reducing nuclear waste



- There will be expected to be a huge opportunity to be used to store excess power from solar



Commercial use of nuclear energy requires whole new set of business environment. We need to build it from the scratch

