Utility of the Future (Utility 3.0) in Smart City/Society

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Japan's Electricity Market & TEPCO

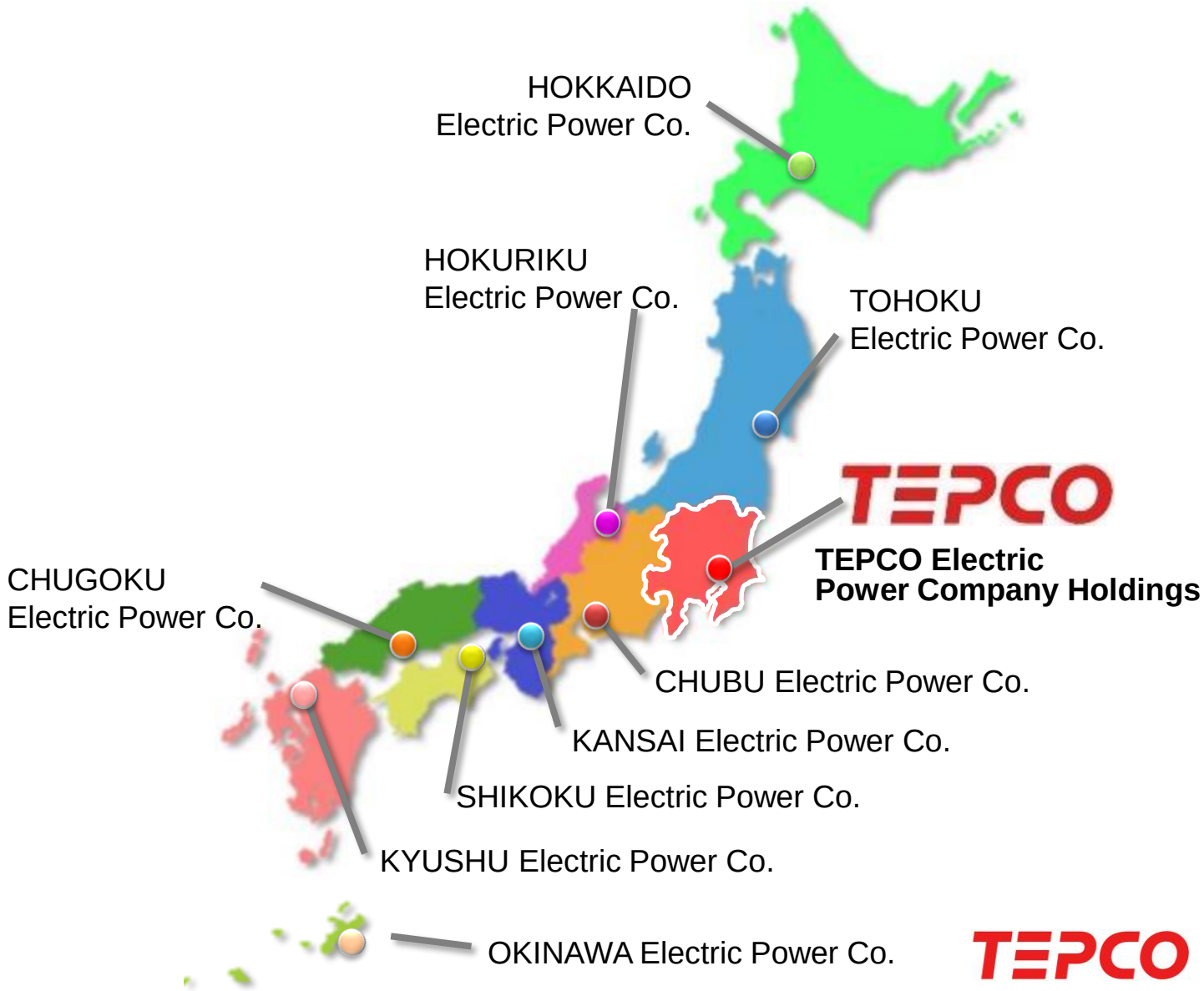
Population

Japan 127 million in 2018
ASEAN 654 million in 2018

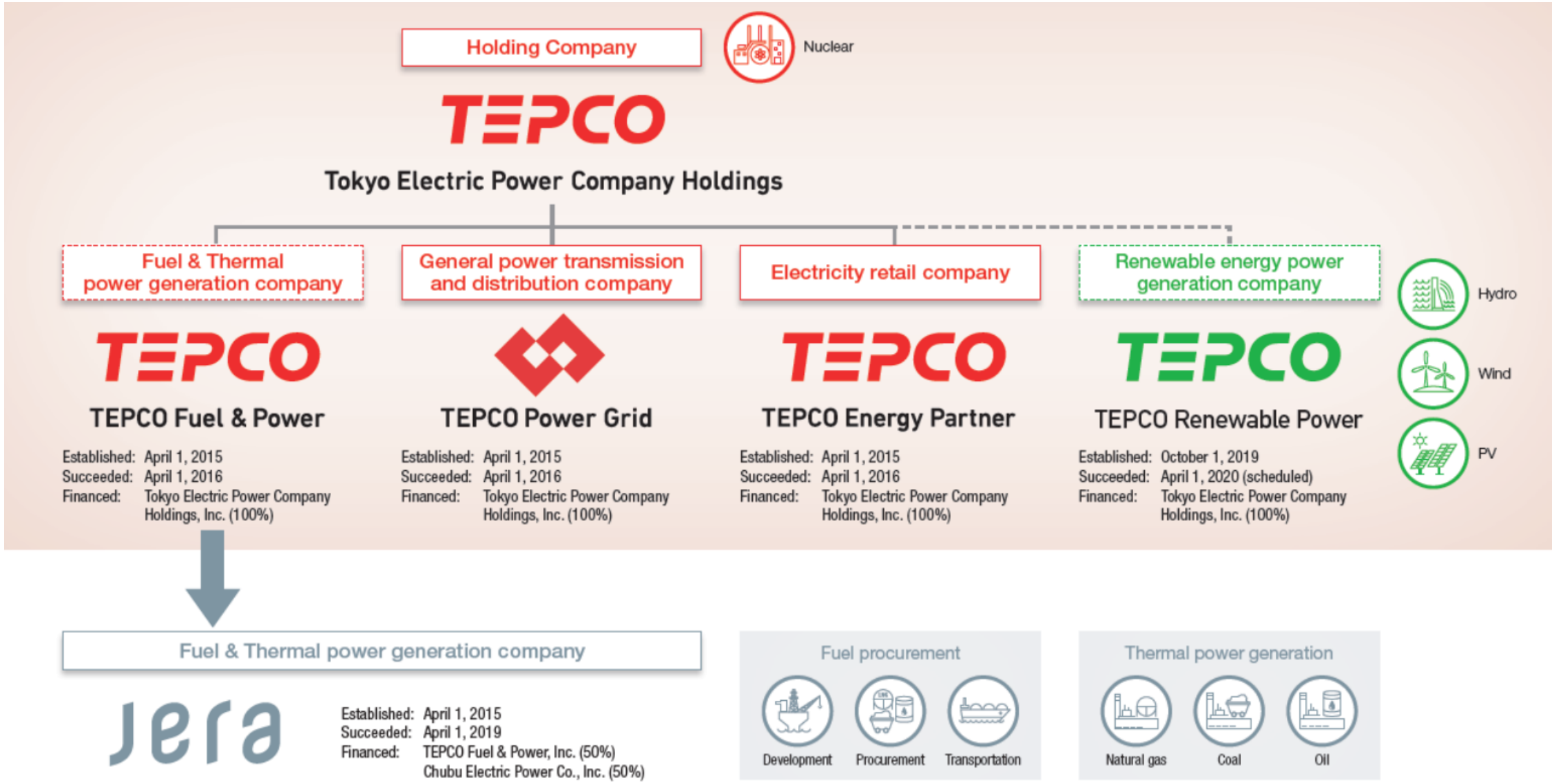
Annual kWh Sales

Japan 896 TWh in FY2018
TEPCO 220 TWh in FY2018

ASEAN 927 TWh in 2015
(Generation)



TEPCO Holdings profile (as of Oct. 2019)



Utility3.0: Vision of Utility of the Future

- Proposed by Accenture & TEPCO ; private Initiative
- 5 major trends (**5Ds**) will change the utility(energy) system & society system

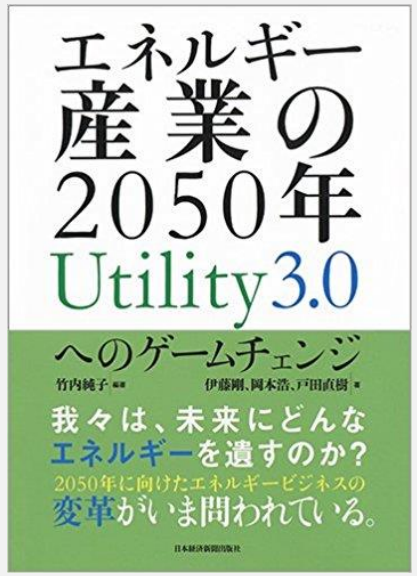
Decarbonization

Dentralization

Digitalization

Deregulation

Depopulation



Published in Sep 2017

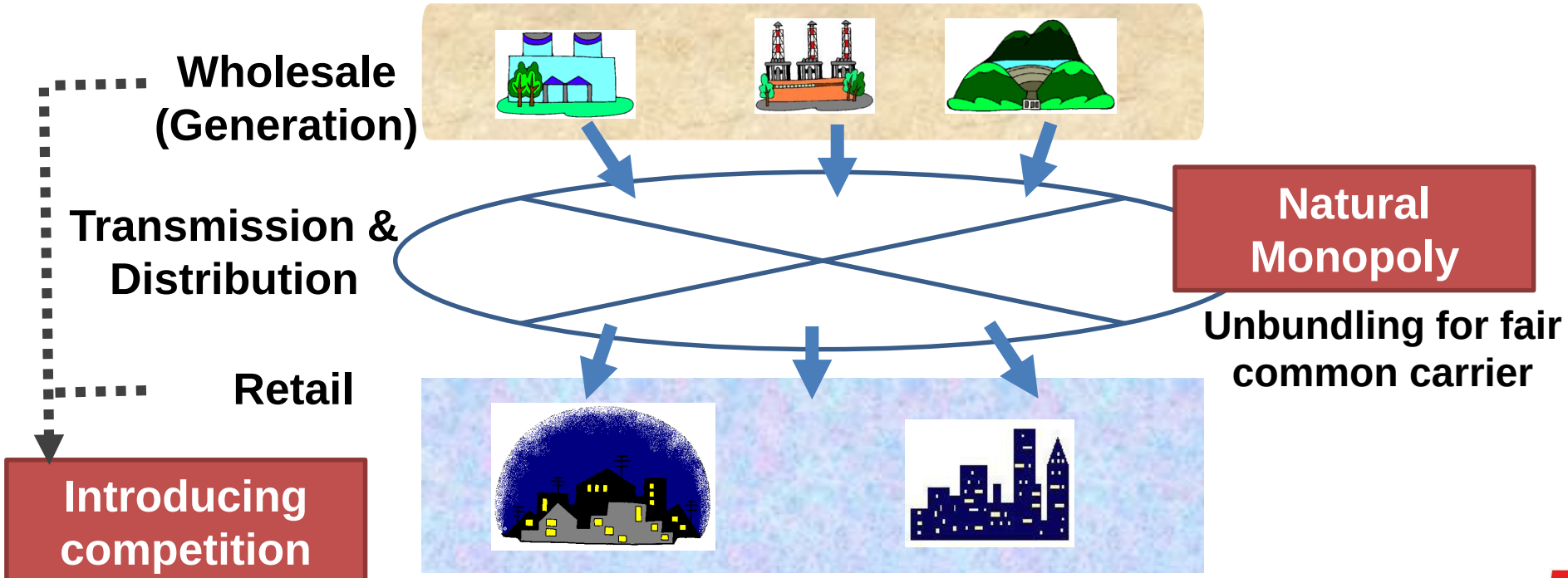
Deregulation: Utility 1.0 to Utility 2.0

Utility1.0

- Strong demand growth & capital investment needs
- Legal monopoly & regulation
- Economies of scale
- Vertically integrated system

Utility2.0

- Low growth economy, supply surplus
- Wholesale and retail competition among incumbents and newcomers
- Unbundling of T&D business for fair common carrier



Transition to Utility3.0 under 5Ds

Utility 1.0： Vertically **Integrated** & Legal Monopoly

Deregulation

Utility 2.0：Wholesale & Retail Competition with **Unbundling**

Decarbonization
Decentralization
Digitalization
Depopulation

\+ **Repowered Deregulation**

Utility 3.0：

- **Technology Shift** from centralized to decentralized & zero marginal cost
- **Integration** with other business, including other network infrastructure business

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Decarbonization: Japan's Long-term Strategy under the Paris Agreement

- **Decarbonized Society** in the 2nd half of 21st century.
- Reduction of GHGs emissions by **80% by 2050**

- Energy Transition & Decarbonization
- Decarbonized Manufacturing
- Well-to-Wheel Zero Emission

- Business-led **disruptive innovation** & exploring **all options**
- Renewables, Carbon Recycling, Hydrogen, Nuclear etc.

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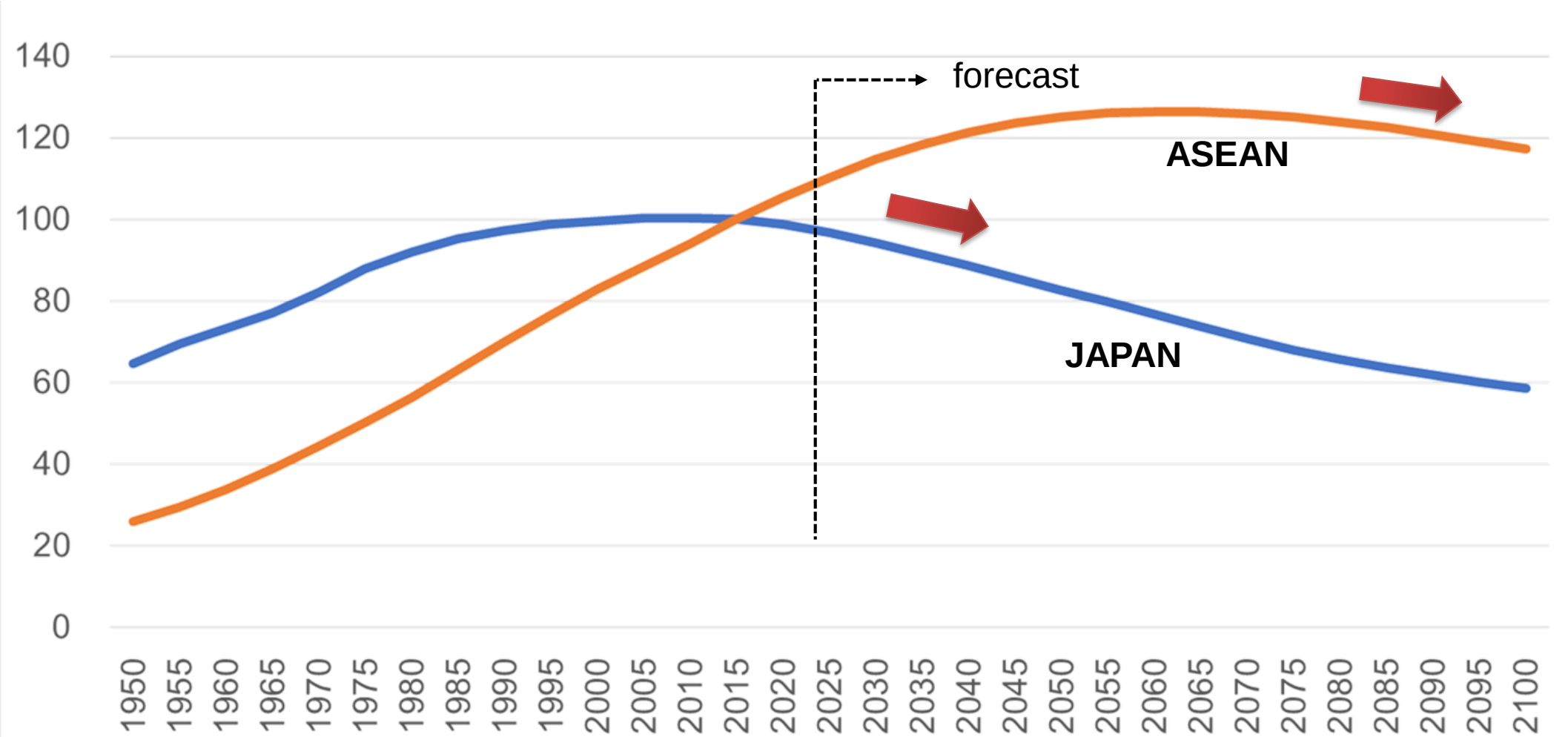
Depopulation: Japan is a “Pioneer” on population challenge

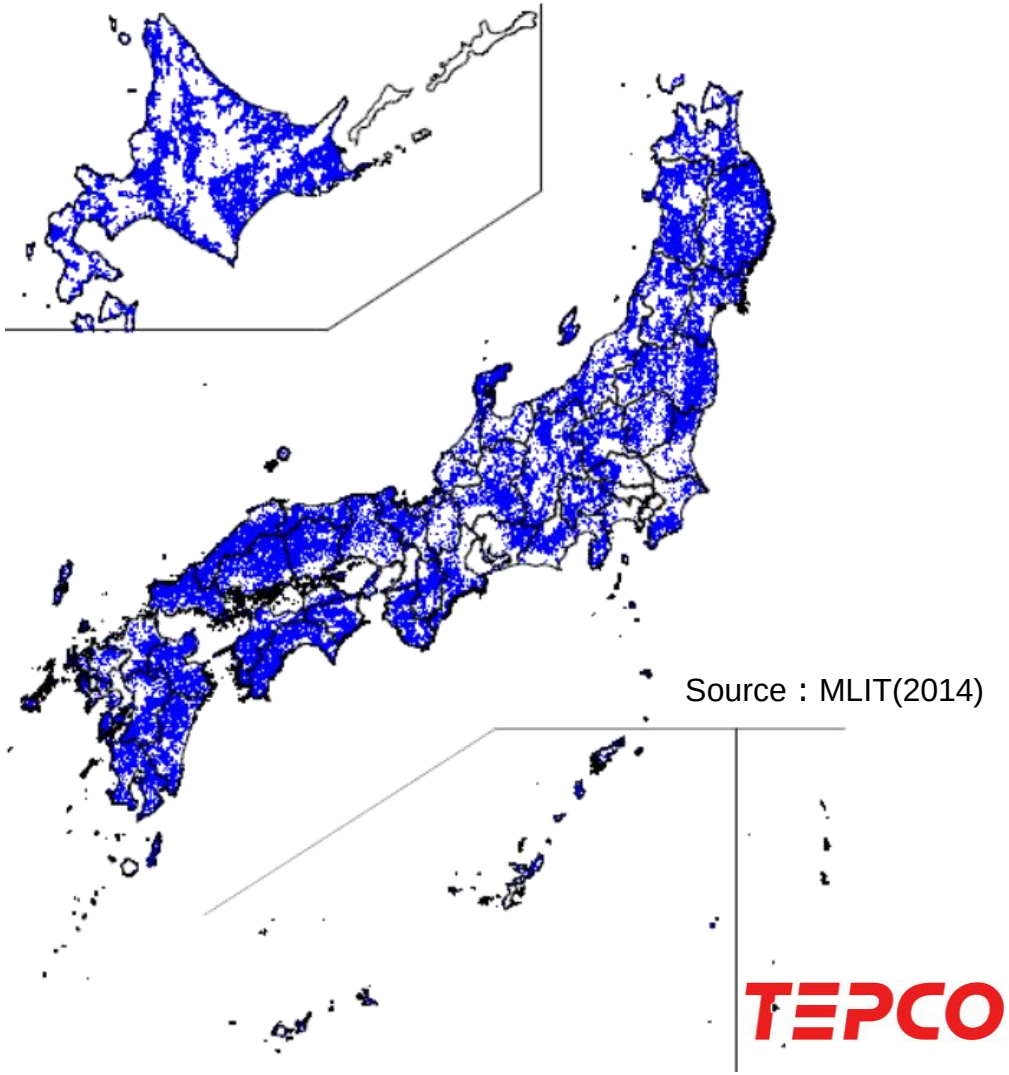
Population trends of ASEAN and Japan (FY2015=100)



Source：UN(2019)

Depopulation: Challenges of infra sustainability

- Rapid Depopulation is expected; **▲20% in 2050**
- More serious in the countryside; **blue** indicates the areas where the population will be halved or less.



Source：MLIT(2014)

- Challenges of sustainability in every infrastructure service
  - Transmission and Distribution,
  - Gas, Telecommunications,
  - Water Supply,
  - Roads / Bridges,
  - Logistics, Public Transportation
  - Medical　etc.

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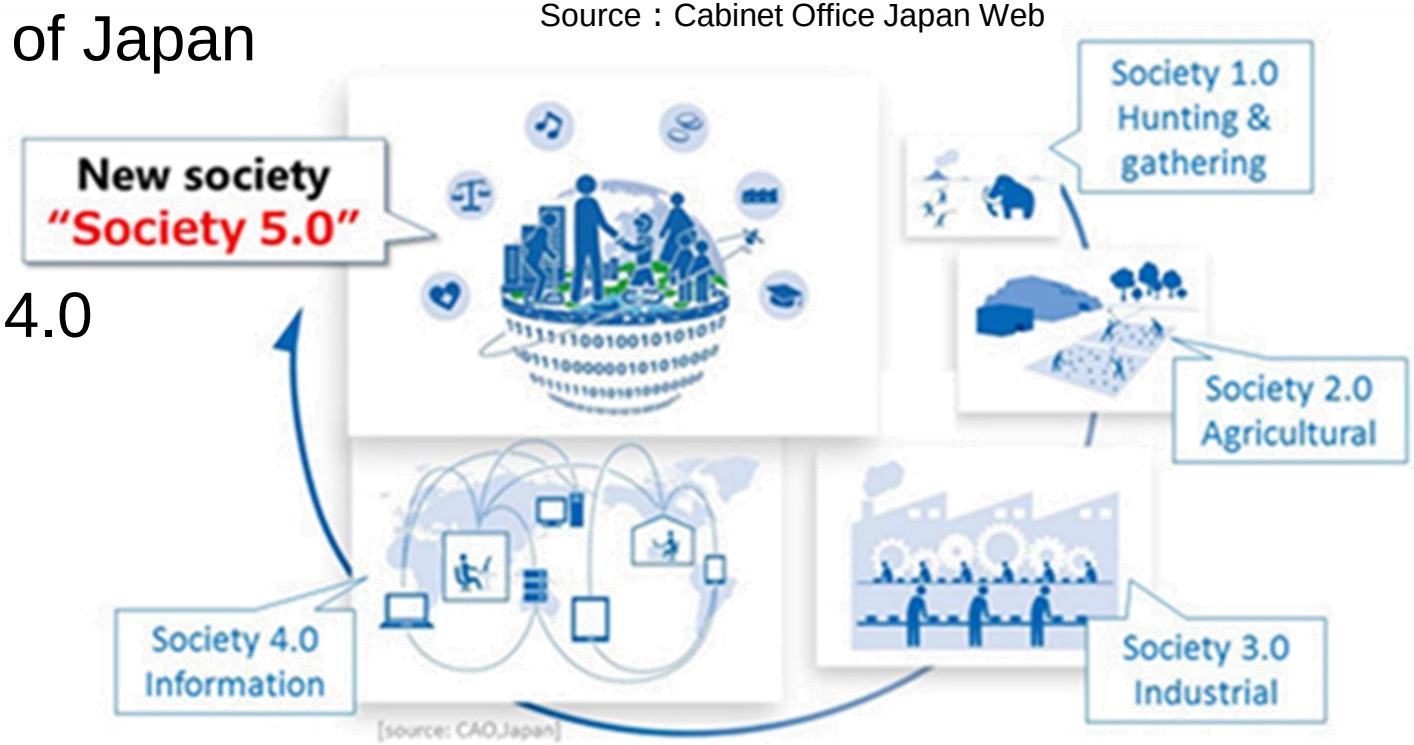
Digitalization: Society 5.0 Vision of Future Society

- Proposed by the Government of Japan

Source：Cabinet Office Japan Web



- Extended concept of Industry 4.0

- **Data-driven & super-smart society**;
  where **everything in everywhere of the society**, including human, machine, asset, and infrastructure, **will be connected** via sensors and actuators to a common data platform (Society 5.0 Service Platform).

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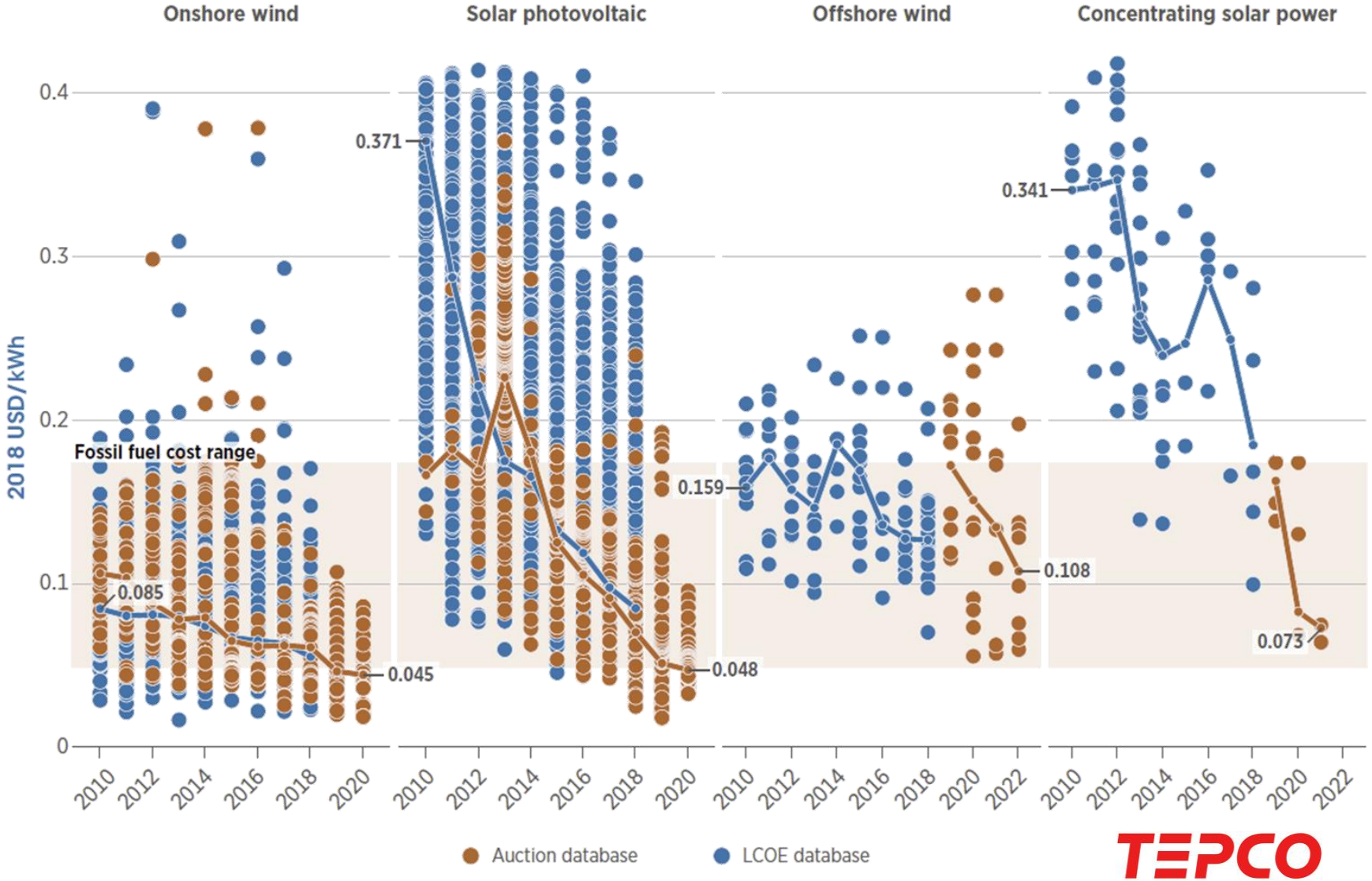
Decentralization: Rapid cost down of Renewables

The LCOE for projects and global weighted average values for CSP, solar PV, onshore and offshore wind, 2010–2022

Global weighted average LCOE of some **VREs**, **onshore wind & solar PV, is lower than any fossil fuel.**

※VREs：variable renewable energy

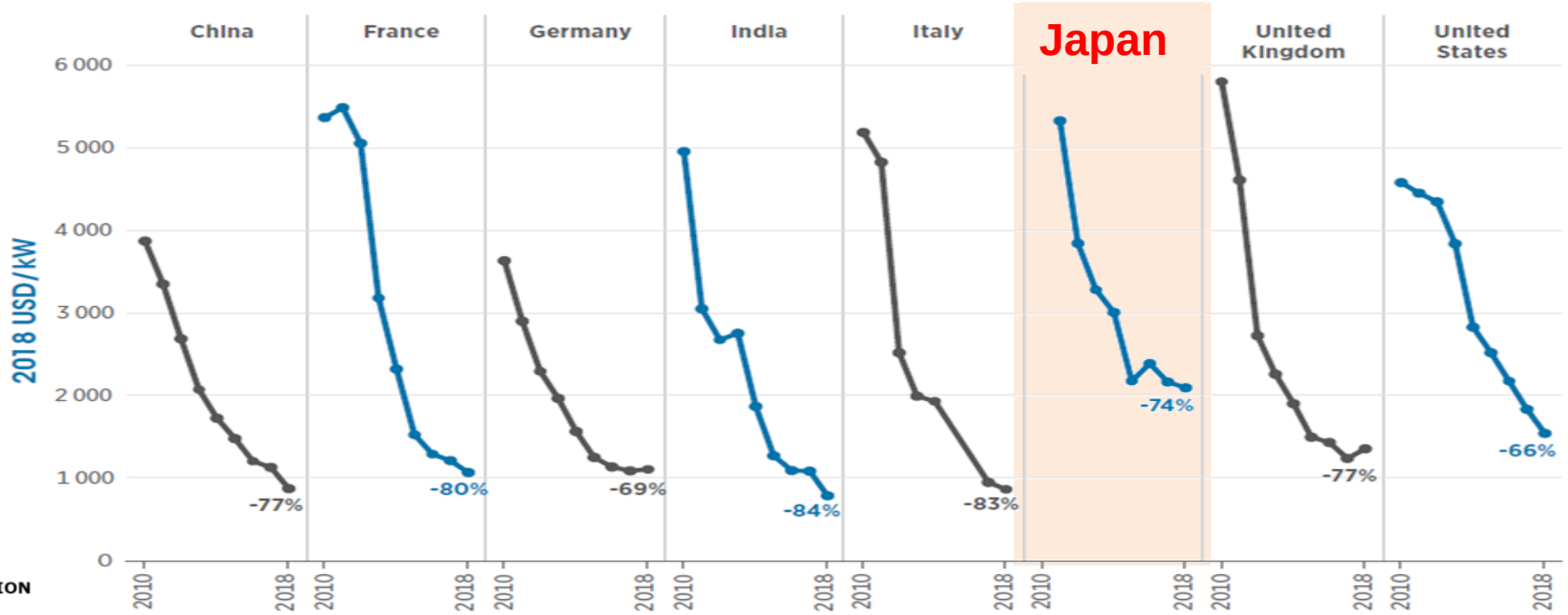


Source：IRENA(2019)

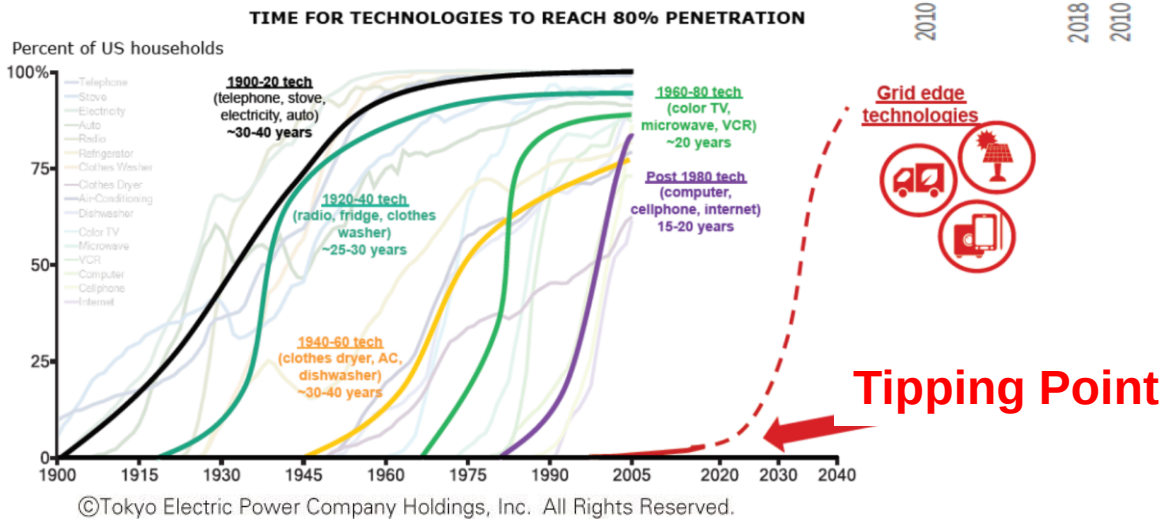
VREs are still expensive in Japan; However…

Utility-scale solar PV total installed cost trends in selected countries, 2010–2018

Source：IRENA(2019)



Source：WEF(2017)



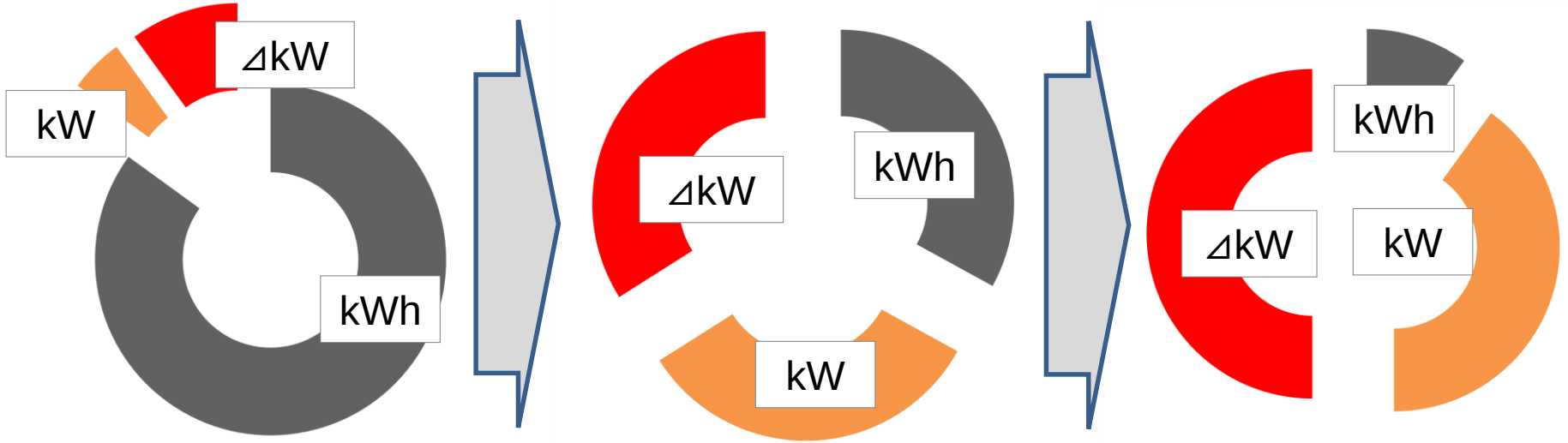
Tipping Point

However, we need to prepare for **Tipping Point** and the following **rapid penetration of VREs**.

Transition of Electricity Market is needed

- **kWh centric market to kW and⊿kW centric market.**
  - kWh value is going down due to penetration of zero marginal cost VREs.
  - kW &⊿kW value is going up. **Effective use of DSRs by Digitalization is needed.**

※DSRs：demand side resources including EV batteries



kWh : value of Energy
kW : value of Capacity
⊿kW: value of Flexibility

⇨ kW& ⊿kW : essential for power system‘s stability.

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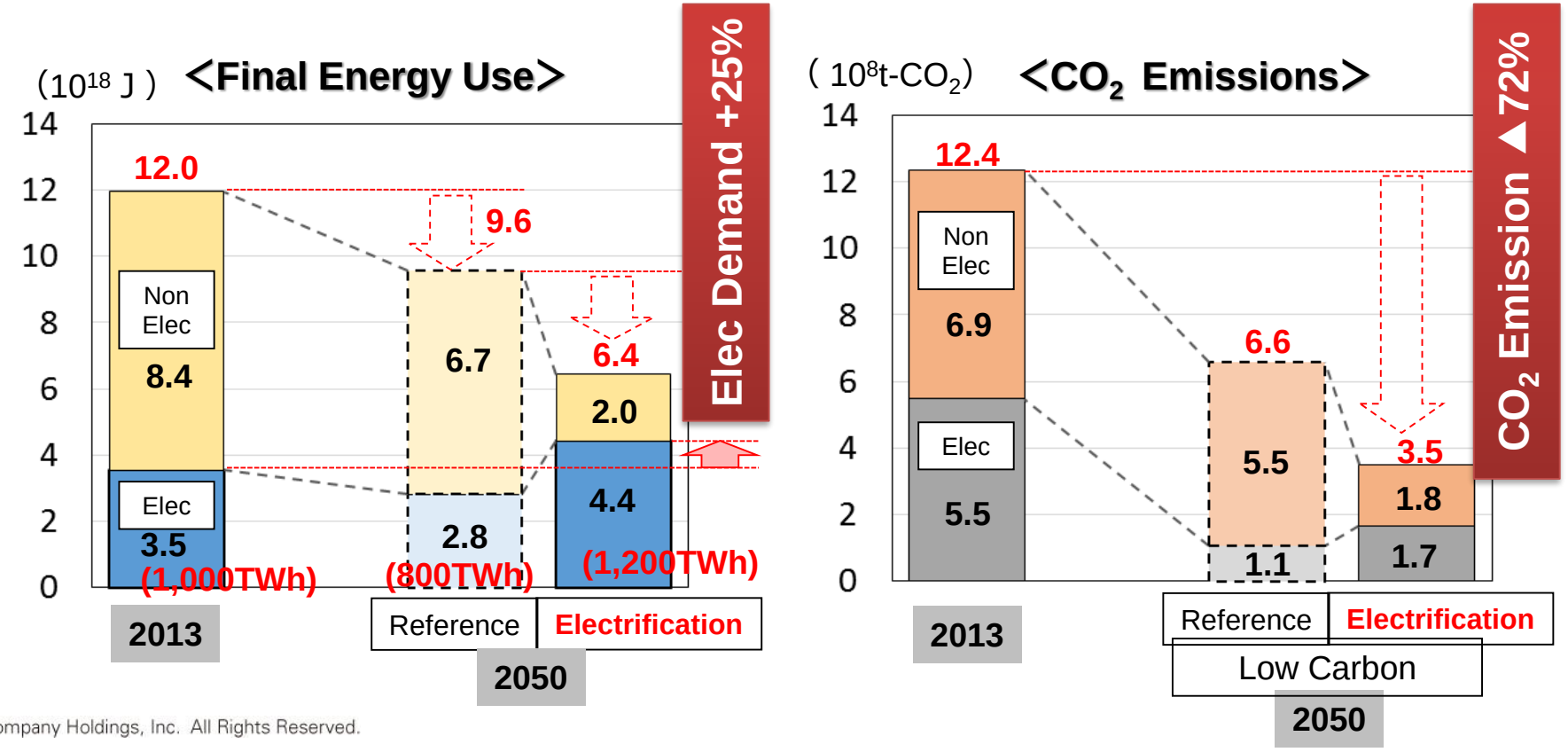
Potential of Electrification

- TEPCO calculated the **potential of electrification** in **CO2 emissions reduction in Japan.**
  - Supply side : Low-carbon generation mix (65% carbon-free)
  - Demand side : Electrification as much as possible



Potential of Electrification (details)

※ Electrification rate : final energy use

Demand side

Sector	Electrification rate(2013)	Potential	Alternative appliance
Residential	49%	100%	・ Heat pump ・ Induction heater (IH)
Commercial	59%	100%	・ Heat pump ・ Induction heater (IH)
Transport	2%	100% except Aviation and shipping (72%)	・ EV
Industrial	31%	100% except direct combustion (51%)	・ Heat pump ・ Induction heater (IH)
Total	30%	69%	

Supply side

※ Renewable : the high case of potential research in MOE(2014)

Renewable	Nuclear	Thermal
55% (PV23%, Wind 11%, Others 21%)	10%	35%

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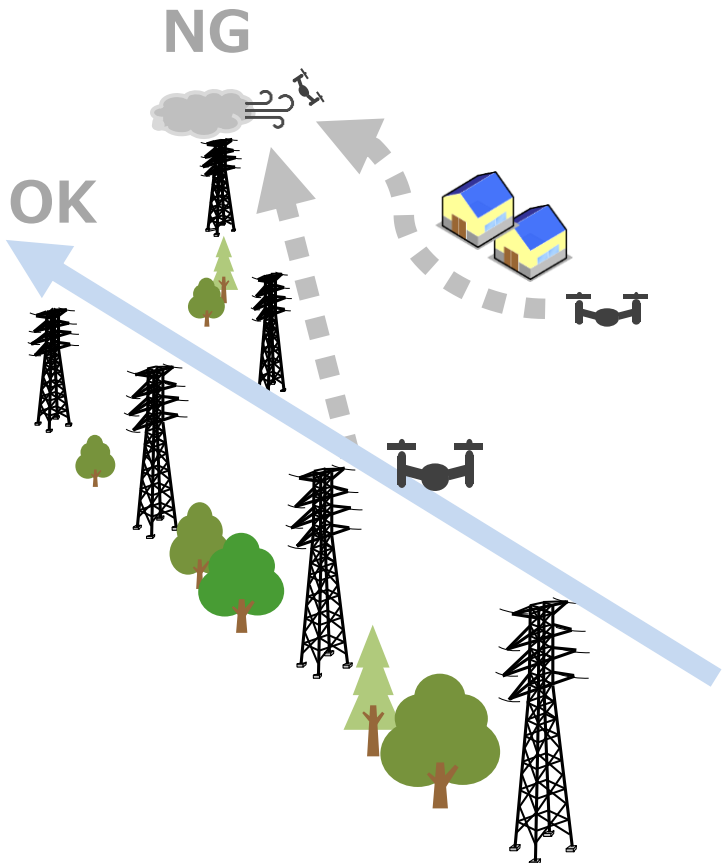
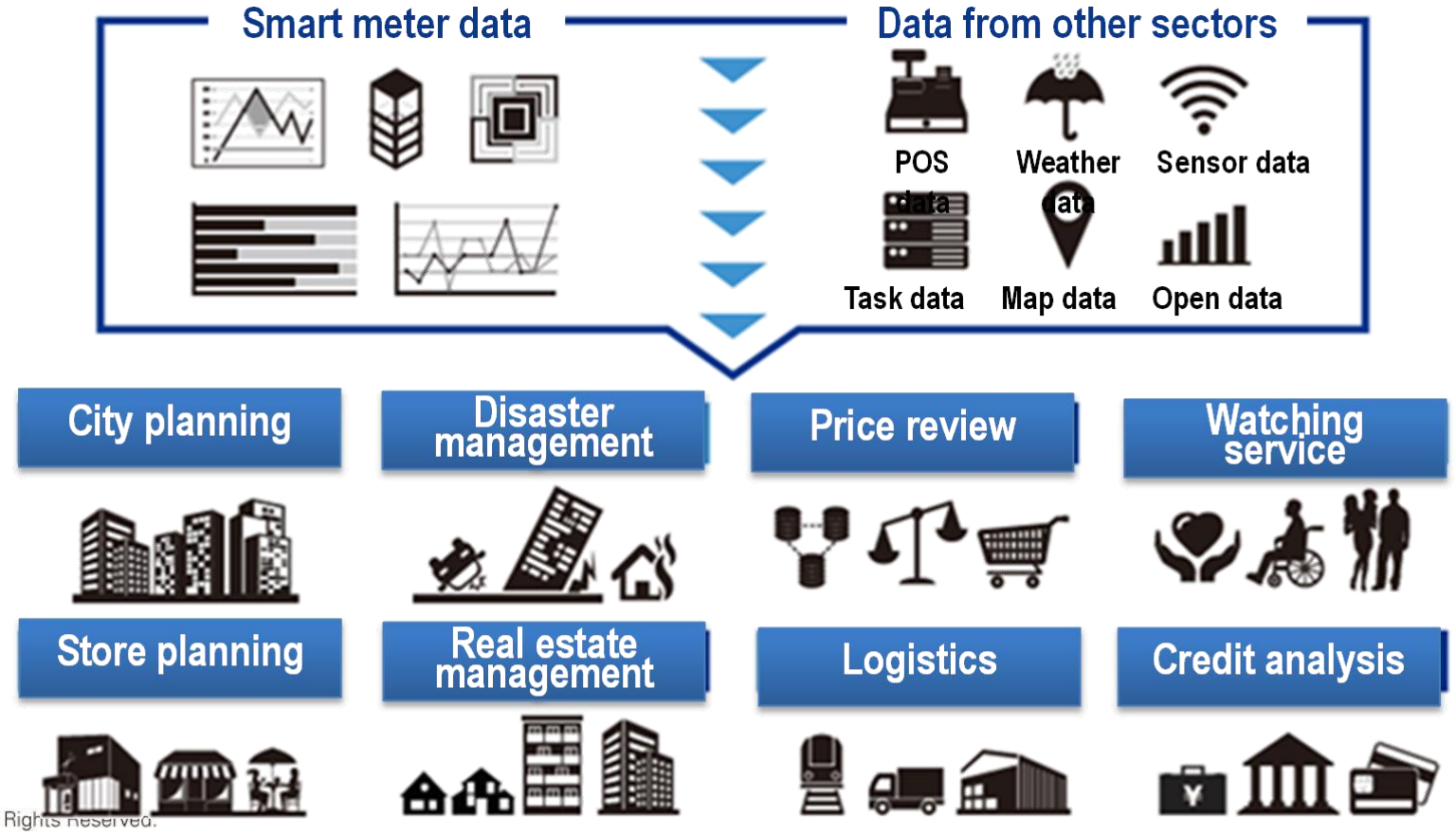
TEPCO's initiative for integration with other NW

- **Drone Highway project**, working with **ZENRIN** (the largest cartographic company in Japan), and Rakuten, (internet commerce company)
- Utilize the **T&D NW** as a **safe flight path of drone**, with;
  - the transmission towers & substations as landmarks
  - charging ports in idle space



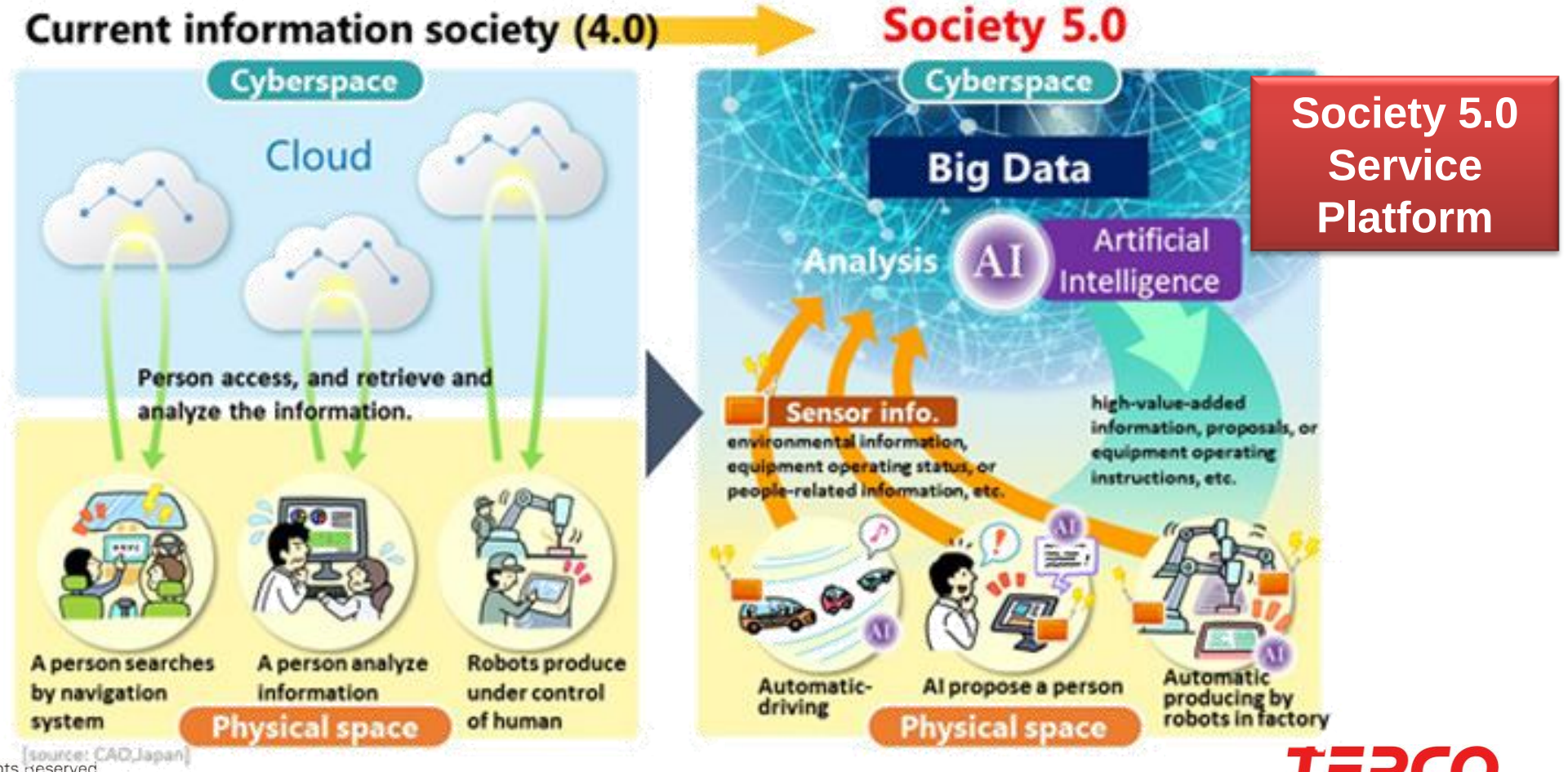
TEPCO's initiative for data-driven business

- **Grid Data Bank Lab project**, working with NTT DATA, Chubu Electric and Kansai Electric
- Combine and analyze power data and data from other sectors to create solutions and business opportunities



How Society 5.0 works

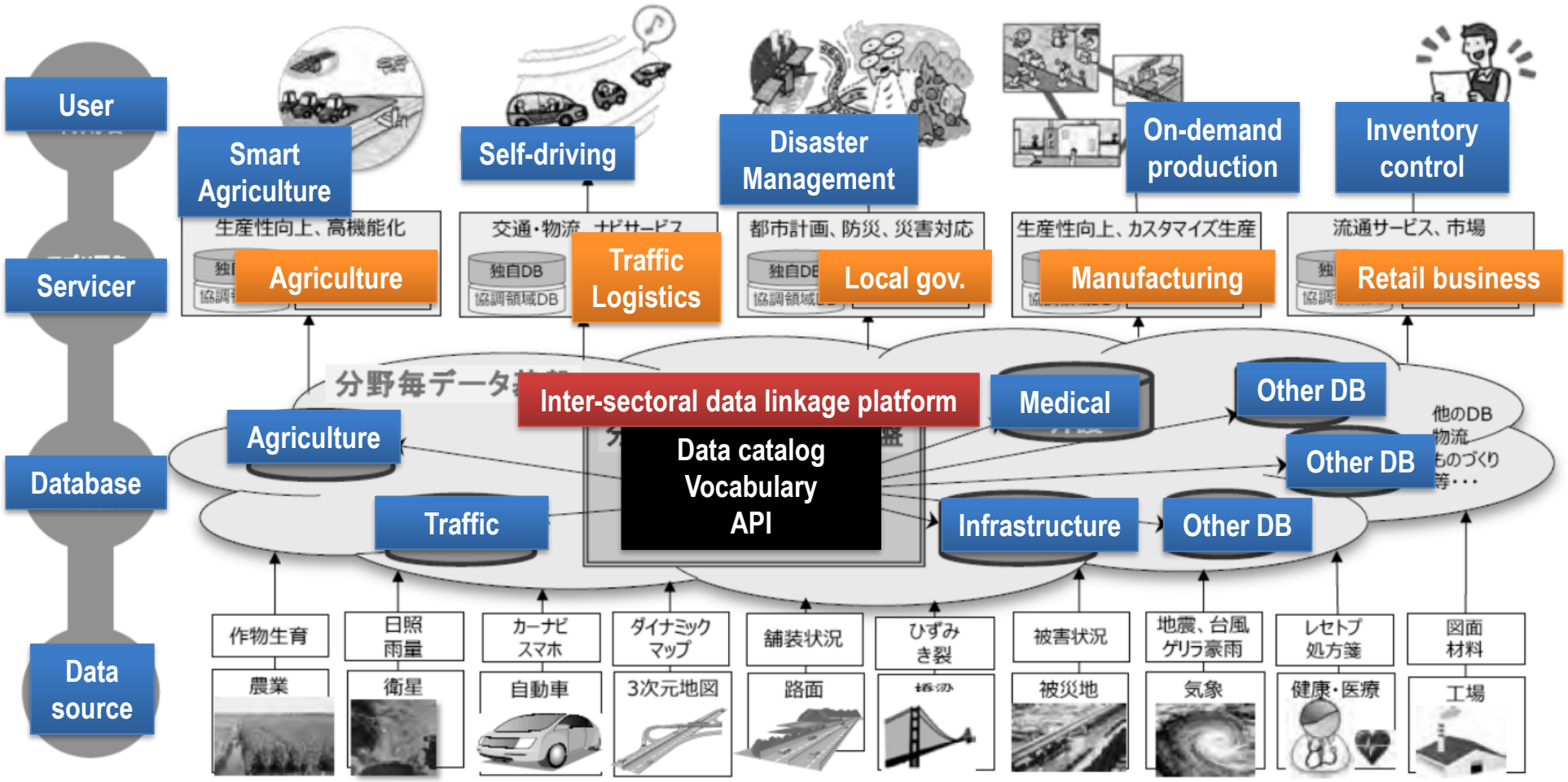
- Everything in physical space is connected to cyberspace, where a huge amount of data from sensors is accumulated.
- AI analyzes the big data, feeds back the result to physical space.



[source: CAO,Japan]

Source：Cabinet Office Japan Web

Inter-sectoral data linkage platform



Source：Cabinet Office Japan (2018)

Challenges for Energy Transition & Smart City/Society

- Five major trends (**5D**s) can bring inevitable and irreversible change in the utility(energy) system & society system.
- Urbanization needs smart city solution. Depopulation (future challenge for ASEAN) also needs smart city/society solution.
- Challenges are;
  - VREs cost down
  - Effective use of DSRs for Capacity(kW) and Flexibility(⊿kW) by Digitalization
  - Legacies: Aged infrastructure, existing data w/o inter-sectoral linkage, out-of-date regulation
  - Adequate and undistorted incentive including carbon price

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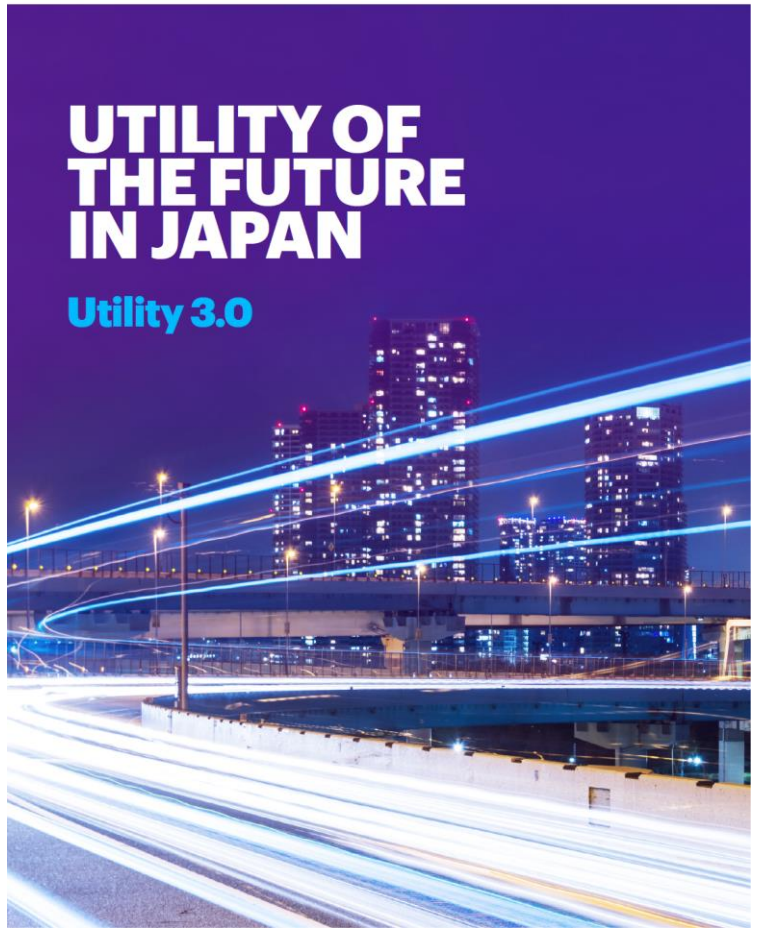
Thank you for your attention.



Available at https://www7.e1.tepco.co.jp/wp-content/uploads/Utility3.0.pdf

References

- Takeuchi etc.(2017) “Energy industry in 2050 - Game change to Utility3.0” written in Japanese
- The Government of Japan (2019) “The Long-term Strategy under the Paris Agreement”
- MLIT(Ministry of Land, Infrastructure, Transport and Tourism, Japan) (2014) “Grand Design of National Spatial Development towards 2050, Japan”
- UN(United Nations)(2019) “World Population Prospects 2019”
- IRENA(International Renewable Energy Agency)(2019) “Renewable Power Generations Costs in 2018”
- WEF(World Economic Forum)(2017) “The Future of Electricity: New Technologies Transforming the Grid Edge”
- MOE(Ministry of the Environment, Japan)(2014) “2050 Reports on potential possibility of distributed energy dissemination including renewable energy” written in Japanese
- Cabinet Office Japan (2018)” Policy for establishing inter-sectoral data linkage platform” ” written in Japanese

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