

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

2019/10/31 @ SIEW 2019 Thinktank Roundtable The Role of Smart Cities in Energy Transformation in ASEAN

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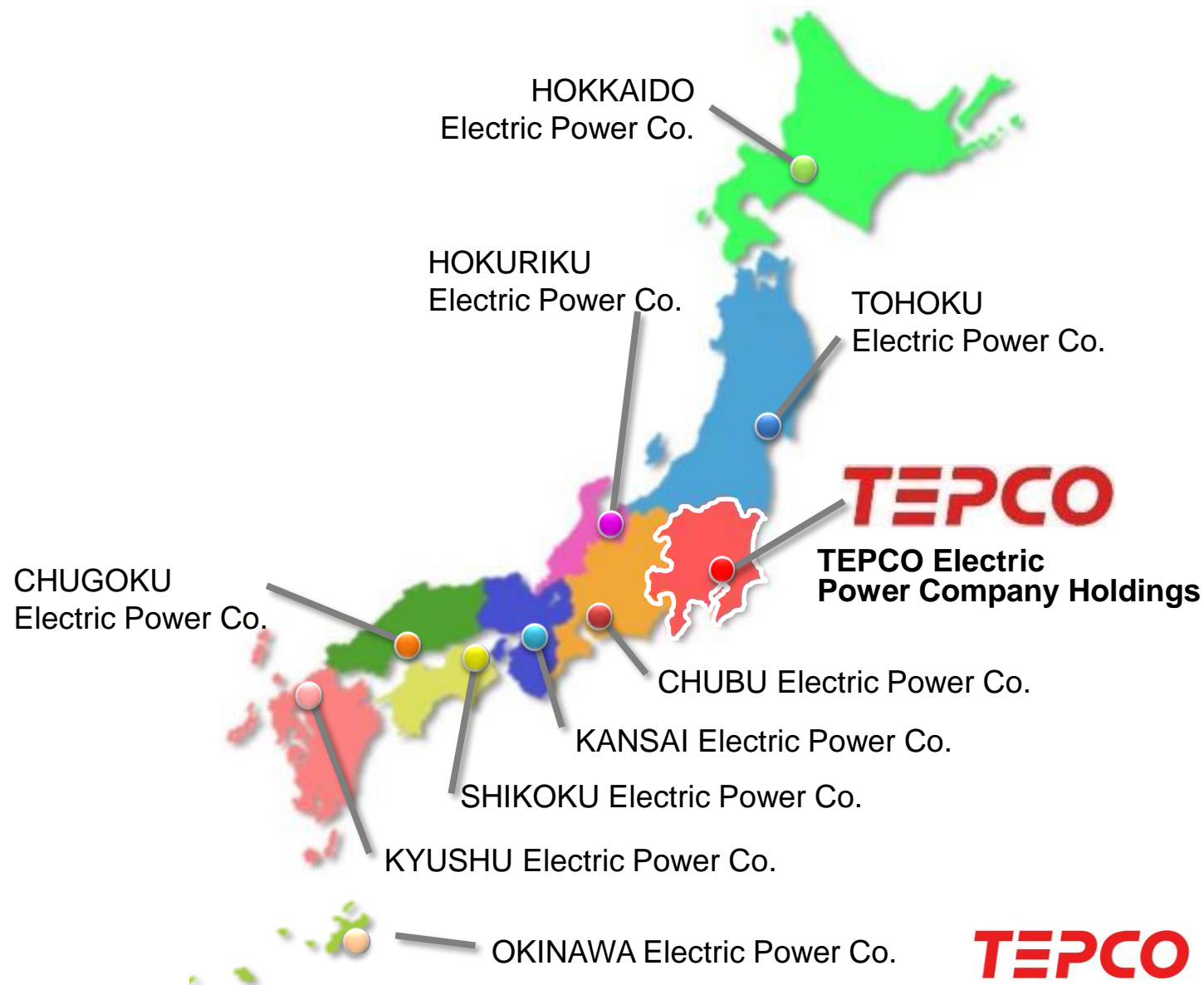
Japan's Electricity Market & TEPCO

Population

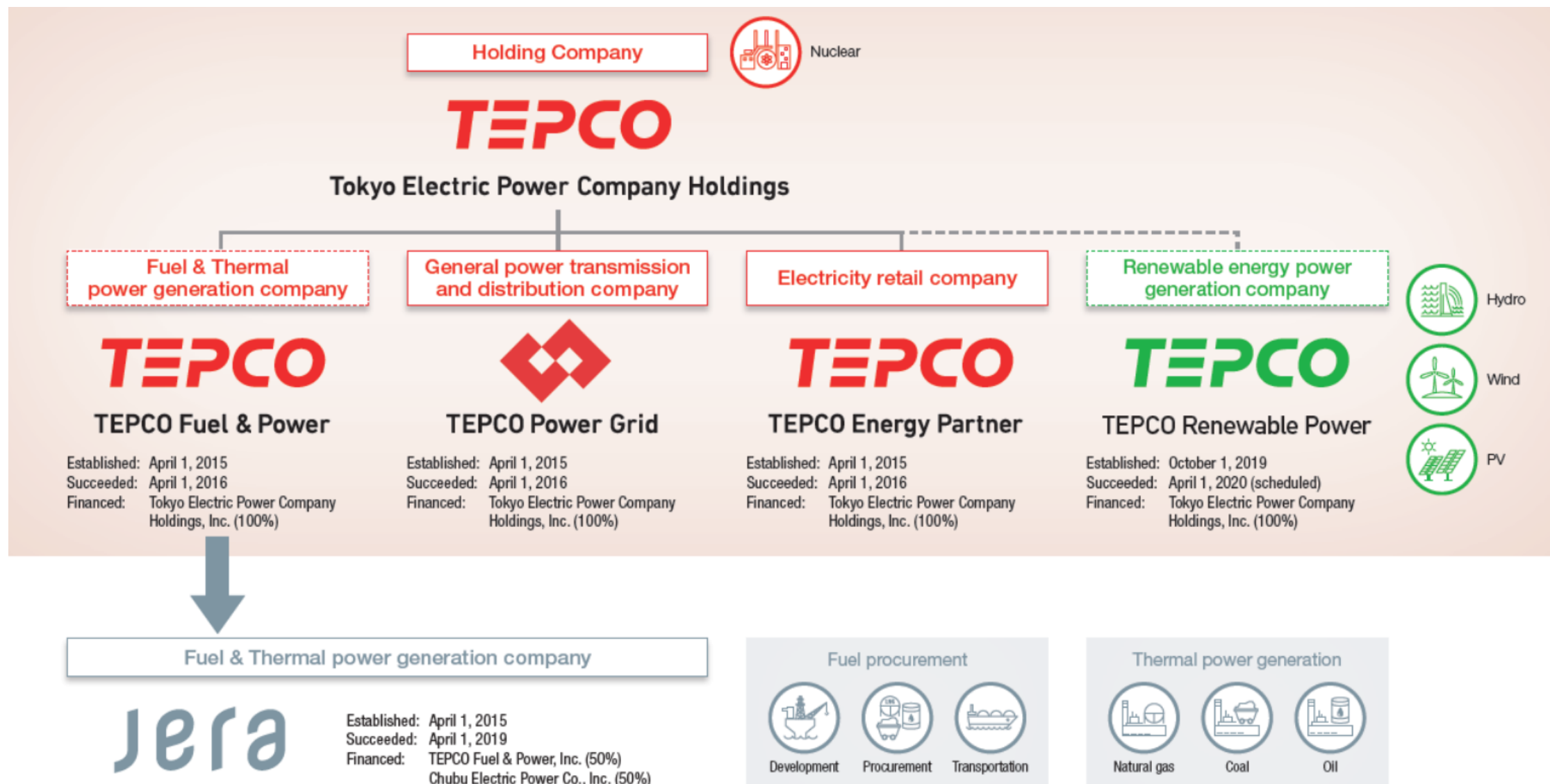
Japan 127 million in 2018
ASEAN 654 million in 2018

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

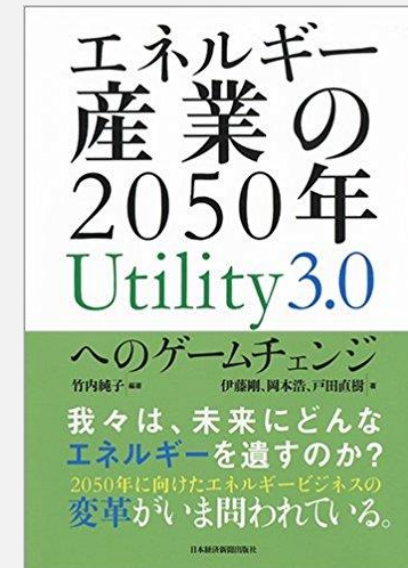
Decarbonization

Dentralization

Digitalization

Deregulation

Depopulation



Published in Sep 2017

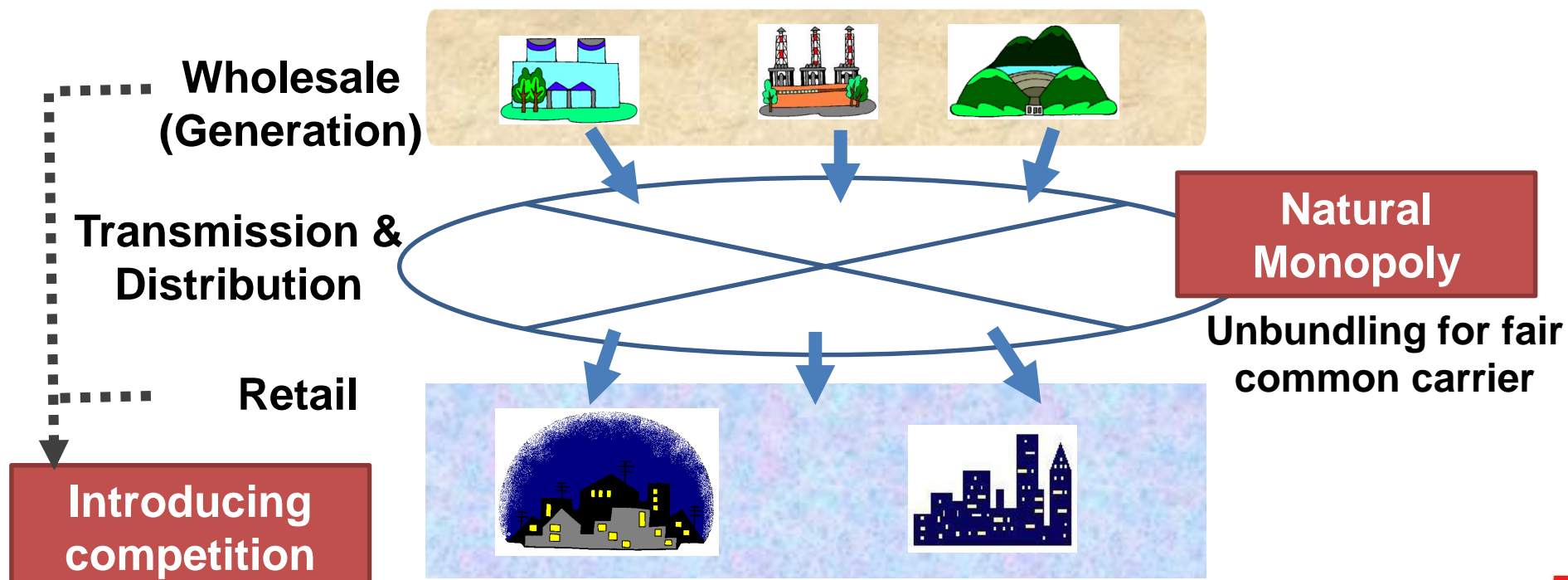
Deregulation: Utility 1.0 to Utility 2.0

Utility 1.0

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

Utility 2.0

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



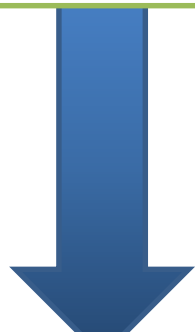
Transition to Utility3.0 under 5Ds

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

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.

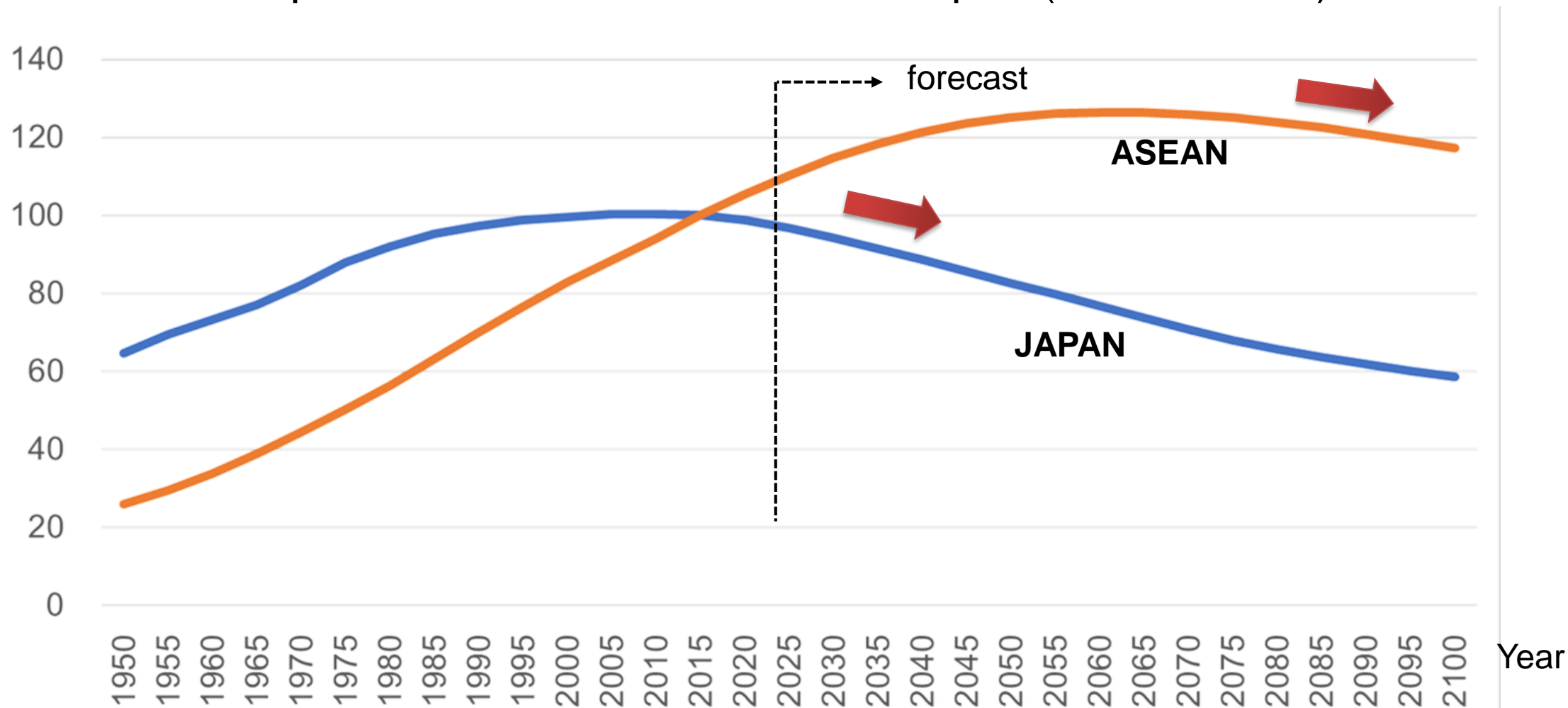
The Long-term Strategy
under the Paris Agreement



June 2019
(Cabinet decision, June 11, 2019)
The Government of Japan

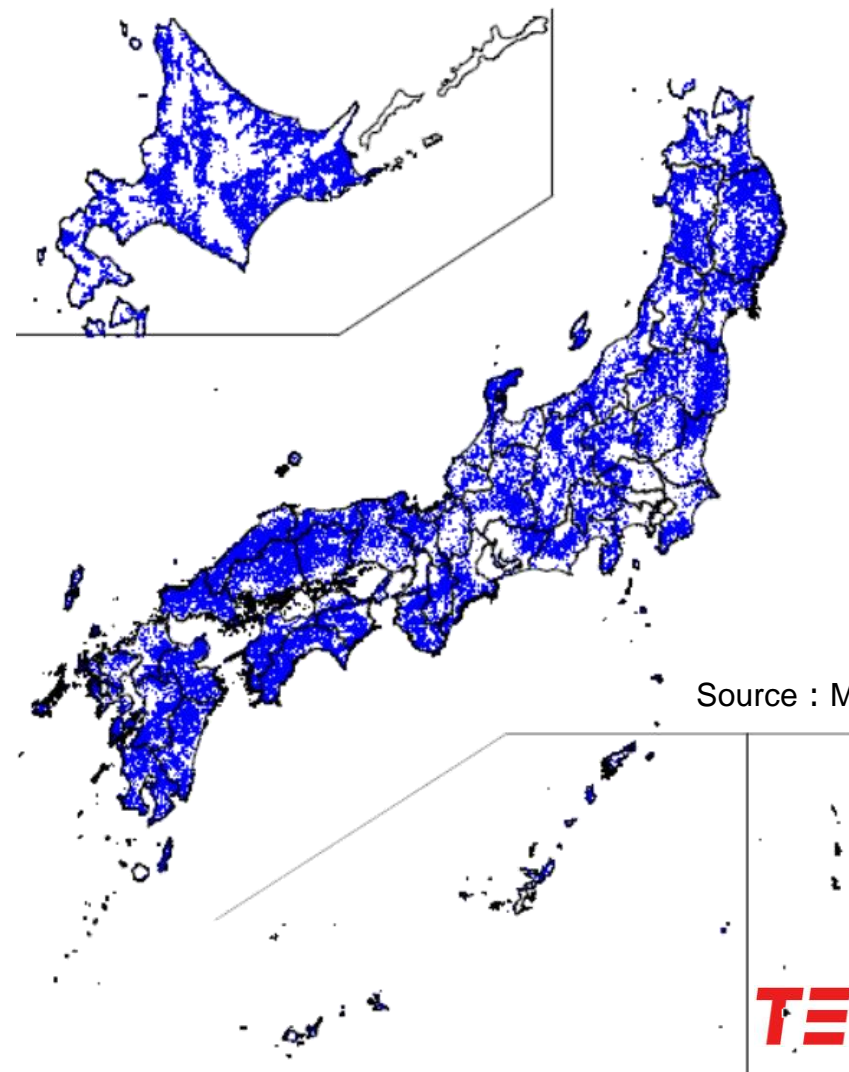
Depopulation: Japan is a “Pioneer” on population challenge

Population trends of ASEAN and Japan (FY2015=100)



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

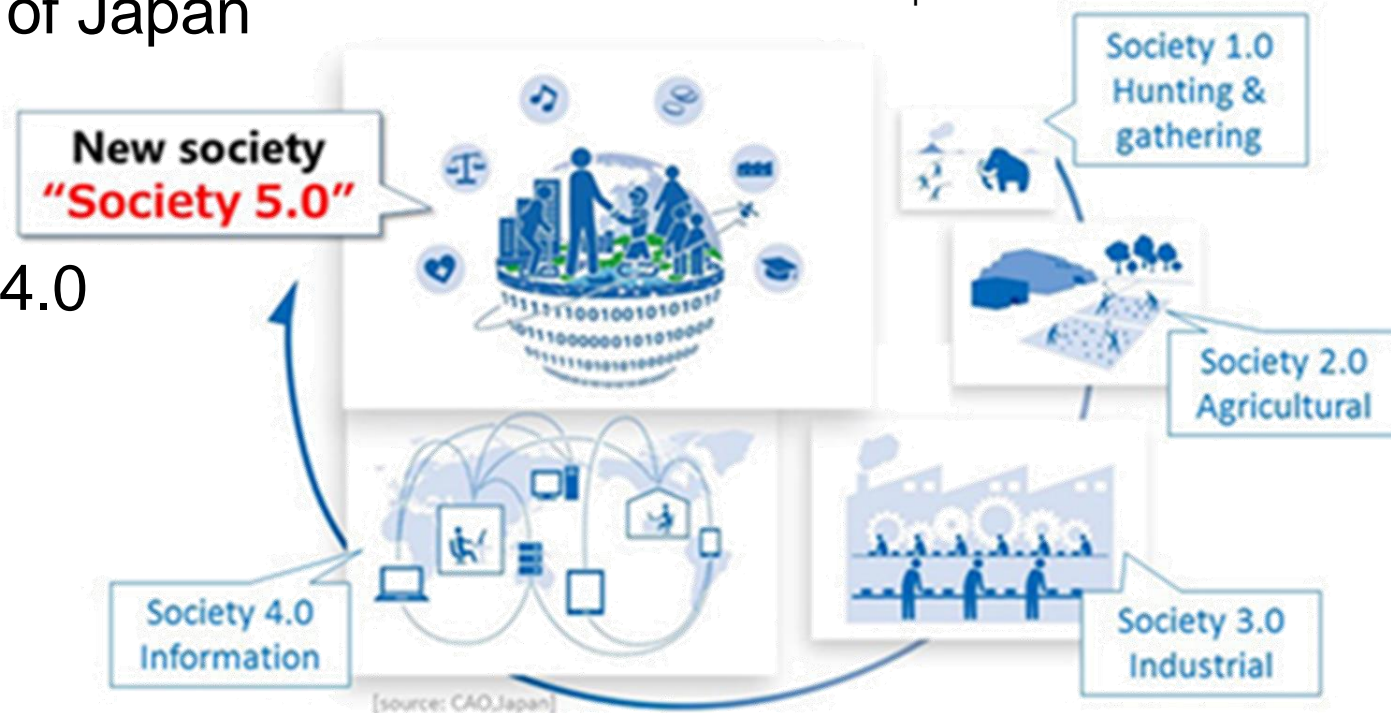


Digitalization: Society 5.0 Vision of Future Society

- Proposed by the Government of Japan

Source : Cabinet Office Japan Web

- Extended concept of Industry 4.0



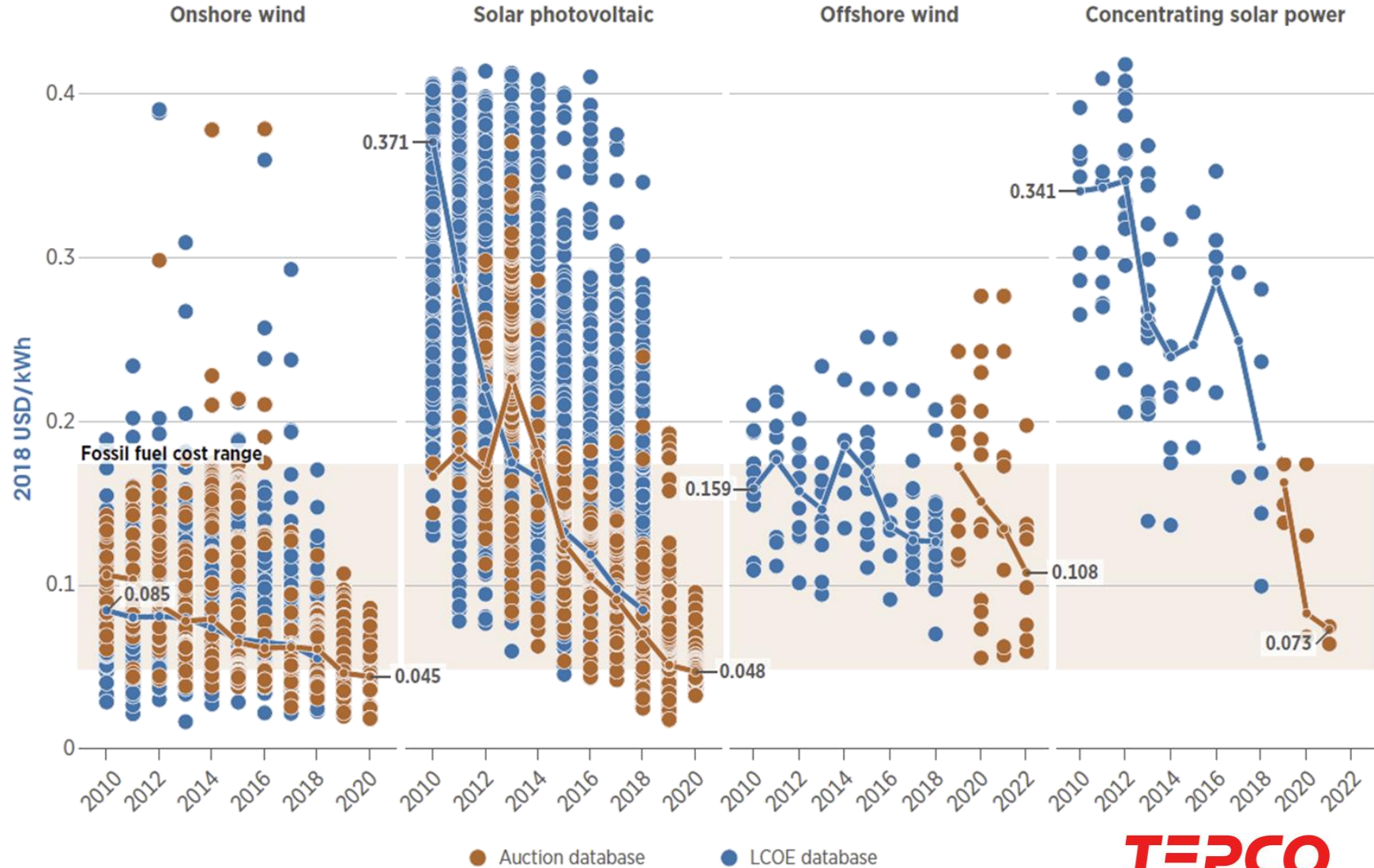
- Data-driven & super-smart society**; where **everything in everywhere of the society**, including human, machine, asset, and infrastructure, **will be connected** via sensors and actuators to a common data platform (Society 5.0 Service Platform).

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

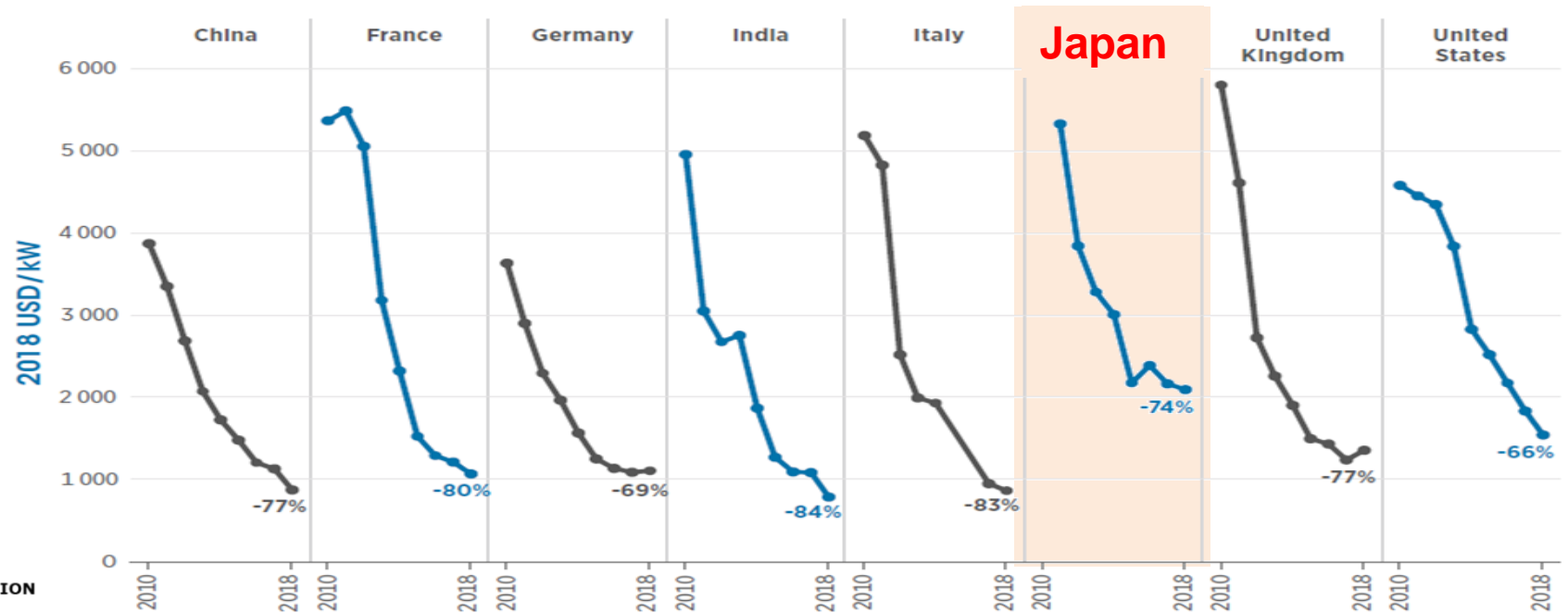


Source : IRENA(2019)

VREs are still expensive in Japan; However...

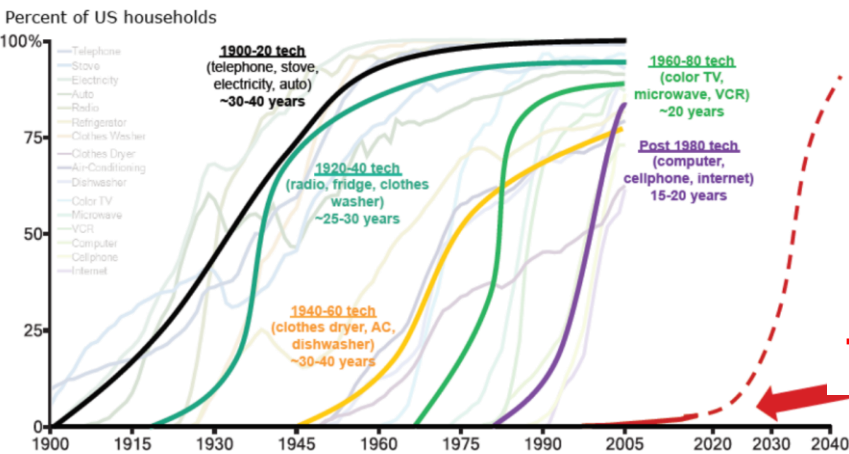
Utility-scale solar PV total installed cost trends in selected countries, 2010–2018

Source : IRENA(2019)



Source : WEF(2017)

TIME FOR TECHNOLOGIES TO REACH 80% PENETRATION



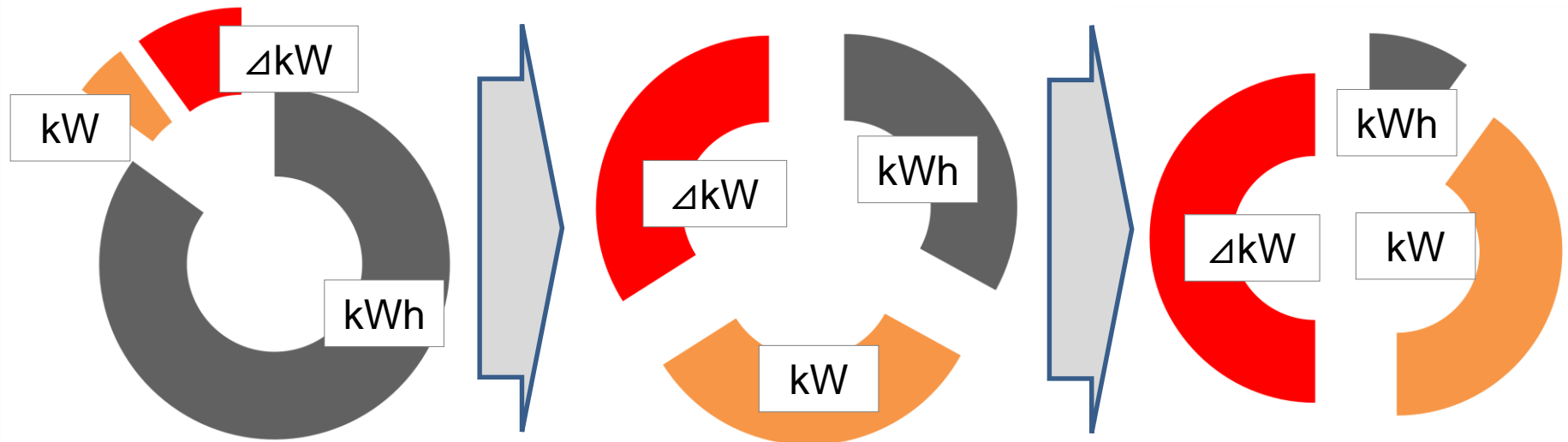
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However, we need to prepare for **Tipping Point** and the following **rapid penetration of VREs.**

Transition of Electricity Market is needed

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

※DSRs : demand side resources including EV batteries



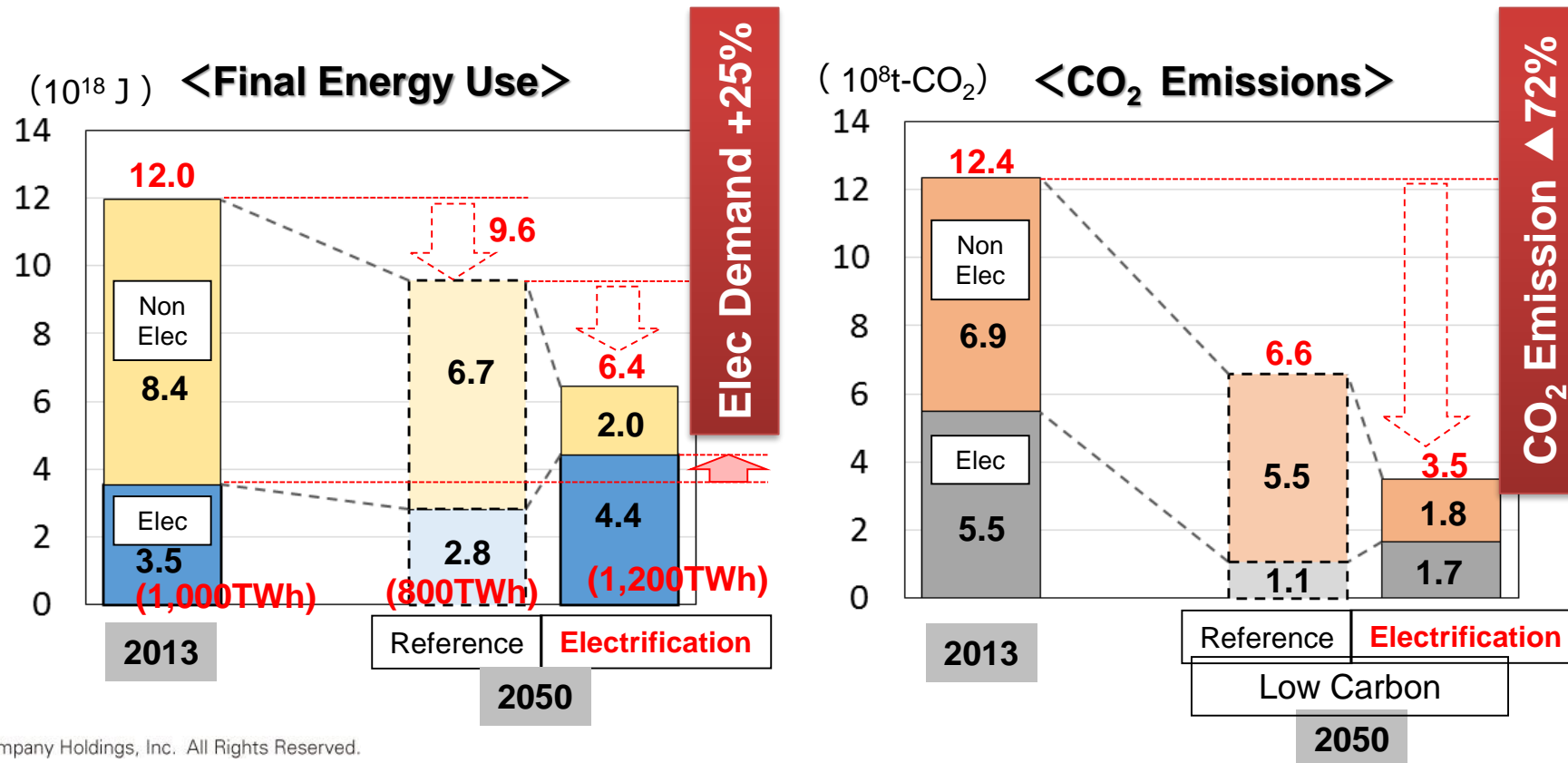
kWh : value of Energy
 kW : value of Capacity
 Δ kW: value of Flexibility



kW & Δ kW : essential for power system's stability.

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%	<ul style="list-style-type: none"> • Heat pump • Induction heater (IH)
Commercial	59%	100%	<ul style="list-style-type: none"> • Heat pump • Induction heater (IH)
Transport	2%	100% except Aviation and shipping (72%)	<ul style="list-style-type: none"> • EV
Industrial	31%	100% except direct combustion (51%)	<ul style="list-style-type: none"> • Heat pump • Induction heater (IH)
Total	30%	69%	

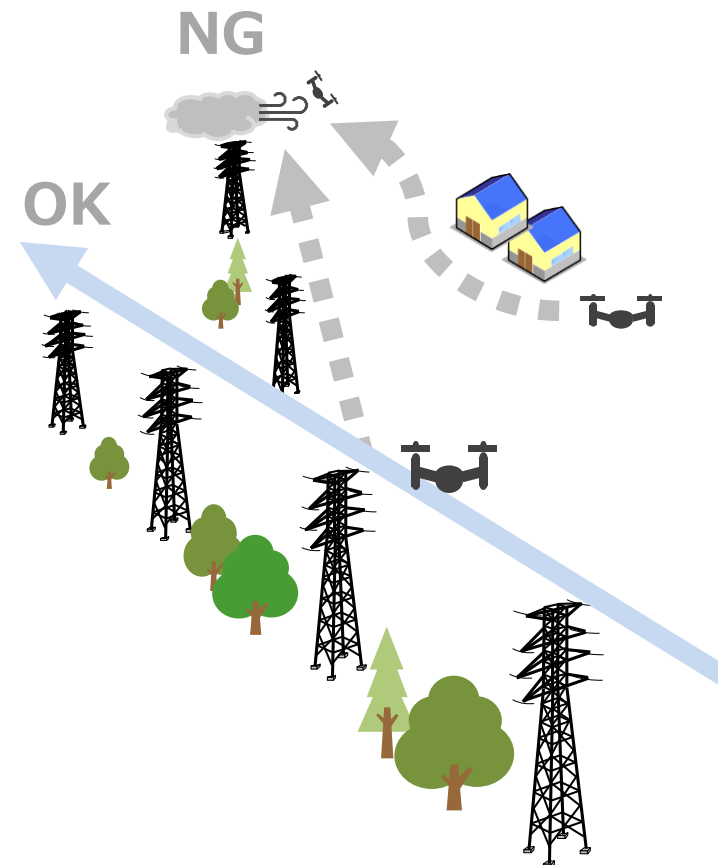
Supply side

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

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

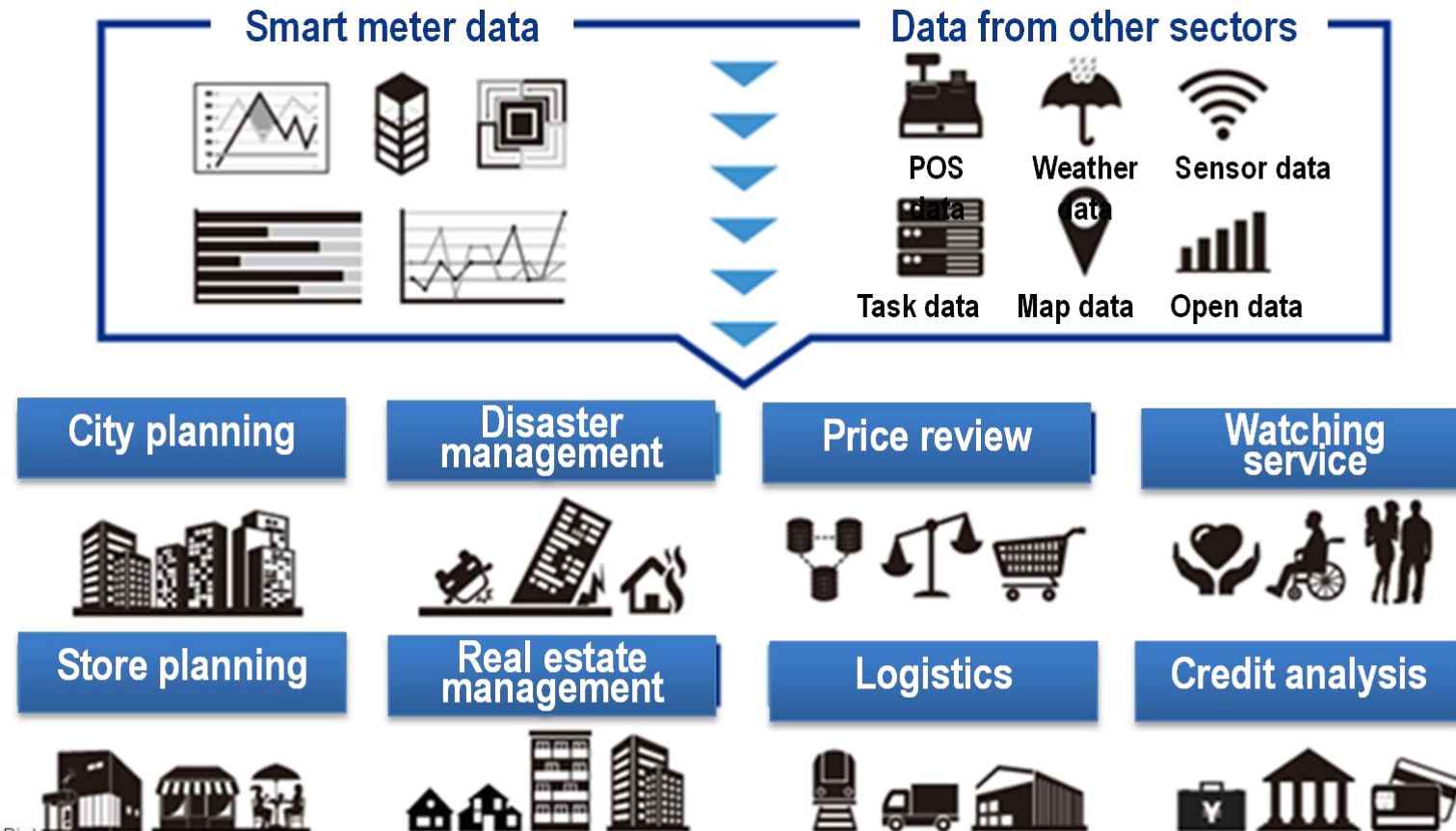
TEPCO's initiative for integration with other NW

- **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



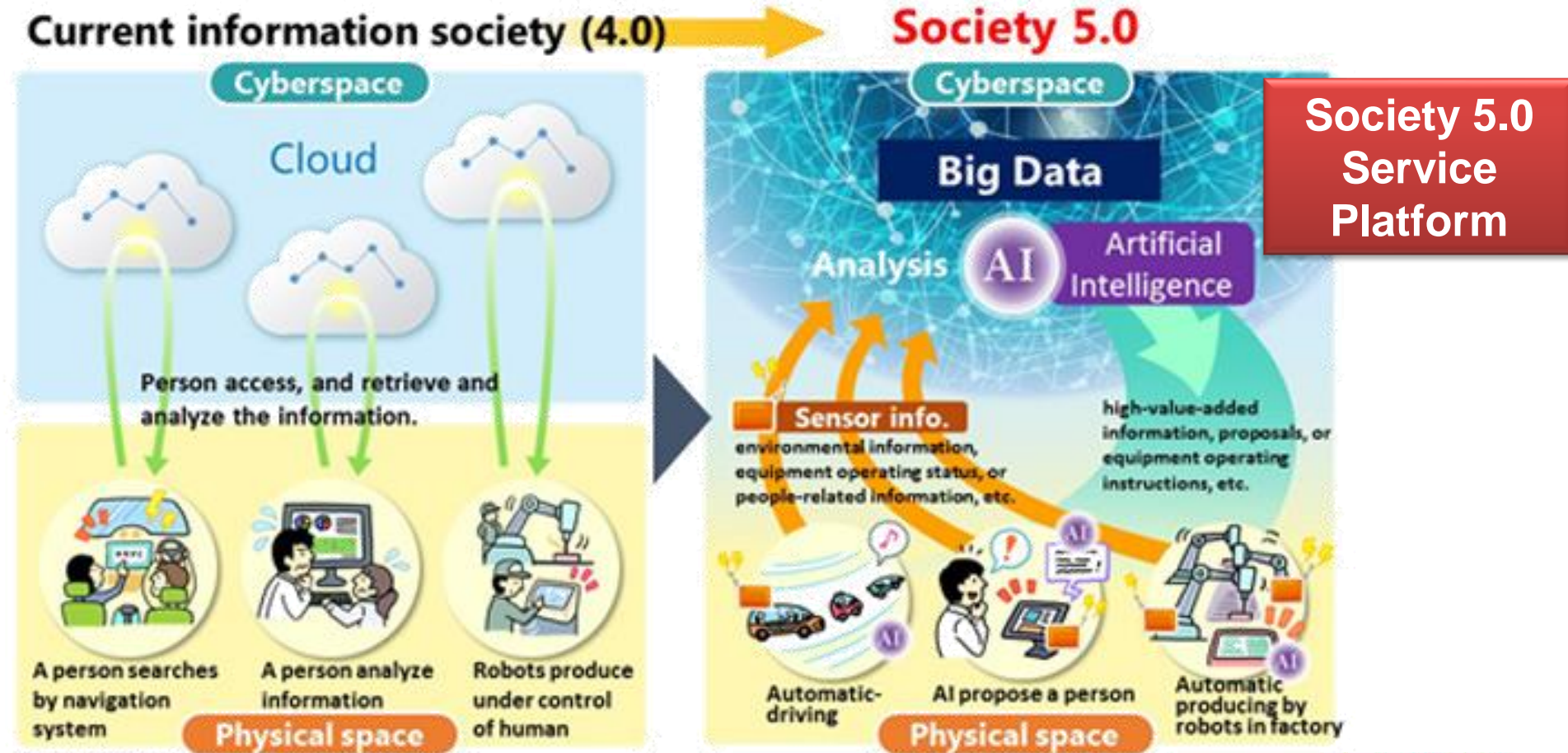
TEPCO's initiative for data-driven business

- **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

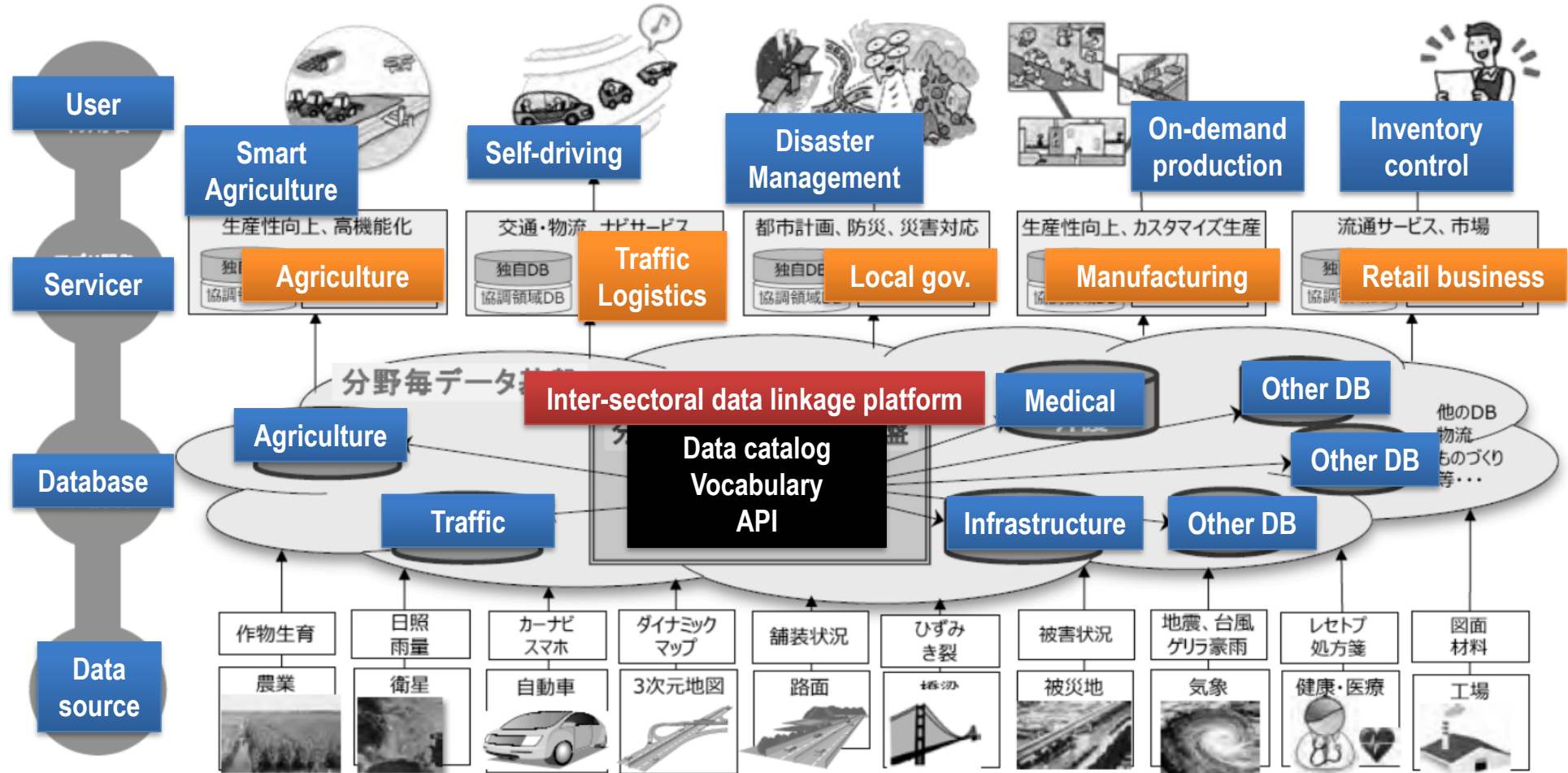


How Society 5.0 works

- 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.



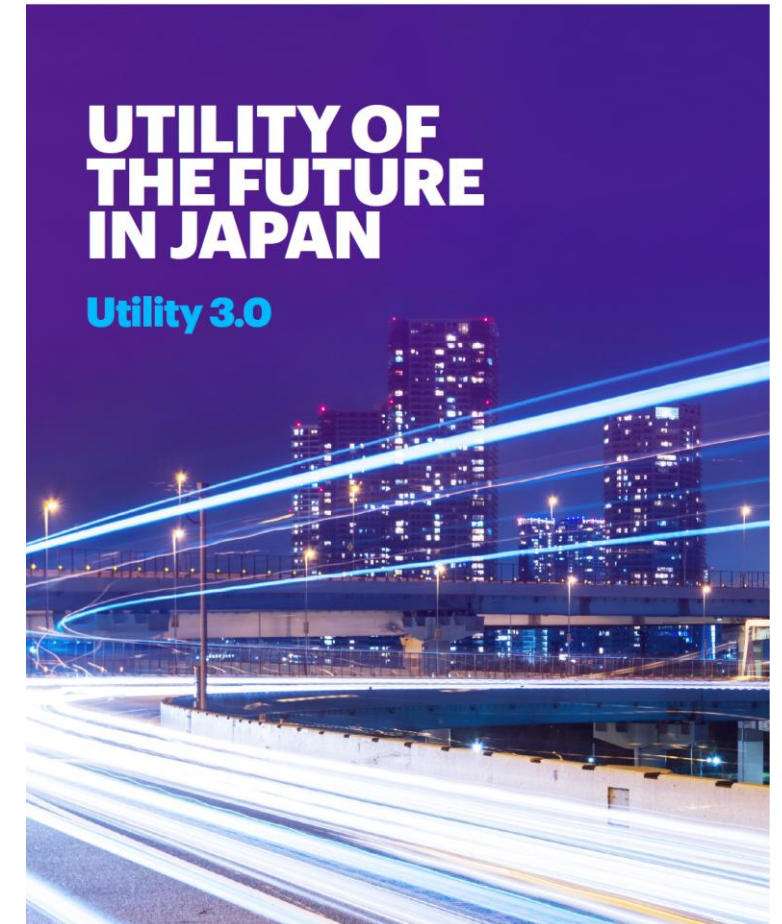
Inter-sectoral data linkage platform



Challenges for Energy Transition & Smart City/Society

- Five major trends (**5Ds**) 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(Δ kW) by Digitalization
 - Legacies: Aged infrastructure, existing data w/o inter-sectoral linkage, out-of-date regulation
 - Adequate and undistorted incentive including carbon price

**Thank you
for your attention.**



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

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