Utility 3.0:
Roles of Future Utility Industries to Decarbonize the Society

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EVP, TEPCO Power Grid Inc.

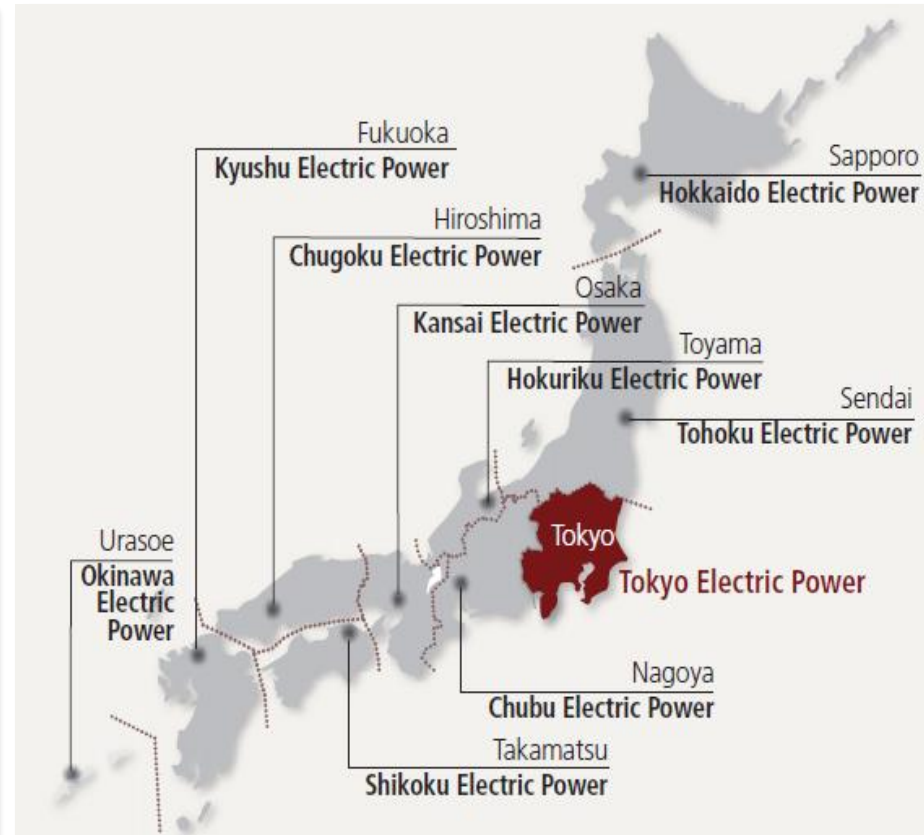# Key Figures of TEPCO Holdings

Number of Customers

29 Million

Annual Electricity Sales

247 TWh

Generation Capacity

66 GW

(As of March 2017)

Fukuoka
Kyushu Electric Power

Hiroshima
Chugoku Electric Power

Osaka
Kansai Electric Power

Urasoe
Okinawa Electric Power

Sapporo
Hokkaido Electric Power

Toyama
Hokuriku Electric Power

Sendai
Tohoku Electric Power

Tokyo
Tokyo Electric Power

Nagoya
Chubu Electric Power

Takamatsu
Shikoku Electric Power

TEPCO Holdings

11,500 employees

Renewable Power

TEPCO

Tokyo Electric Power Company Holdings

Decommissioning of Fukushima site

Nuclear Power

2,400 employees

TEPCO

TEPCO Fuel & Power
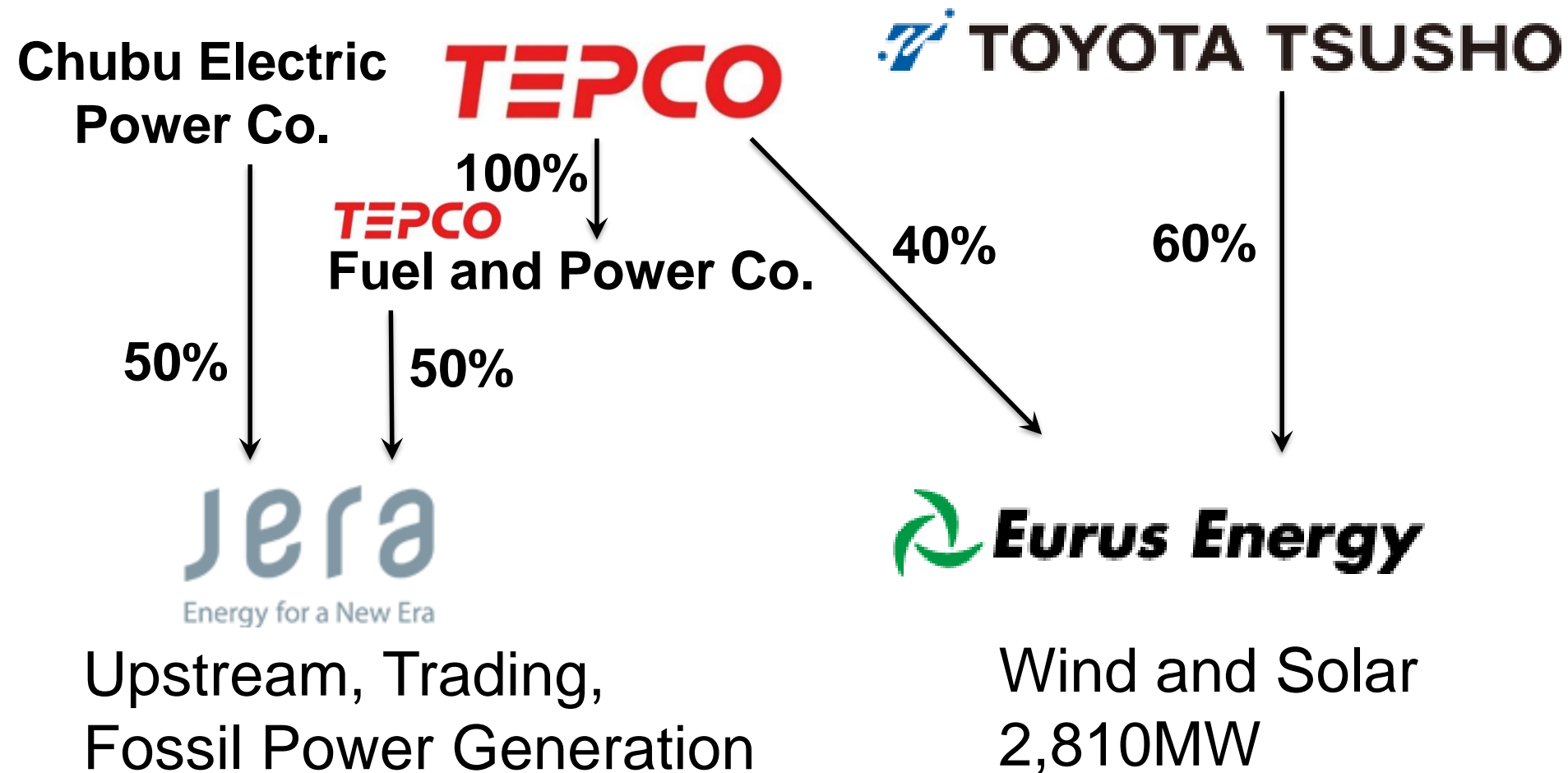
21,700 employees

TEPCO Power Grid

Regulated sector

3,200 employees

TEPCO

TEPCO Energy Partner

Global Expansion of Upstream and Generation Business with Partners

Chubu Electric Power Co.

TEPCO

TOYOTA TSUSHO

100%

TEPCO Fuel and Power Co.

40%

60%

50%

50%

Jera — Energy for a New Era

Eurus Energy

Upstream, Trading, Fossil Power Generation

Wind and Solar 2,810MW

Utility Transformation Driven by "5D's"

Utility 1.0 : Vertically Integrated Utility

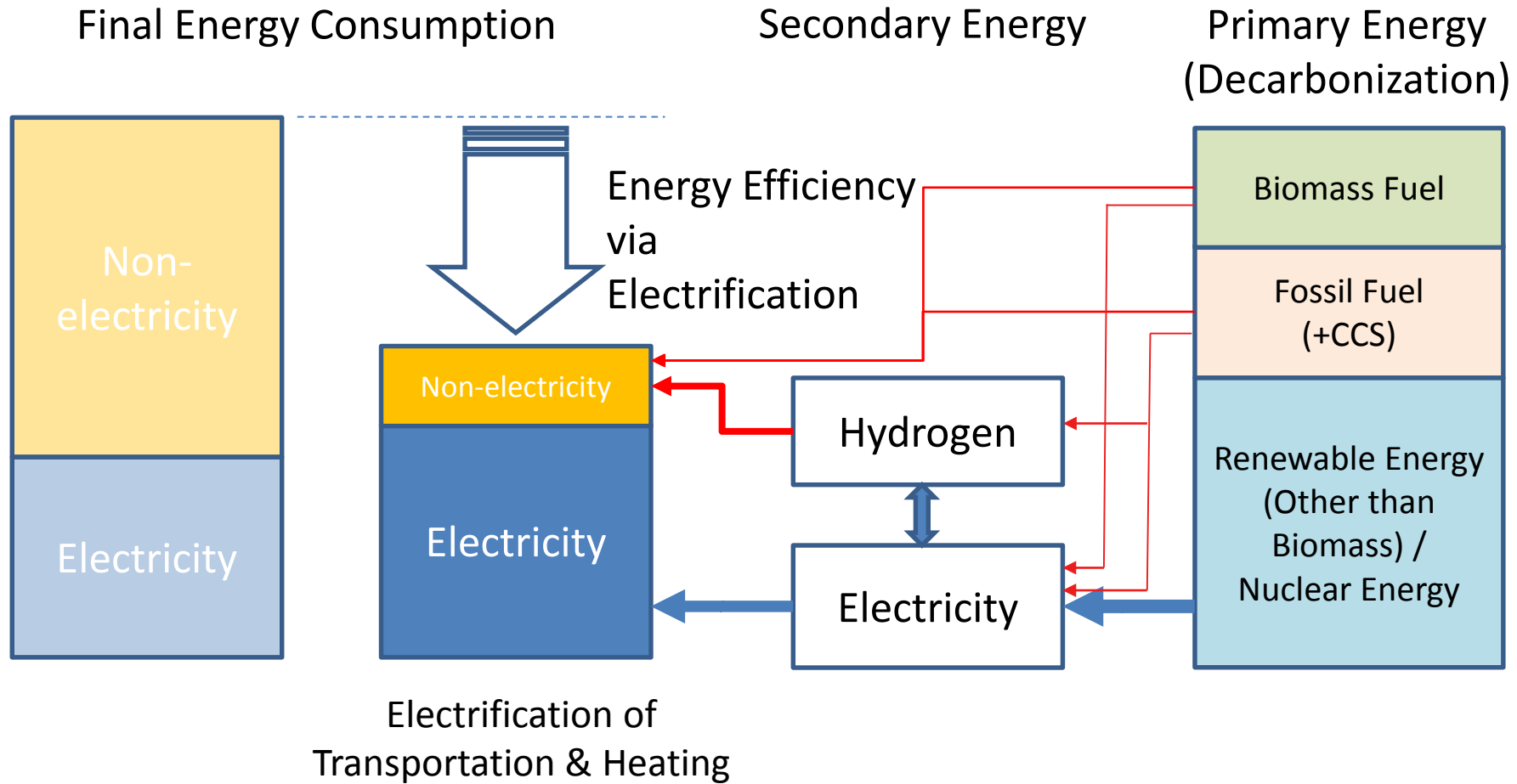**Deregulation**

Utility 2.0 : Unbundling of T&D Business

Decarbonization
Decentralization
Digitalization
Depopulation
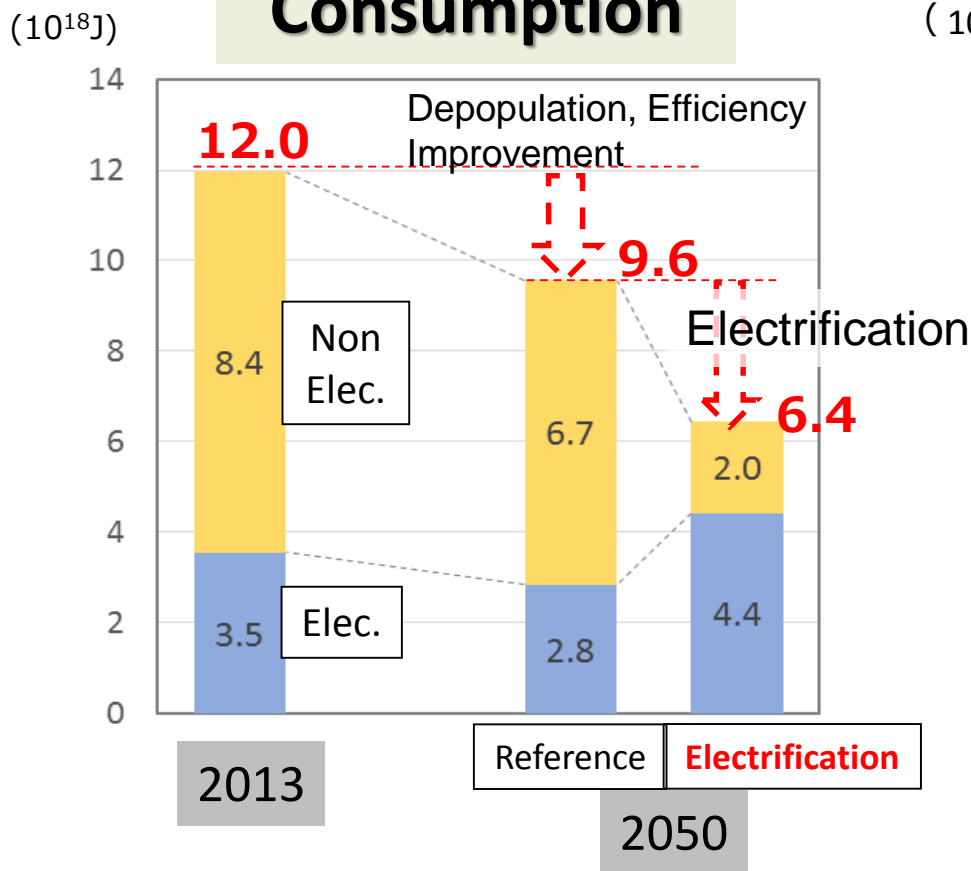
Utility 3.0 : Integration with Other Platforms

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Road to CO$_2$ Net Zero Emissions

Final Energy Consumption

Secondary Energy

Primary Energy (Decarbonization)

Non-electricity

Electricity

Energy Efficiency via Electrification

Non-electricity

Electricity

Electrification of Transportation & Heating

Hydrogen

Electricity

Biomass Fuel

Fossil Fuel (+CCS)

Renewable Energy (Other than Biomass) / Nuclear Energy

Electrification: Key to Decarbonization

Final Energy Consumption

$(10^{18}J)$

Depopulation, Efficiency Improvement

12.0

9.6

Electrification

6.4

Non Elec.

8.4

6.7

2.0

Elec.

3.5

2.8

4.4

2013

Reference | **Electrification**

2050

CO$_2$ Emissions

$(10^8 t\text{-}CO_2)$

12.4

Non Elec

6.9

6.6

CO$_2$ Emissions **▲72%**

Elec

5.5

5.5

3.5

1.8

1.1

1.7

2013

Reference | **Electrification**

2050
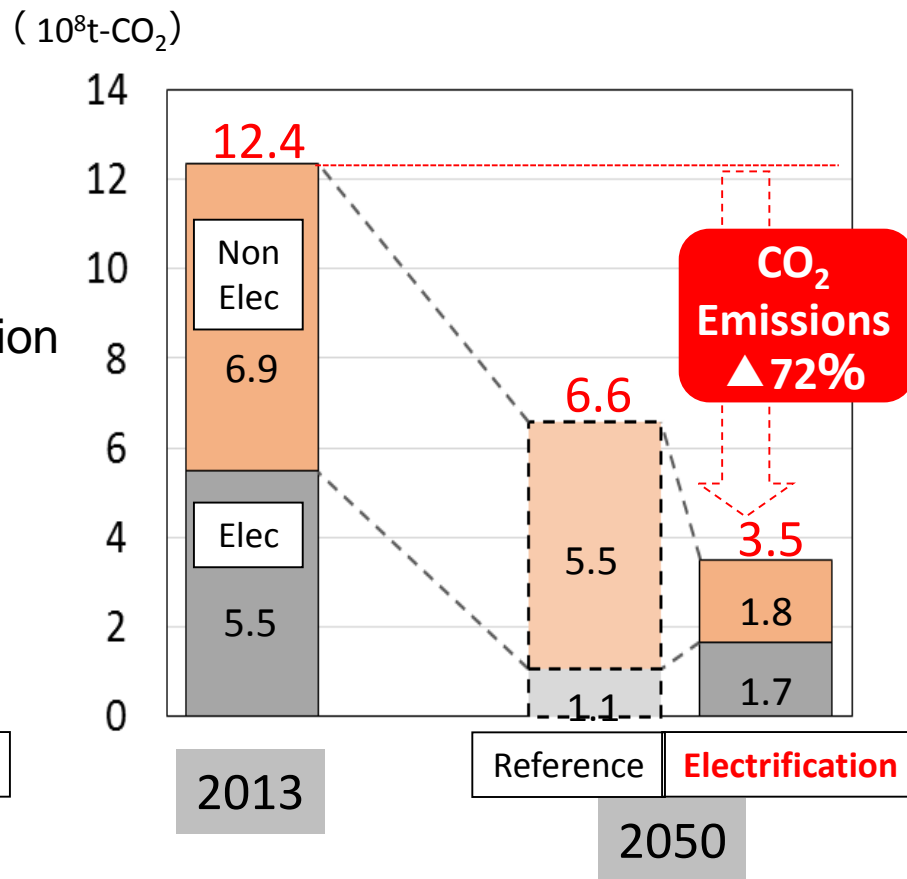
Source: TEPCO Research Institute

Decentralization with Electrification

Flexibility (ΔkW)

Capacity (kW)

Energy(kWh)

Flexibility (ΔkW)

Energy(kWh)

Capacity (kW)

Energy(kWh)

Flexibility (ΔkW)

Capacity (kW)
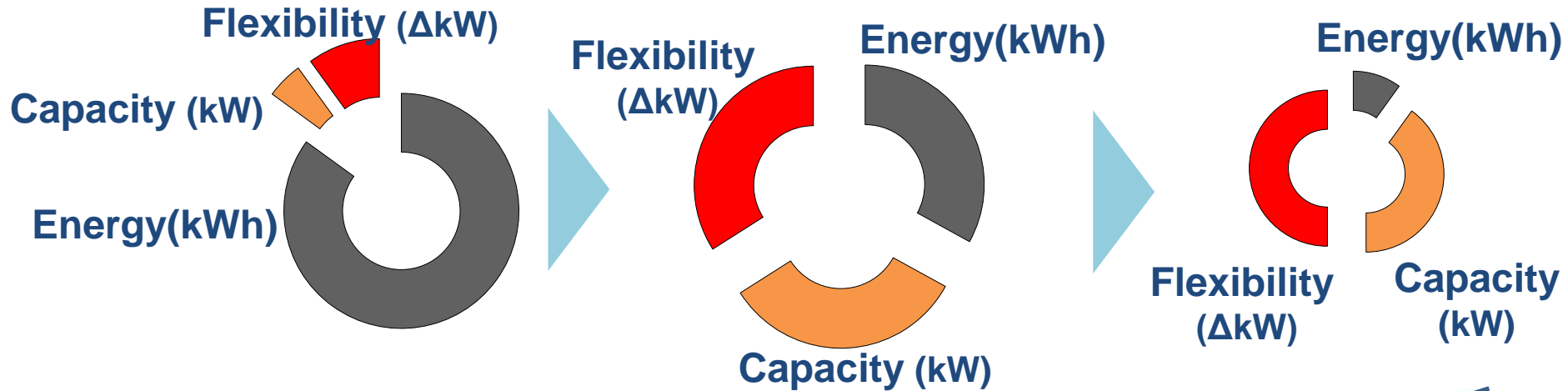
Electricity Consumption

Electrification

BER(Bulk Energy Resource)

DER

DER+Storage

2013 ➜ 2020 ➜ 2030 ➜ 2050
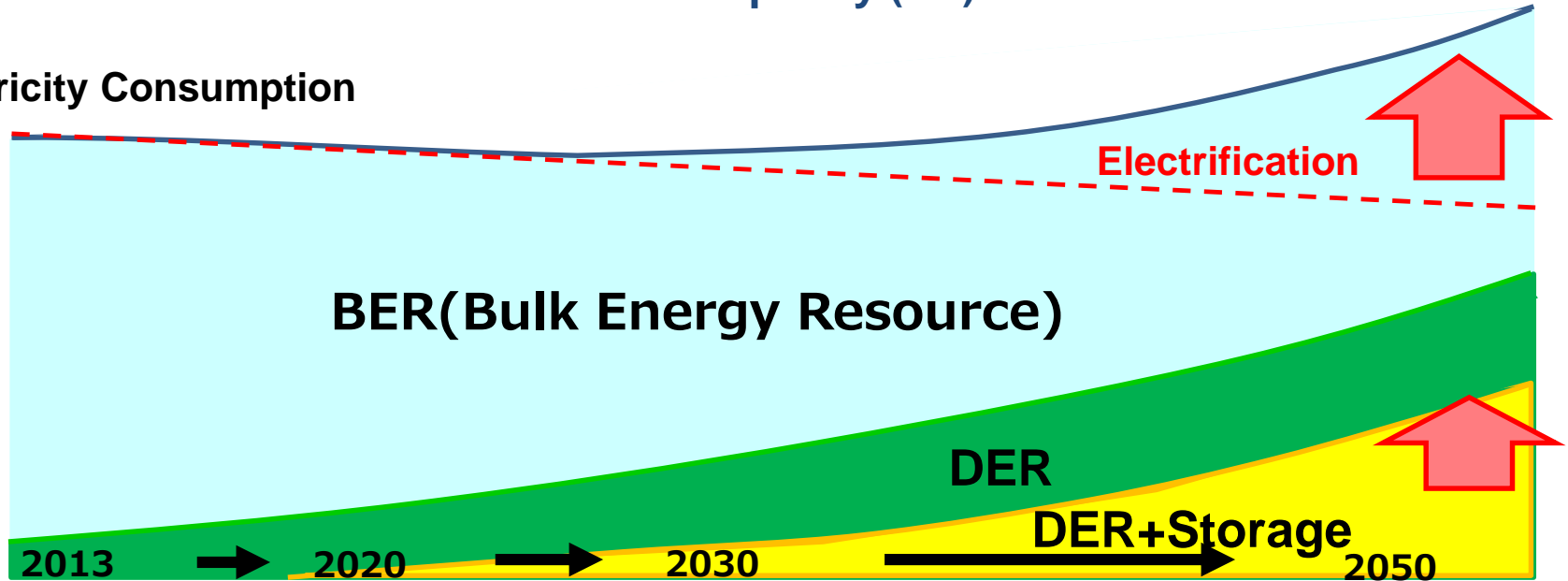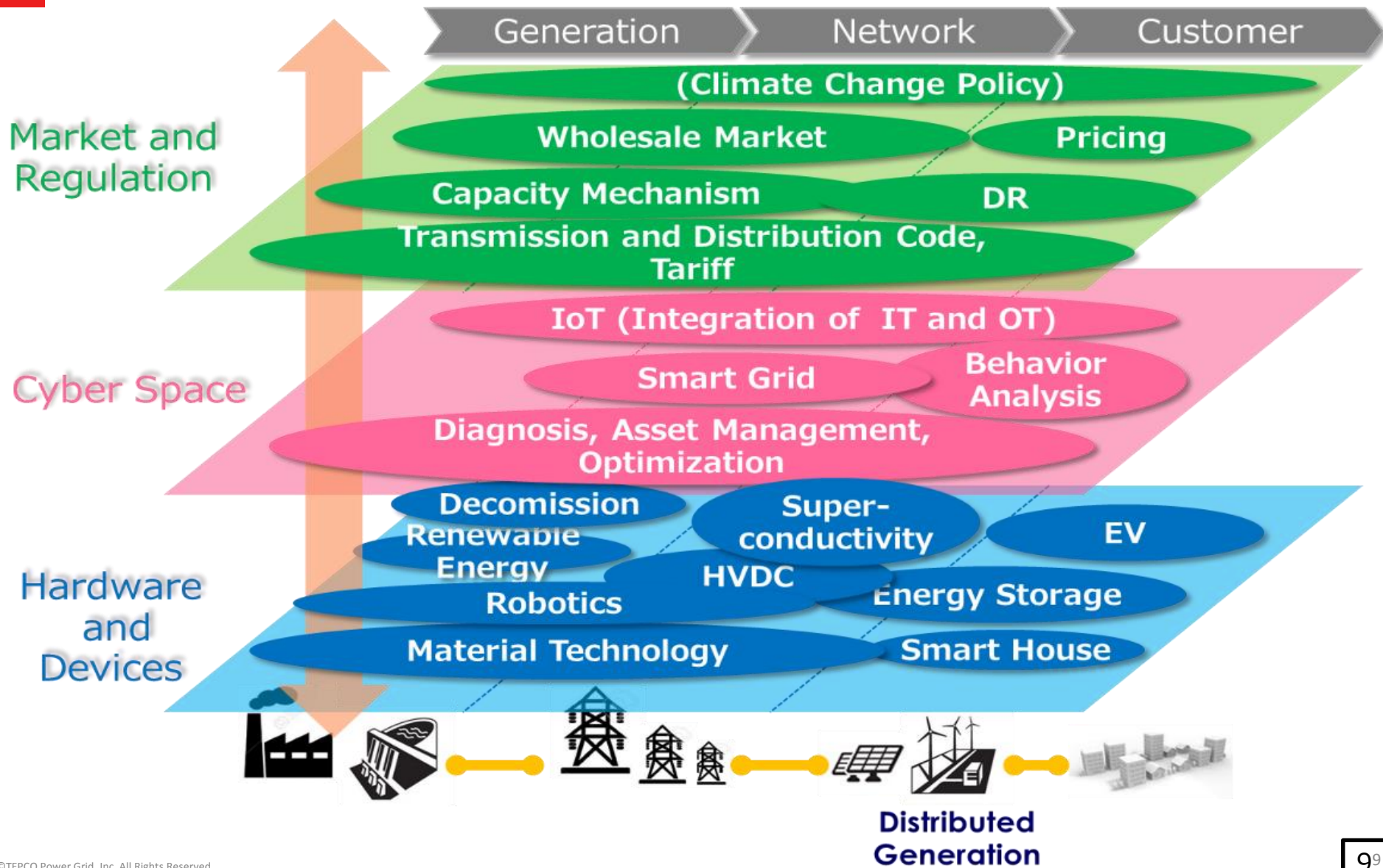
Source: TEPCO Research Institute

Utility 3.0
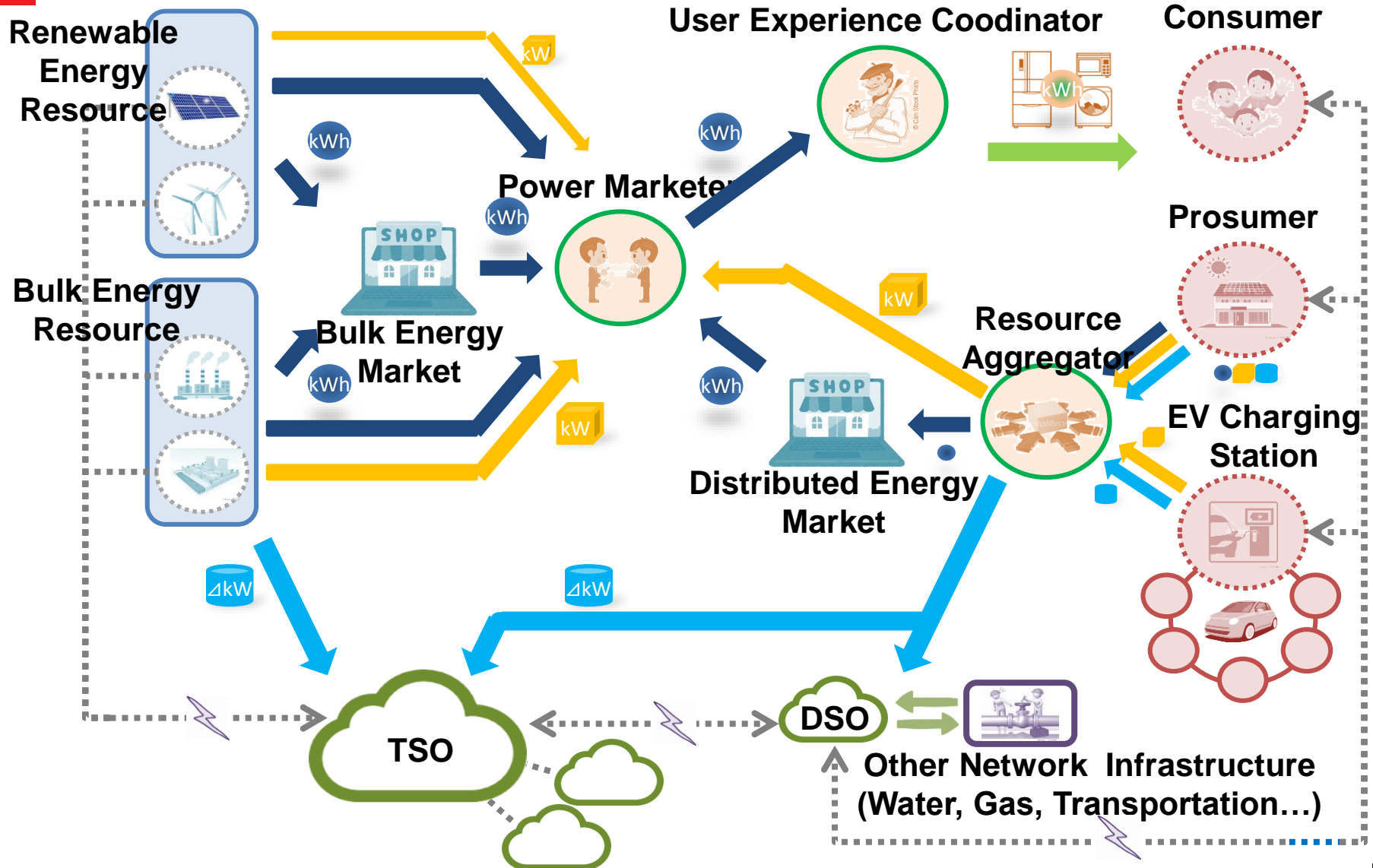
Towards a Digital Utility

Integration of Transportation and Power System

IT Network

Power Grid

G

G

Hub

Hub

Transportation Network with EV

EV

Storage

Storage

Charging /Discharging Station

Power Grid

DG

EV

DSO

Prosumer

DG

DS

Dynamic Locational Pricing

Device

Human

Device

GW

SP

Home Area Netowrk

G:Generator   DG:Distributed Generator   DS:Data Storage
SO:System Operator SP:Service Provider   GW:Gateway

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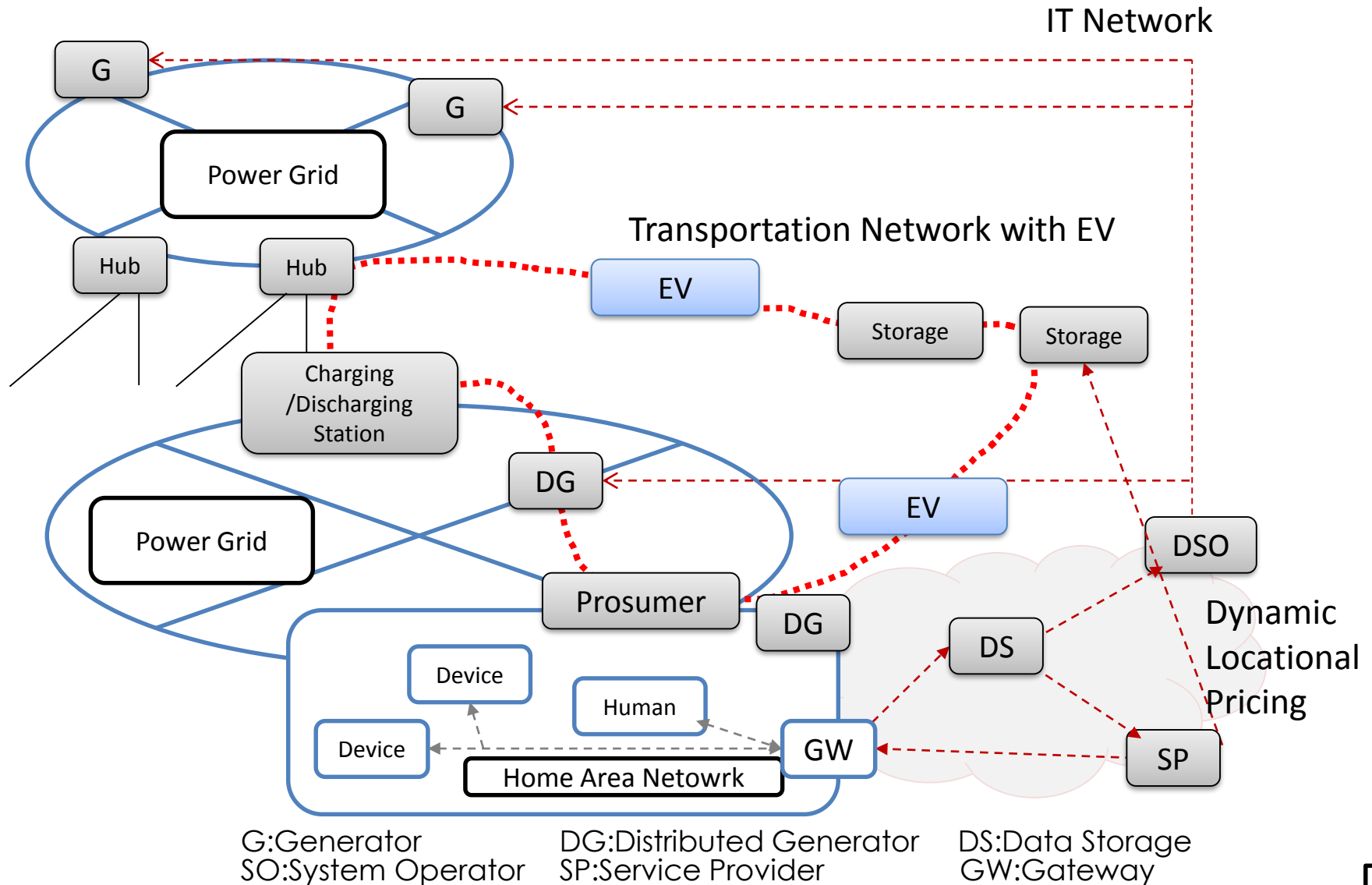
Distributed Energy Transaction

P2P Transaction Platform (e.g. blockchain)

Real World

Dynamic Pricing, Congestion

Digital Twin for Transportation Network and Power Grid

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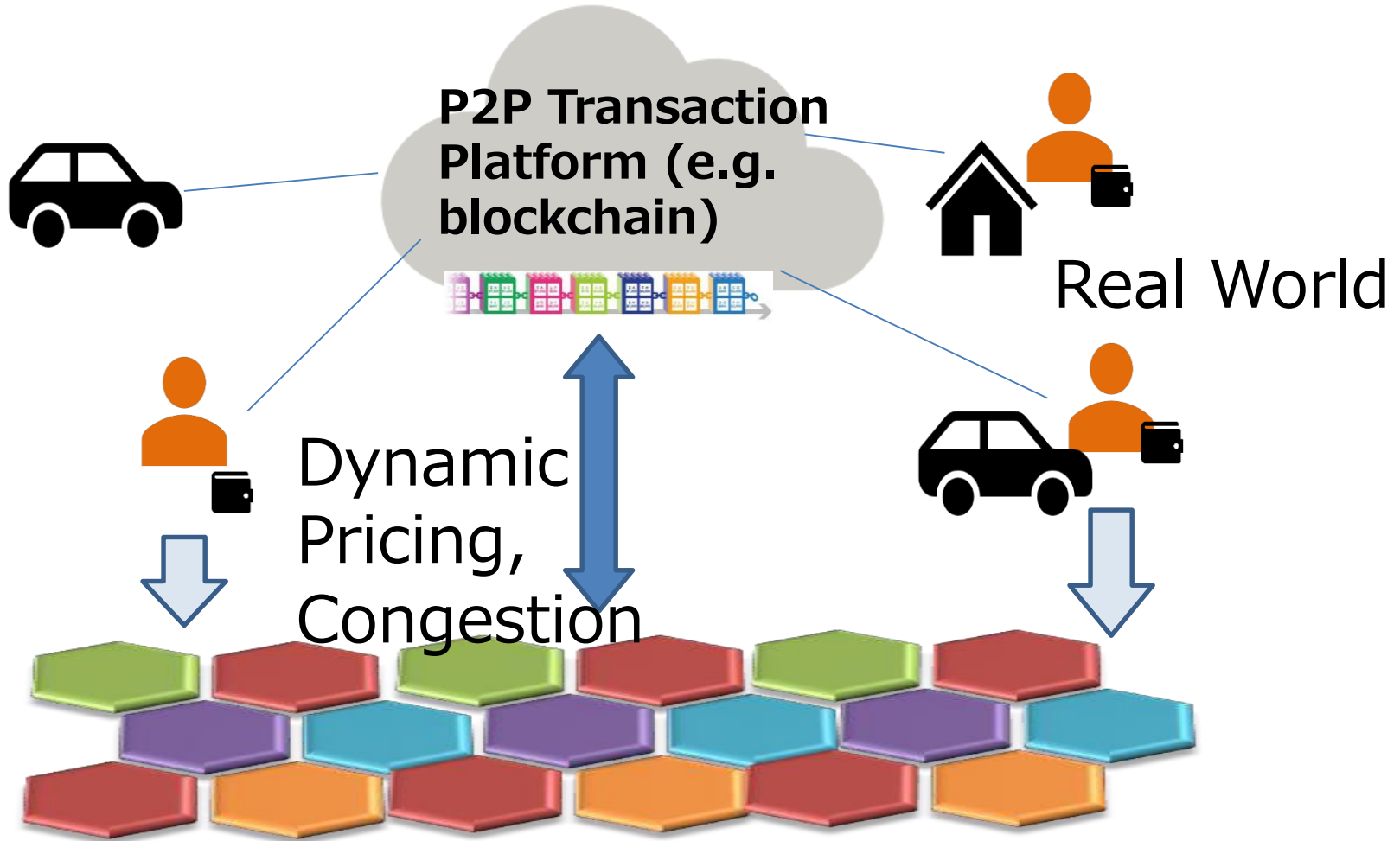
Role of Future Power System Platform of Utility 3.0

Energy and Market Management

DER and BER, Storage, Electrification of Heating and Transportation...

Integrated Network Infrastructure

IT, Transportation（EV/Drone）, Water, Gas/Hydrogen

Sensing, Measuring, Analytics, Billing...

Integrated Data Platform

Conclusions

- 5D's (deregulation, de-carbonization, decentralization, digitalization and depopulation) will be triggers for the transformation to Utility 3.0.

- Future power systems will play a key role in realizing Utility 3.0 as an integrated platform with other network infrastructures, energy & market management, and integrated data management.