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Heat Roadmap Japan: Smart energy system combining renewable energy and district energy to decarbonize urban area in Japan

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Hironao MATSUBARA,
Makoto TAJIMA, Tetsunari IIDA

Institute for Sustainable Energy Policies (ISEP)

<http://www.isep.or.jp/en>

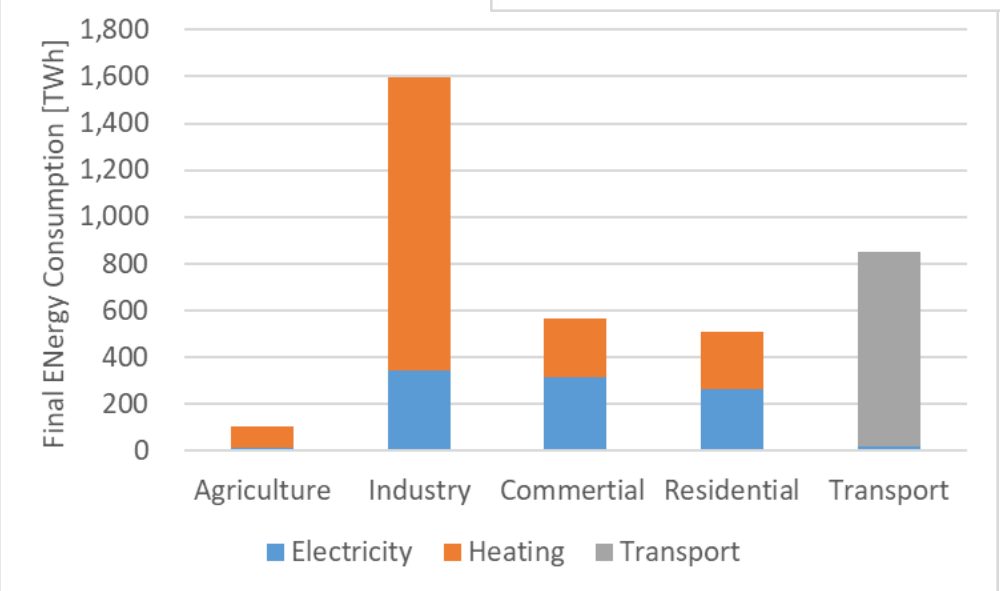
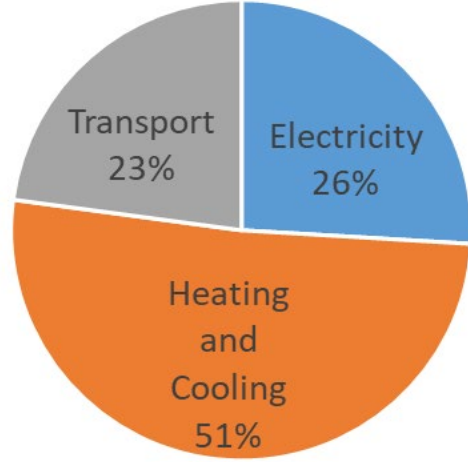
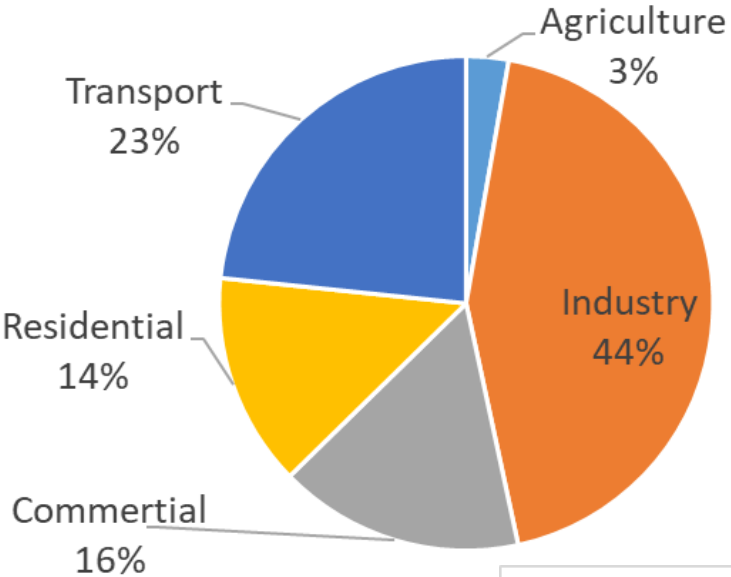


Heat Roadmap Japan: Smart energy system combining renewable energy and district energy to decarbonize urban area in Japan

- To address climate change and formulate effective energy policies in accordance with the Paris Agreement, Heat Roadmap Europe 2050 is an informative reference for decarbonization of heat sector and evolution of the 4th generation district heating.
- We plan to study different scenarios focusing on the urban areas of Japan to achieve 100% renewable energy by 2050 with smart energy systems and sector coupling.

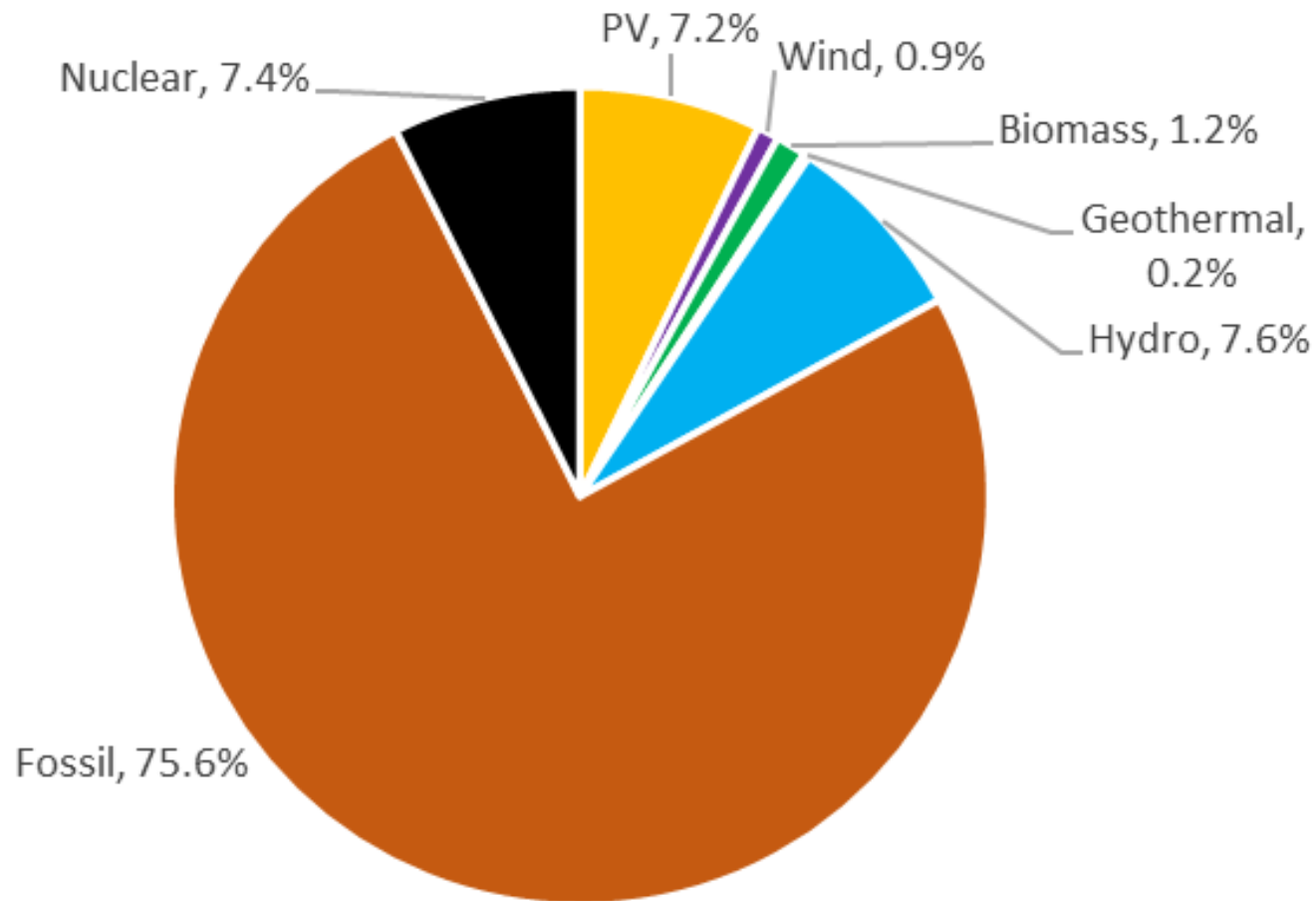
Total Energy Balance of Japan

Final Energy Consumption (FY2018)



Japan: net electricity generation mix supplying the grid in 2019

Share of renewable energy power generation of grid increased to 17.5% in 2019



Source: TSO's in Japan

EnergyPLAN model for electricity market of Japan

Reference(2019)

- Demand(Electricity): 885.5 TWh/y Open data of 10 TSO's in Japan
- Supply
 - Heat and Electricity: 1.7GWe(CHP Condensing Mode Operation) Biomass
 - Central Power Production: 200GW(PP2:Fossil Power Plant)
9GW(Nuclear) 0.3GW(Geothermal) 14GW(Hydro) Open data of 10 TSO's in Japan
No transmission line capacity
 - Variable Renewable Electricity: 3GW(Wind) 40GW(PV) Open data of 10 TSO's in Japan
- Balancing and Storage(Electricity)
 - Minimum grid stabilisaion share: 0.3
 - Minimum CHP: 1.7GWe
 - Electricity Storage 1(Pumped Hydro): 24GW(240GWh)
 - Electricity Storage 2(Battery, etc.): 0GW

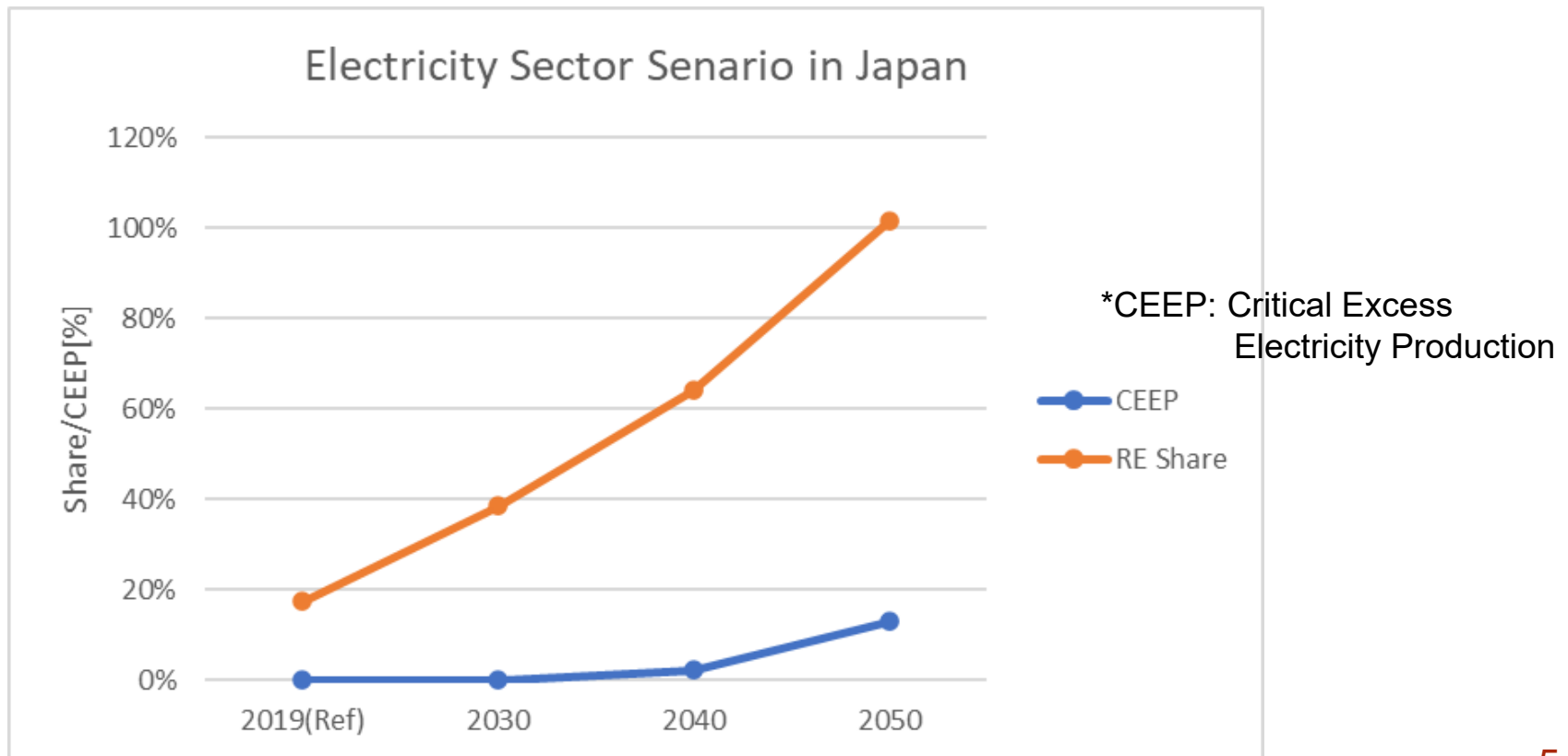


Scenario(2030,2040,2050)

- Demand(Electricity): Fix to 2019 level
- Central Power Production: zero Nuclear, Increase Geothermal and Biomass gradually
- Variable Renewable Electricity: Increase PV and Wind dramatically
- Minimum grid stabilisaion share: 0.0
- Electricity Storage: Increase Battery dramatically

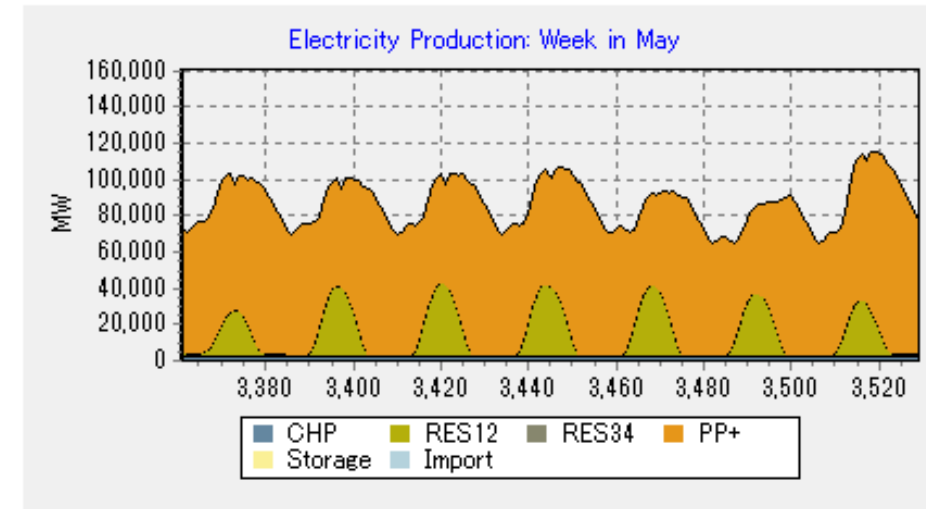
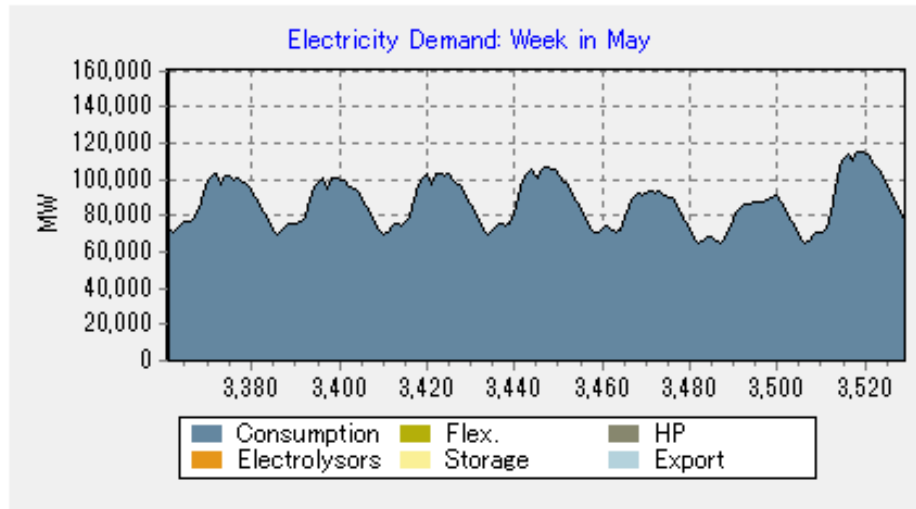
Japan: 100% RE Electricity sector simulation

	RE	VRE	PV	Wind	Geo	Bio	Nuclear	Storage	CO2[Mt]	CEEP
2019	17.5%	8.0%	40GW	3GW	0.3GW	1.7GW	9GW	240GWh	385	0.0%
2030	38.6%	27.3%	100GW	30GW	1GW	3GW	0GW	480GWh	315	0.0%
2040	64.1%	49.3%	170GW	60GW	3GW	6GW	0GW	720GWh	197	2.3%
2050	101.4%	84.6%	260GW	120GW	5GW	10GW	0GW	960GWh	69	13.0%

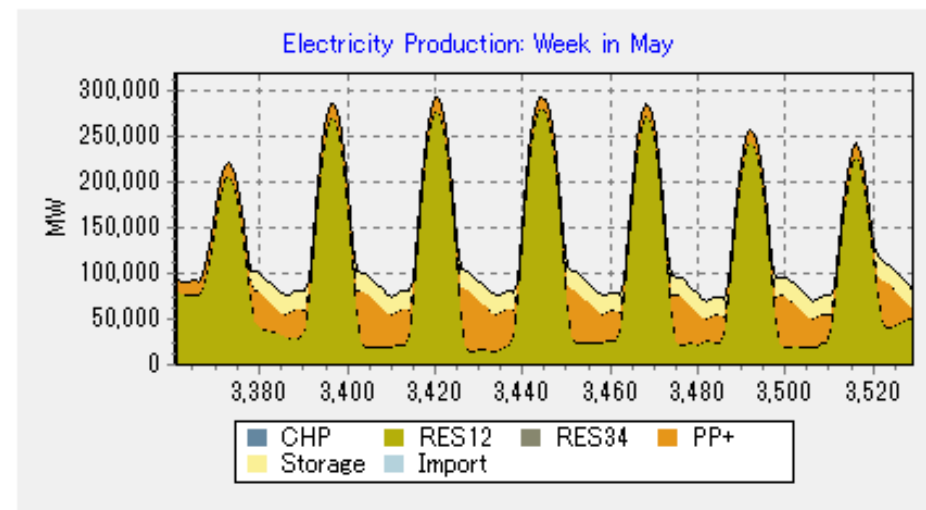
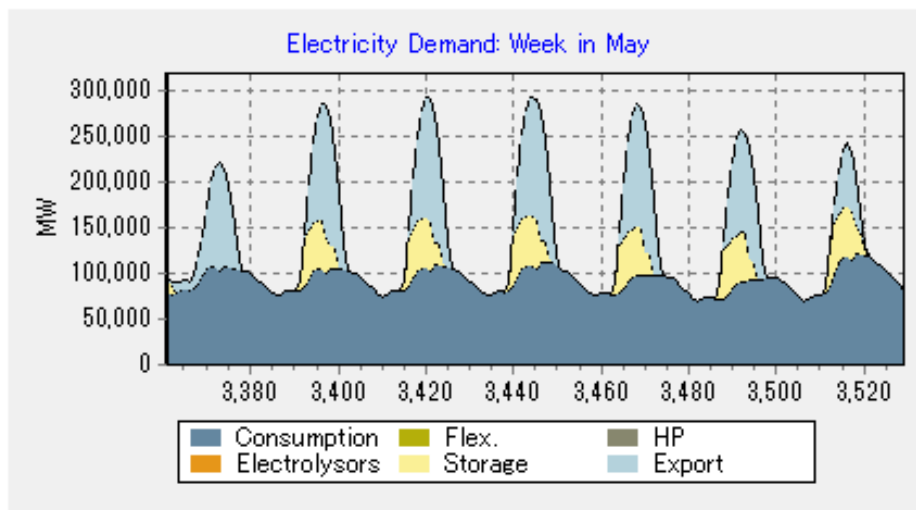


Japan's 100% RE Electricity sector simulation: Electricity demand & production

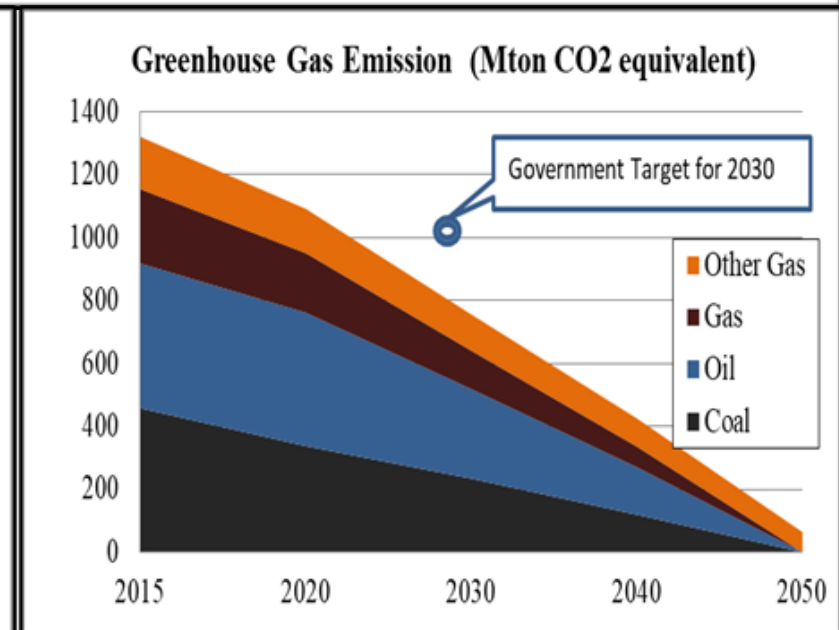
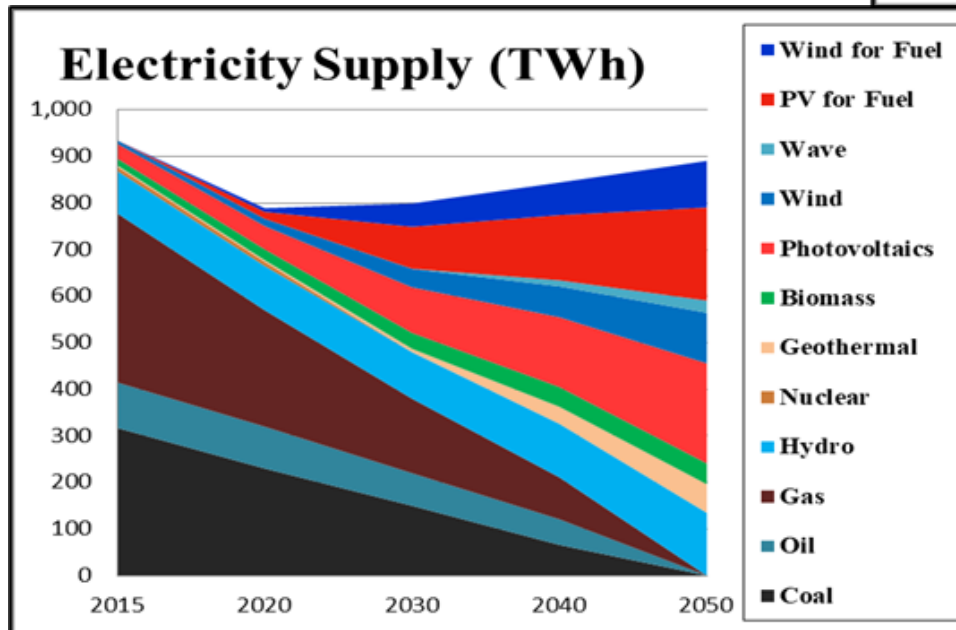
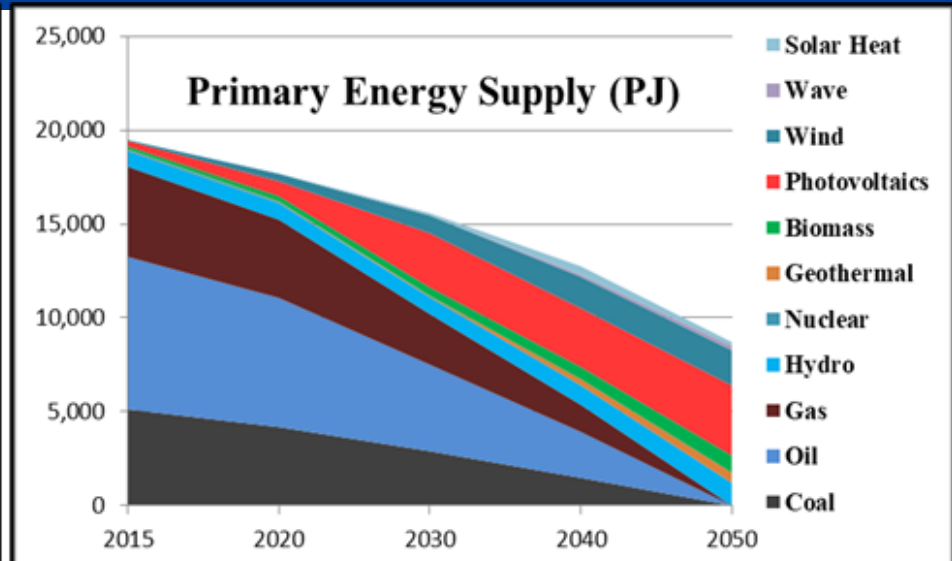
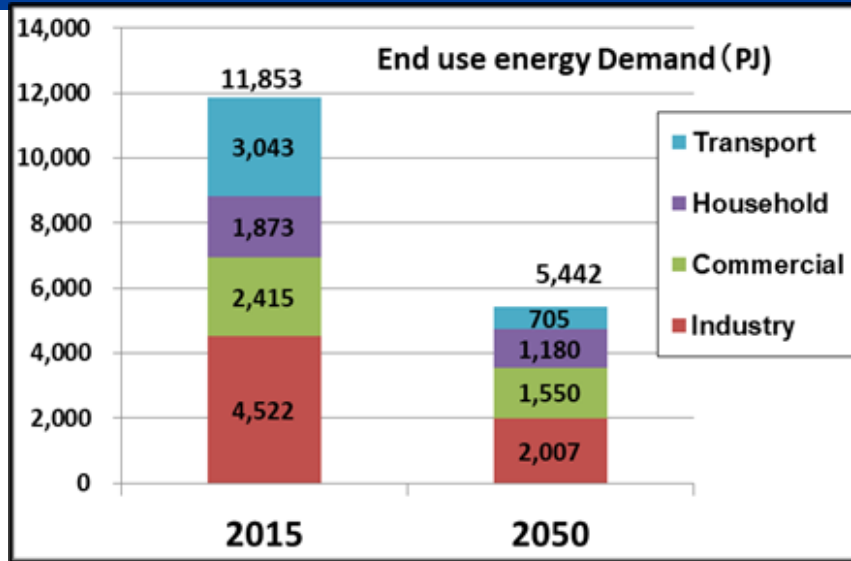
2019



2050



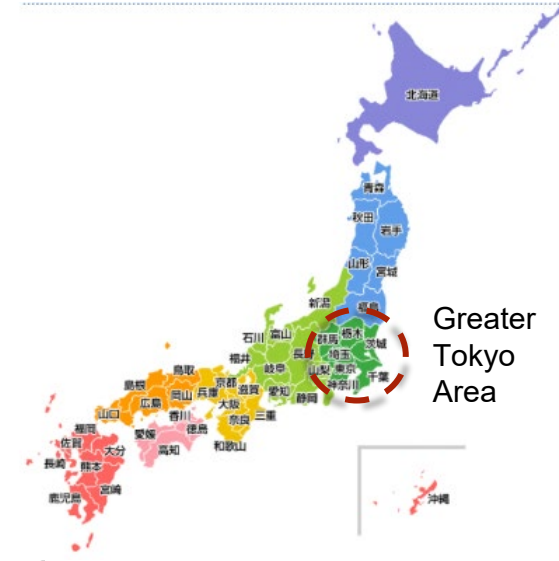
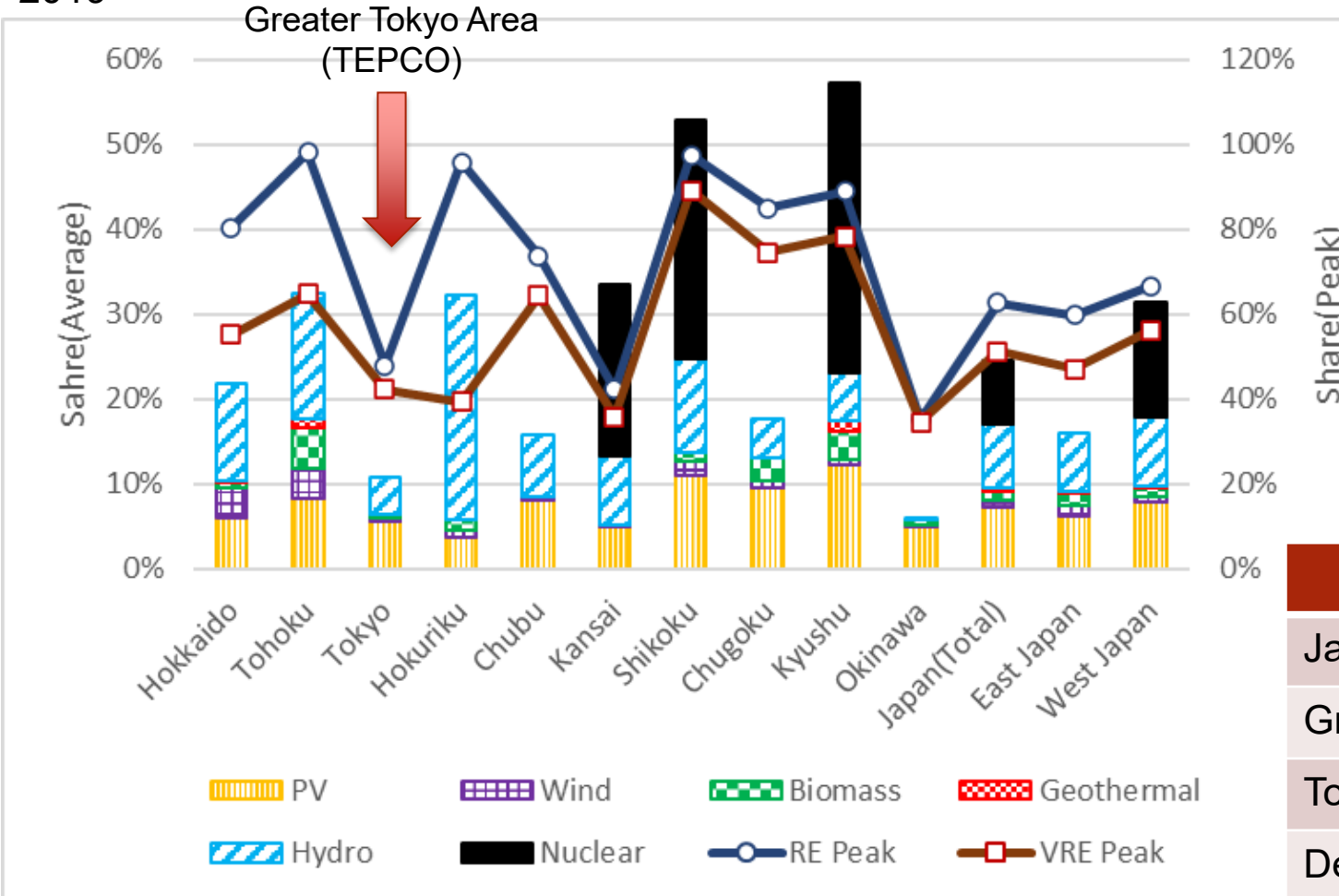
Example of 100% Renewable Energy Scenario 2050 for Japan



Source: JUST(2017) <http://justclimate.jp/en>

Share of renewable electricity and VRE supplying the grid in Japan(2019)

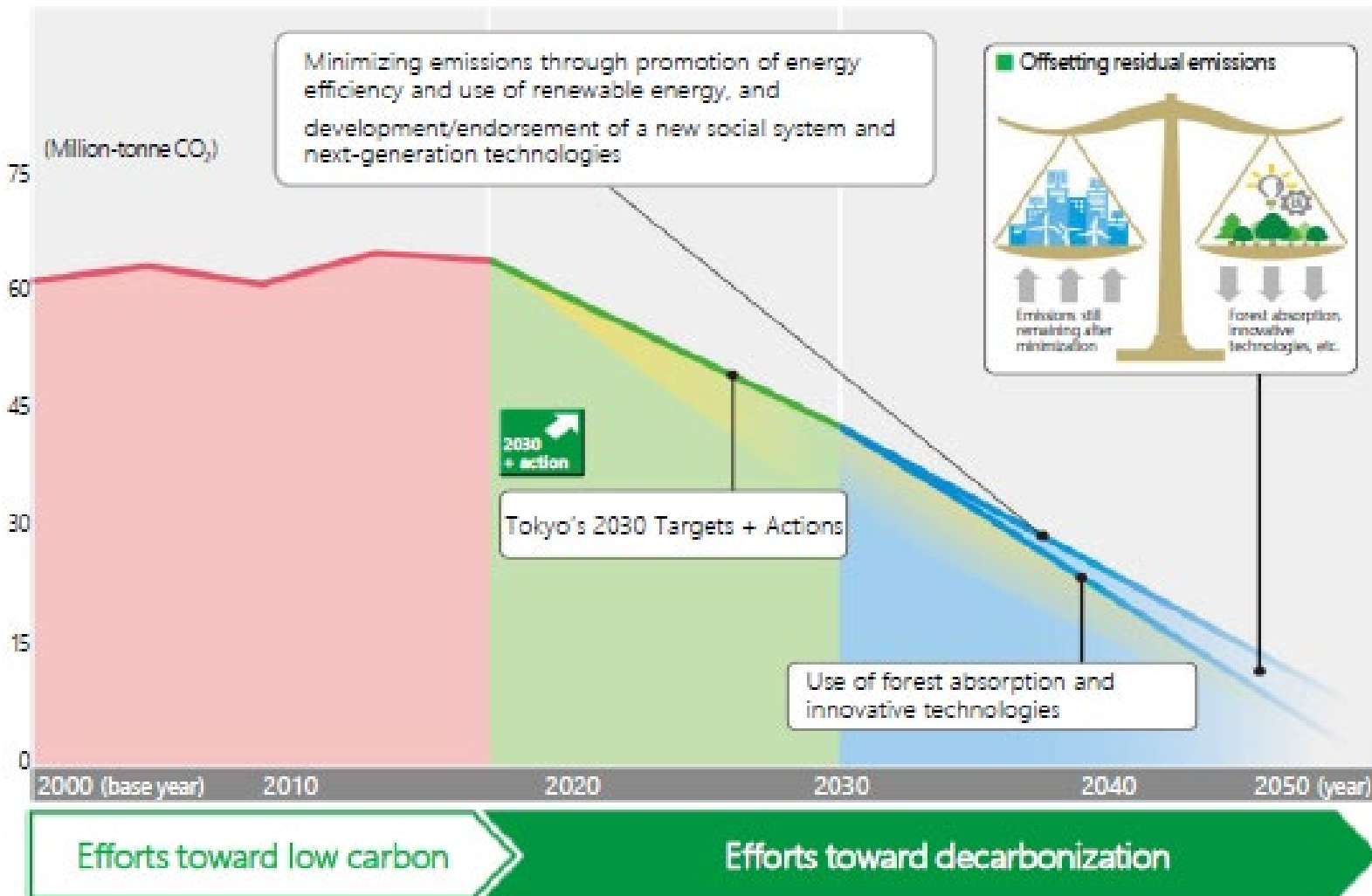
2019



	Population
Japan	126 mil.
Greater Tokyo	38 mil.
Tokyo	14 mil.
Denmark	6 mil.
Copenhagen	0.6 mil.

Source: each TSO data in Japan

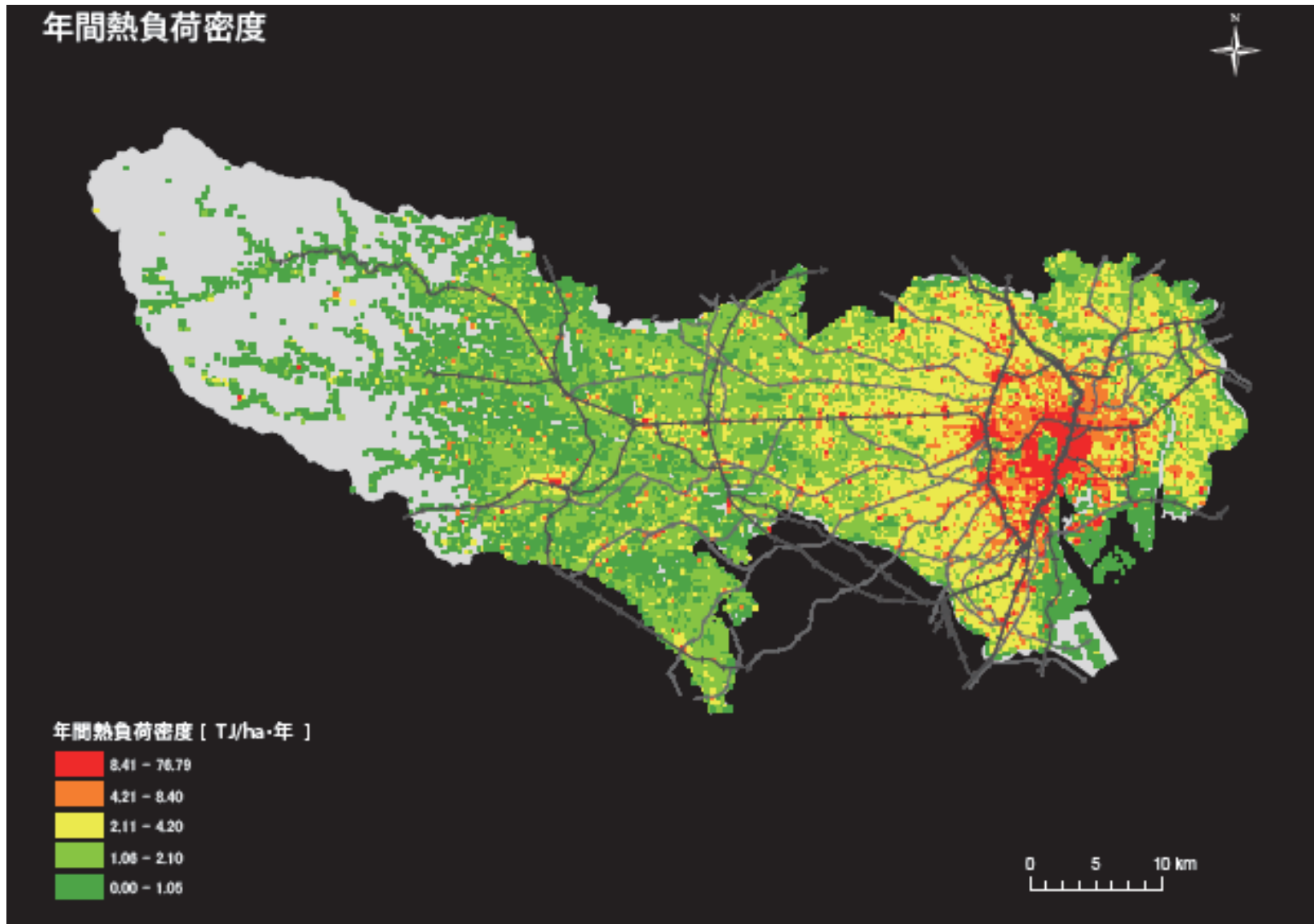
Zero Emission Tokyo Strategy by local government Roadmap for CO2 emissions reductions by 2050



Source: Tokyo Metropolitan Government

https://www.kankyo.metro.tokyo.lg.jp/en/about_us/zero_emission_tokyo/strategy.html

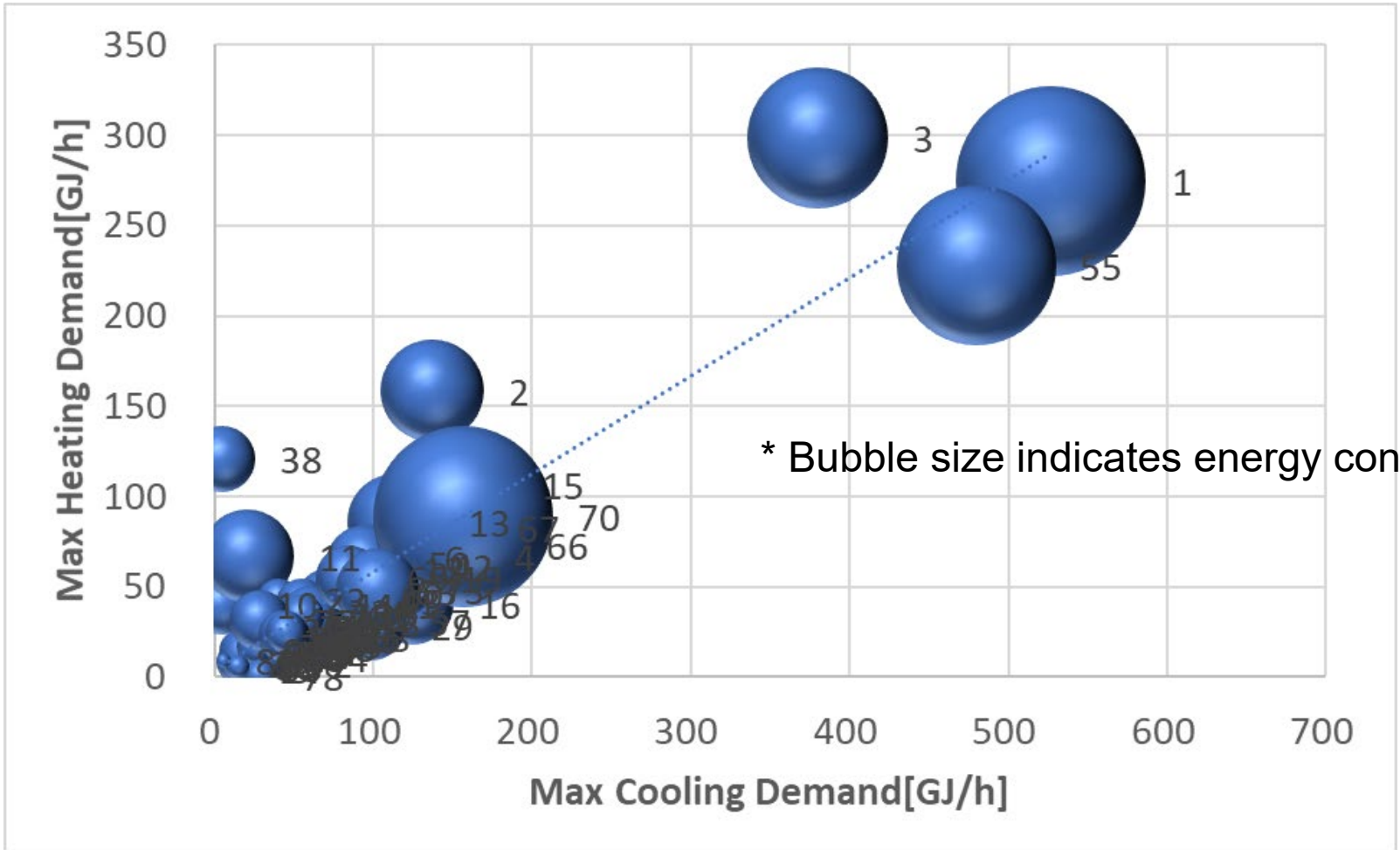
Heat Map of Tokyo Metropolitan Area



Source: Tokyo Metropolitan Government

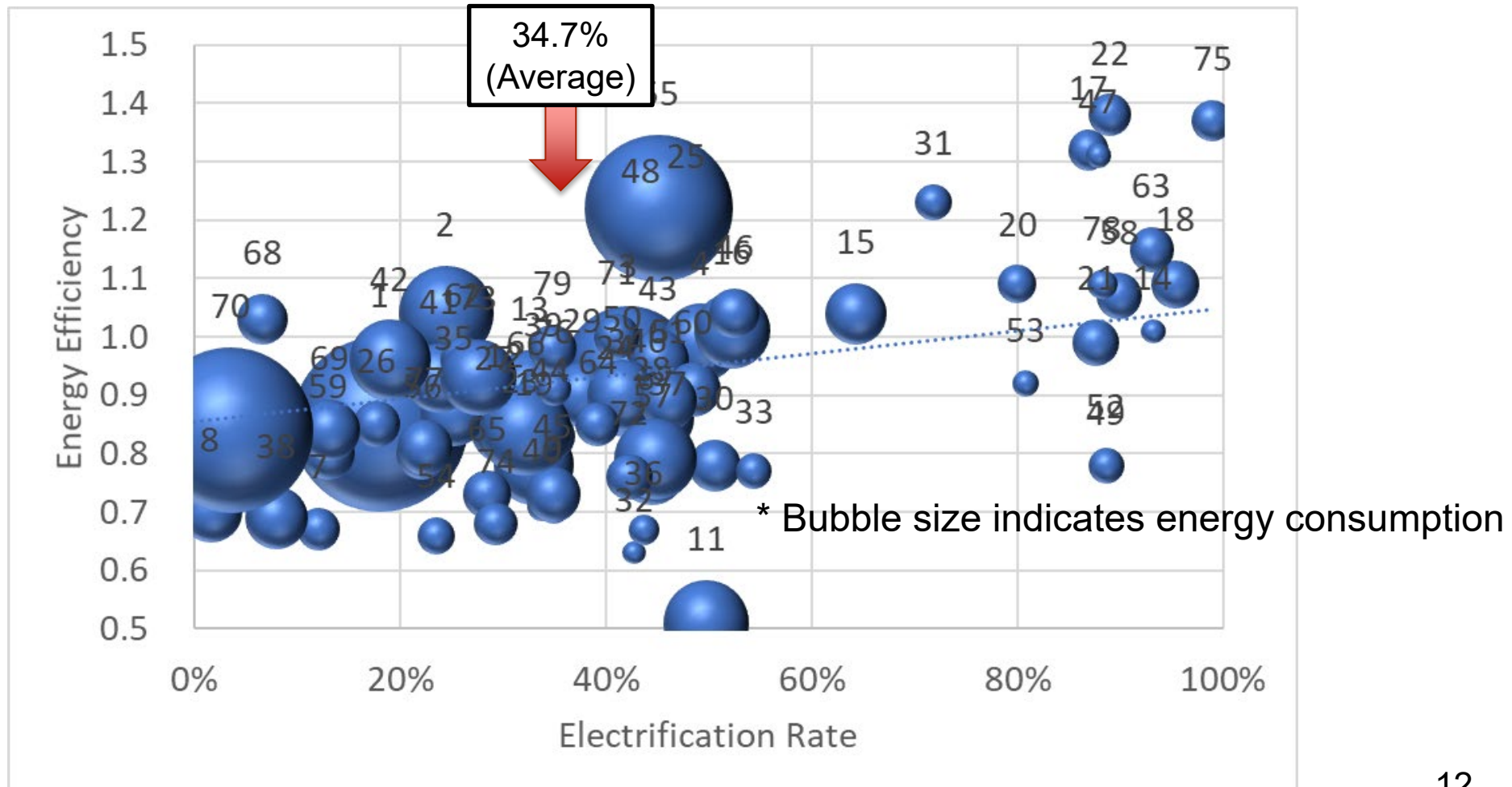
Demand of District Heating and Cooling in Tokyo(FY2018)

- Total heat supply of DHC systems was 3.8TWh (FY2018) which corresponds about 10% of heat consumption of commercial sector in Tokyo
- Cooling demand is two times larger than heating demand of DHC plant in Tokyo

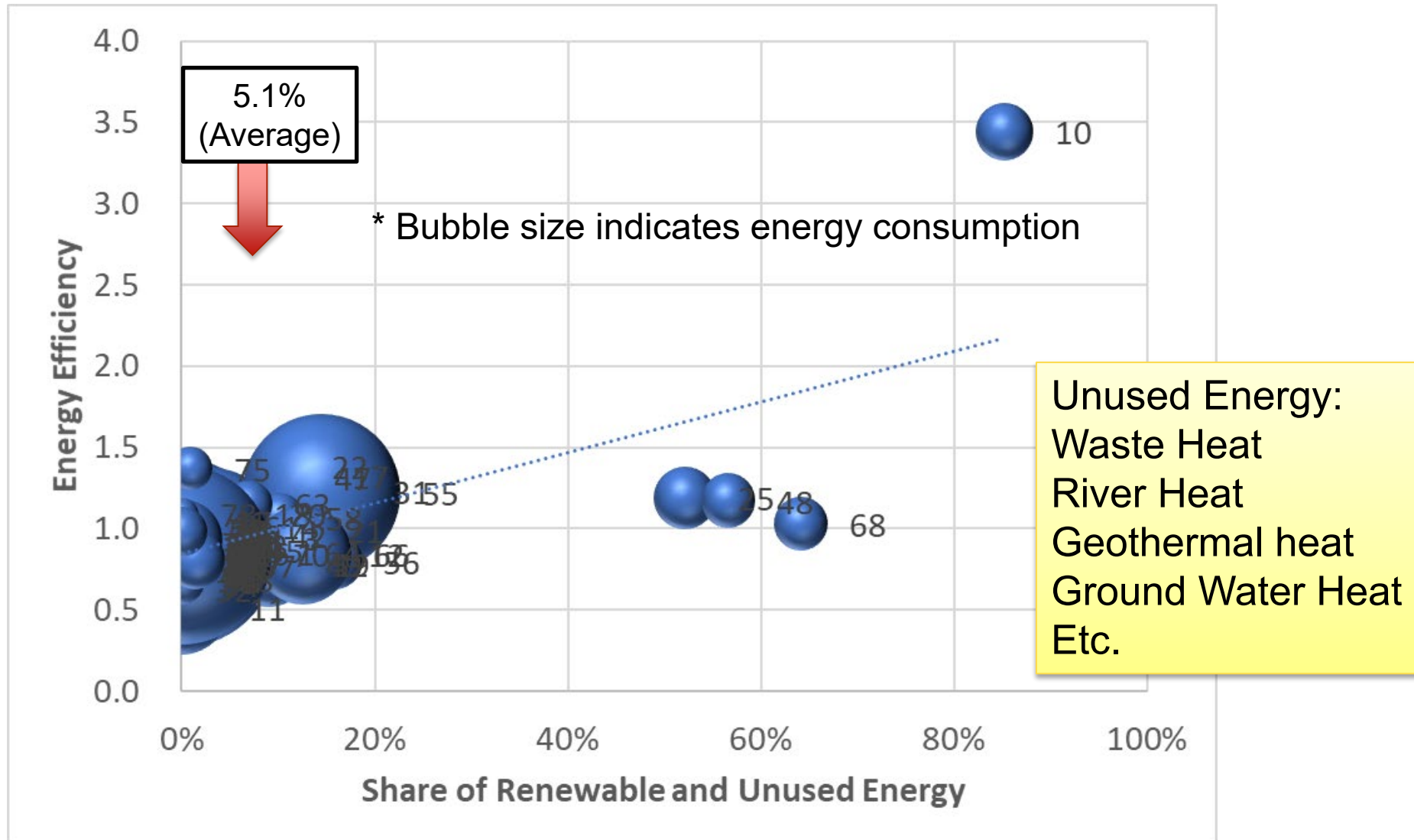


Energy Efficiency of District Heating and Cooling in Tokyo(FY2018)

- Average of Electrification rate is 34.7%. Share of renewable energy is about 5%

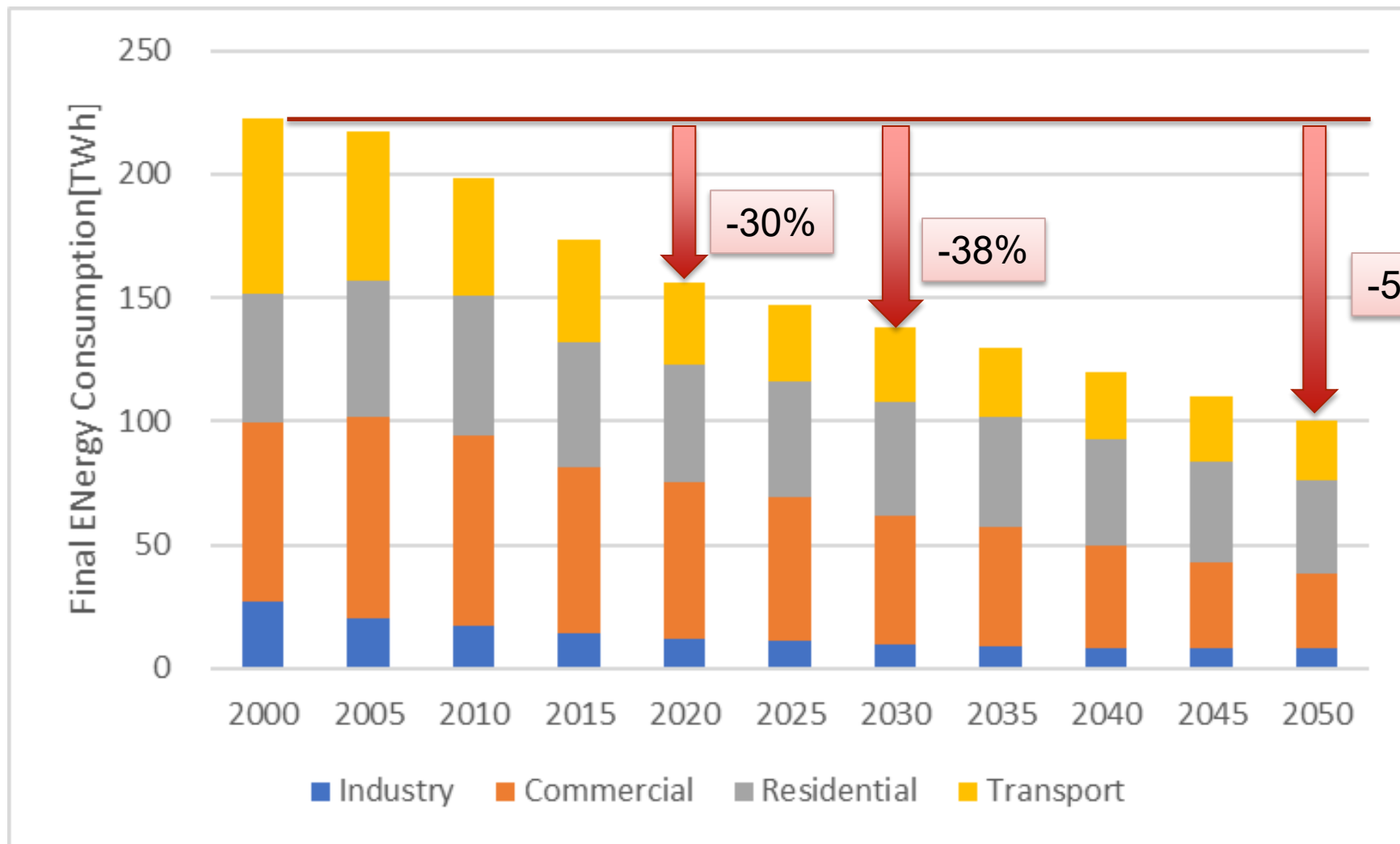


Share of Renewable and Unused energy of District Heating and Cooling in Tokyo(FY2018)



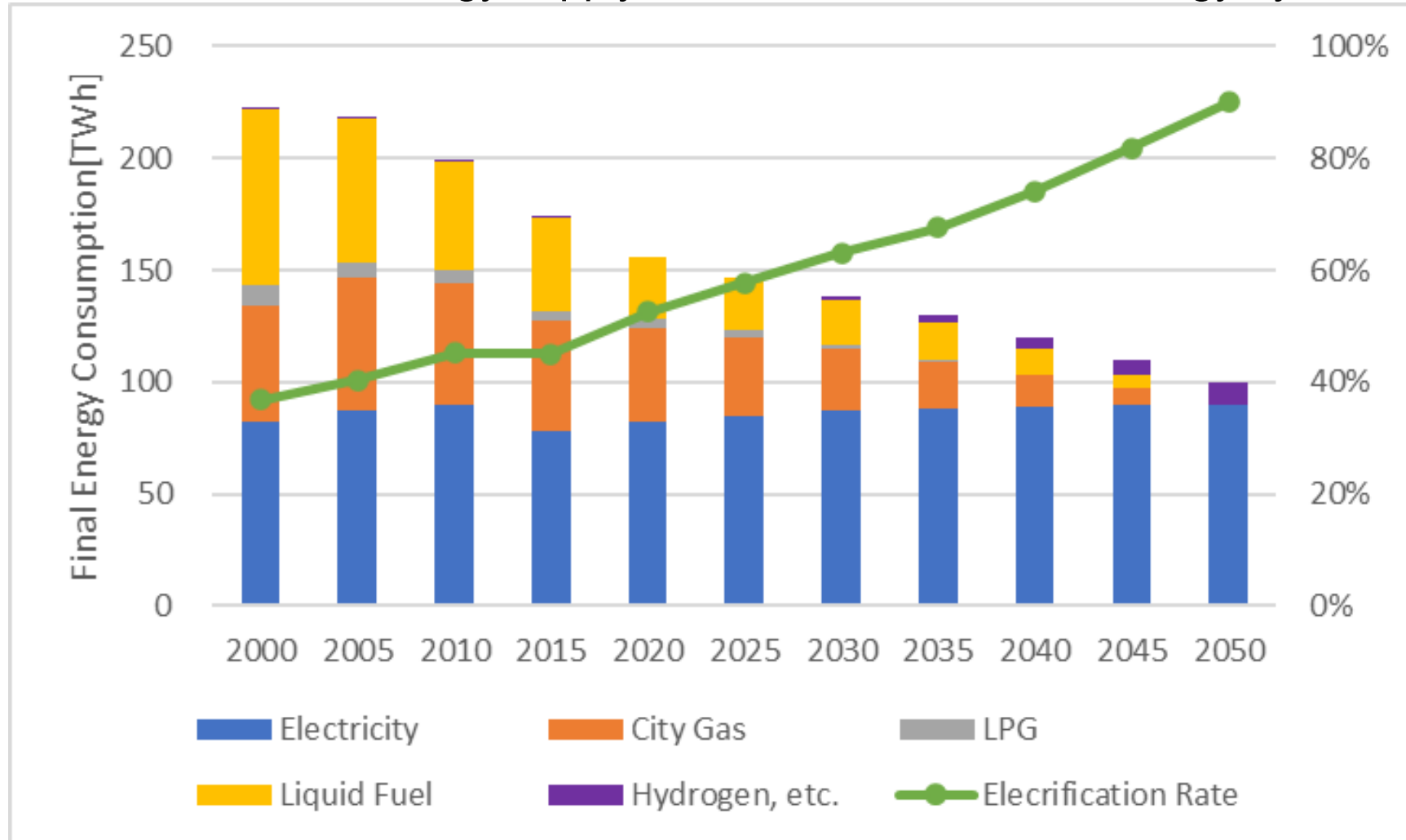
Energy Scenario by 2050 for Tokyo Metropolitan Area

- 30% reduction of final energy consumption by 2020, 38% reduction by 2030 and 50% reduction by 2050 compared with 2000



Energy Scenario by 2050 for Tokyo Metropolitan Area

- In this scenario, Electrification Rate will increase to 90% by 2050 compared with about 50% in 2020
- All sources of the energy supply will become renewable energy by 2050



Concluding Remarks

- EnergyPLAN models is adopted to assess the feasibility of energy transition through decarbonization in the domestic electricity market. This model will be adopted for heat and transportation sector.
- The model incorporates the present situation and potential of district heating system in urban areas in Japan, and the possibility of decarbonization of heat sector by renewable energy and energy efficiency.
- Both locally and regionally available renewable energy resources should be utilized for district energy system in the urban area of Japan.
- The model will be optimized for energy efficiency through comprehensive use of unused heat resources such as exhaust heat, geothermal, and sector coupling with electricity market according to regional characteristics.
- We will study a heat roadmap of the urban area including Tokyo Metropolitan with a smart energy system for district energy.

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Thank you !

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