

*4th International Conference on
Smart Energy Systems and 4th Generation District Heating
13-14 November 2018 · Aalborg University · Aalborg, Denmark*



Analysis of regional heat demand and renewable supply to introduce 4DH into Japan

Nov. 13th, 2018

Hironao Matsubara, Tetsunari Iida,

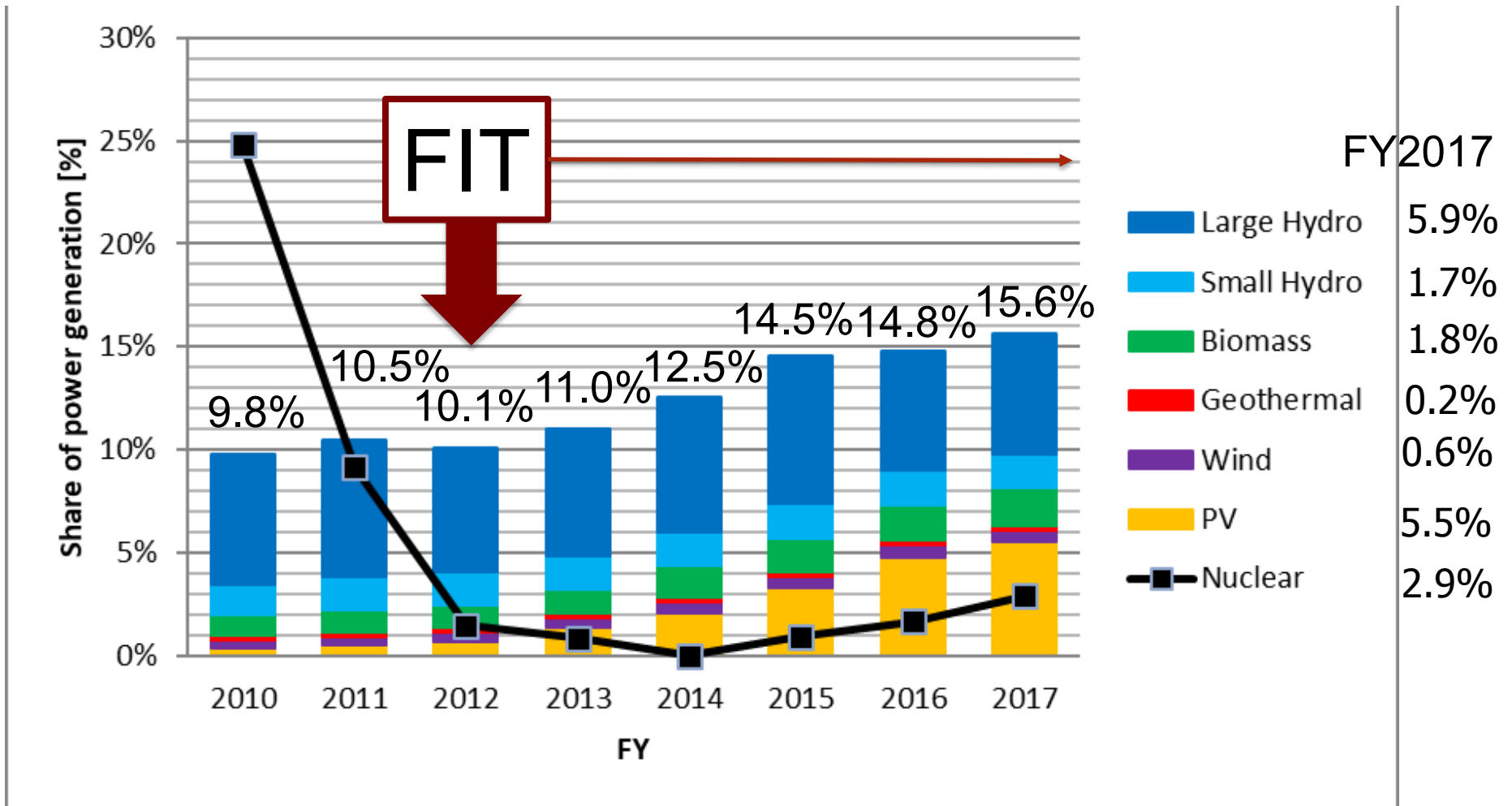
Institute for Sustainable Energy Policies, Tokyo, Japan

Outline

- Introduction
 - Renewable electricity supply share in Japan
 - District heating, electricity and gas Market
- Renewable heat supply in the regional level
- Residential and commercial heat consumption in the regional level
- Feasibility studies for 4DH into Japan
- Launching Japan 4DH forum

Renewable Electricity Supply in Japan

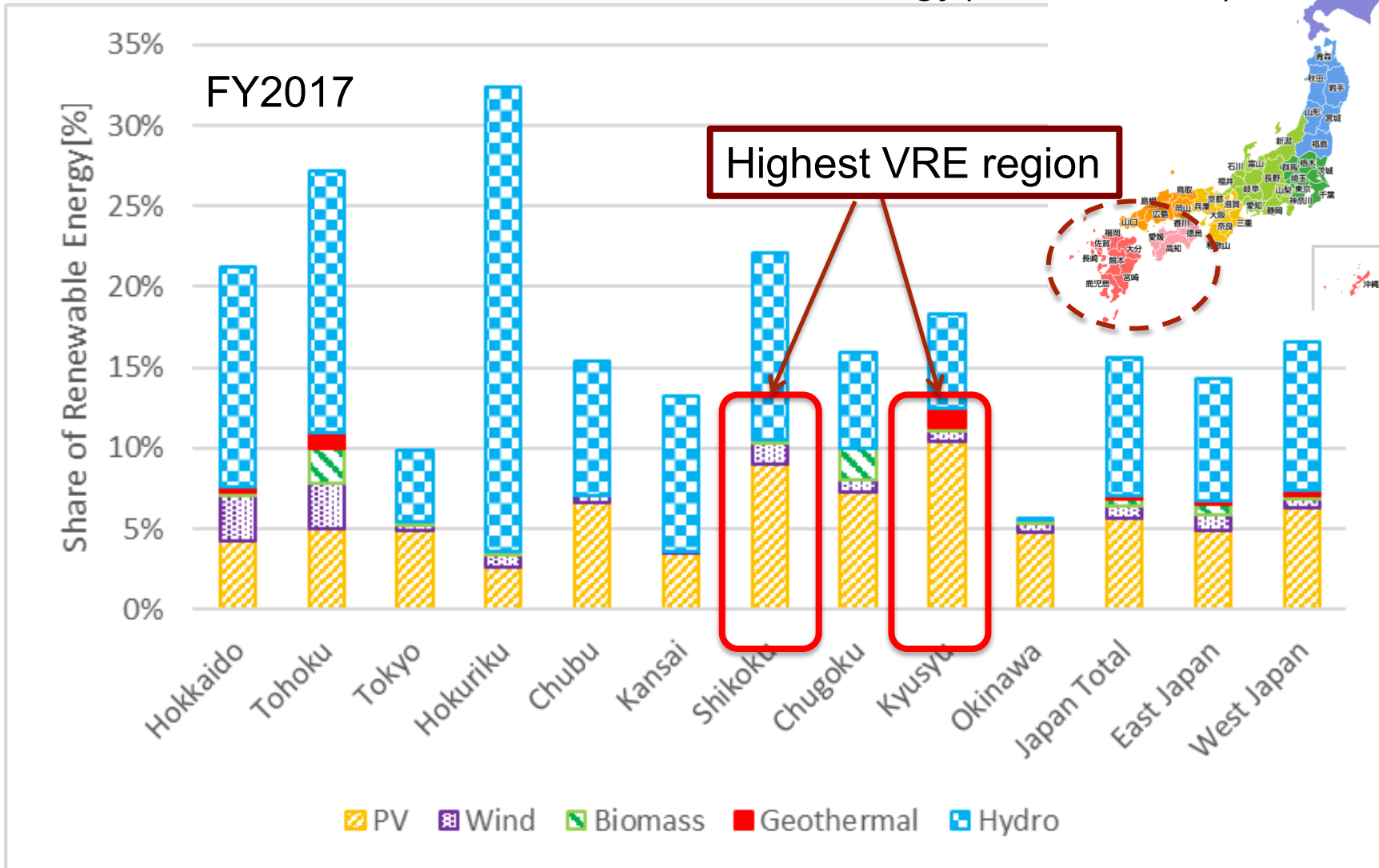
- Share of renewable energy power generation increased to 15.6% in FY2017
- In FY2017, share of solar PV. Increased more than 10 times compared with FY2010



Source: METI, ISEP(Renewables Japan Status Report)

Share of renewable electricity and VRE in each area

※VRE: Variable Renewable Energy(PV and Wind)

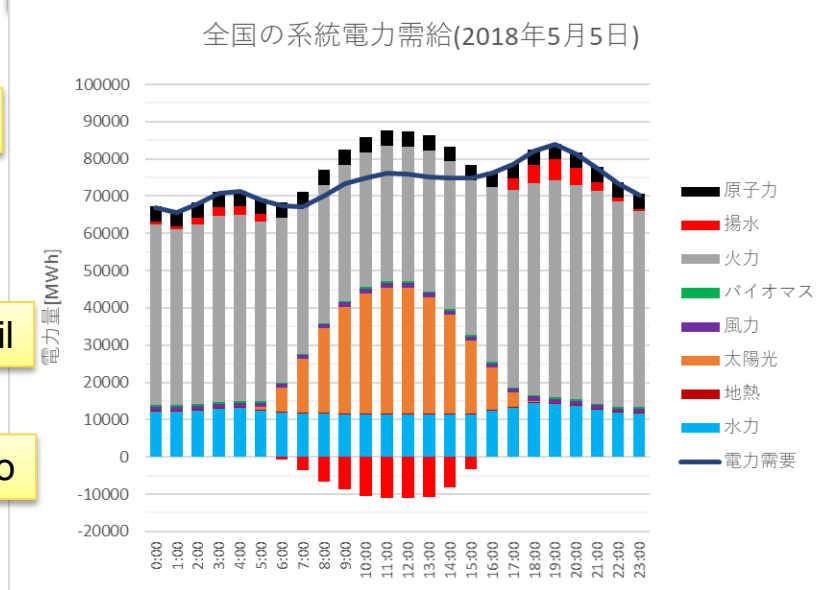
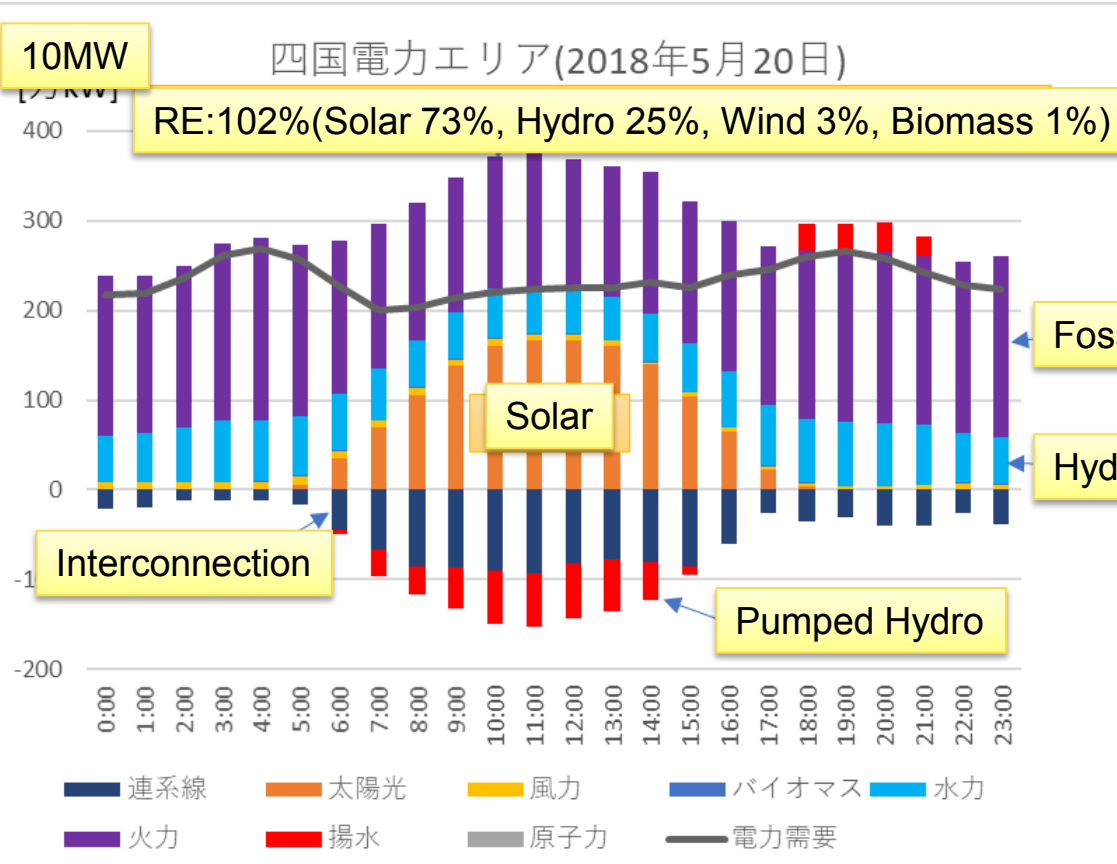


Source: each TSO data

Supply and demand balance of electricity by TSO

The renewable energy of the Shikoku Electric Power Area
Up to more than 100% of electricity demand (1 hour value)

Renewable energy throughout Japan is up to
62% of the grid electricity demand (1 hour
value)



May 5th, 2018 Renewable Daily Share: 34%

May 20th 2018 Renewable Daily Share: 52%

ISEP Energy Chart
Visualization site of electricity ·
energy supply and demand
<https://www.isep.or.jp/chart>

Source: Supply and demand data from each TSO

Market of District Heating and other energy business in Japan

- DH market is very small in comparison with gas and electricity in heating sector
- This is because;
 - ✓ historically speaking, there has been absence of “heat policy” in Japan,
 - ✓ DH has been less importance in Japan’s energy policy,
 - ✓ as a result, oil, gas and electricity industry has been dominant in Japan’s heat market, and compete each other, which resulted in excluding renewable heat historically.

Source: METI

	Electricity Market	Gas Market	District Heat Market
Supply Area(Share of land area)	100%	5.7%	0.01%
Number of consumers	84 million	29 million	36,000
Annual Sales Turnover	16 Trillion JPY	3.7 Trillion JPY	145 Billion JPY
Total No. of Employee	130,000	32,400	2300
No. of Employee in each area	13,000	155	17
Data Year	FY2012	FY2012	FY2013
Notes	10 Big Utilities Over 400 retail Sales Company	Not including LPG	75 Companies, 127 Regions (As of 2017)

Operators of District Heating System in Japan

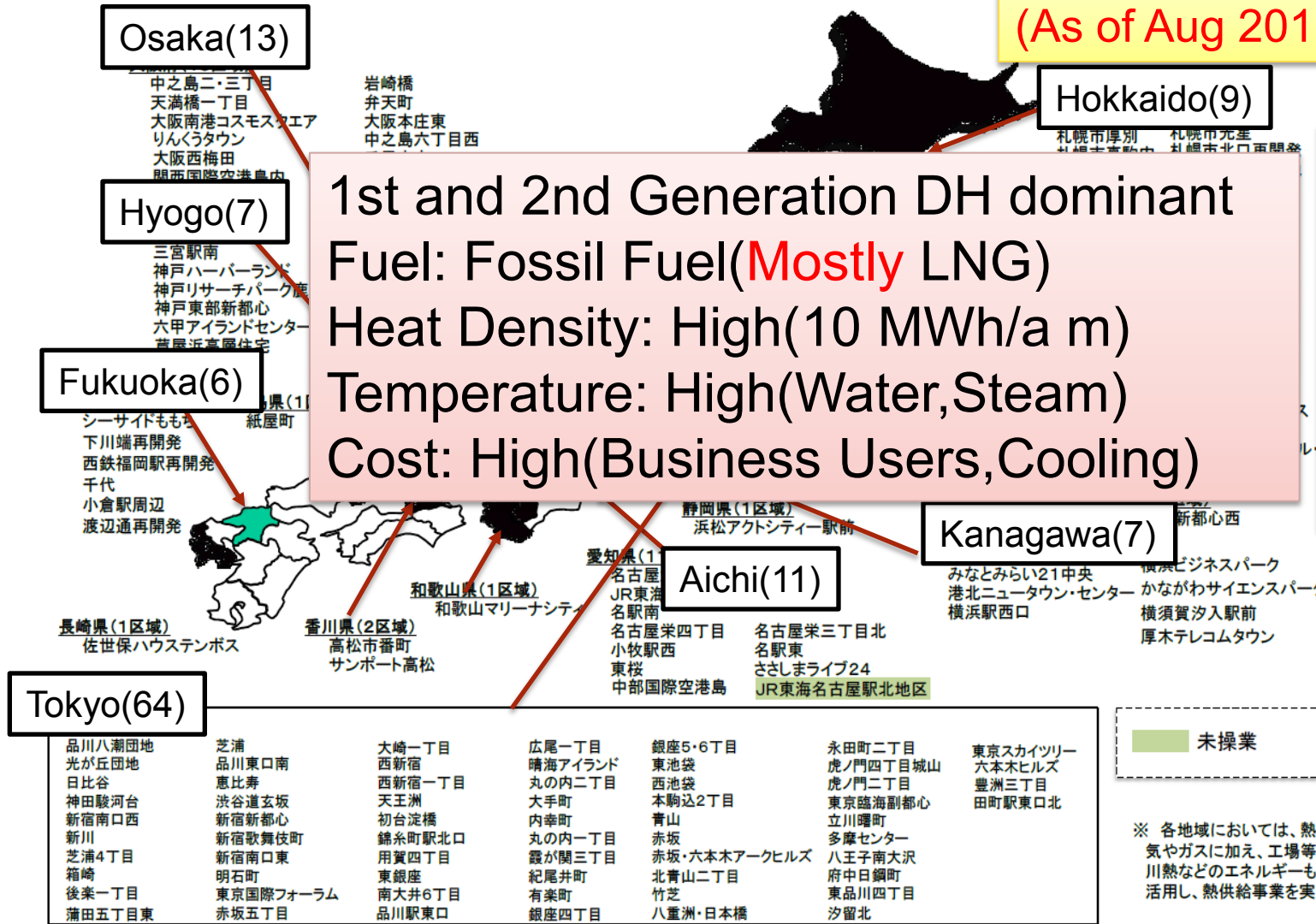
75 Companies, 127 Regions
(As of Aug 2017)

1st and 2nd Generation DH dominant
 Fuel: Fossil Fuel (Mostly LNG)
 Heat Density: High (10 MWh/a m)
 Temperature: High (Water, Steam)
 Cost: High (Business Users, Cooling)

District Heating (Regulated):

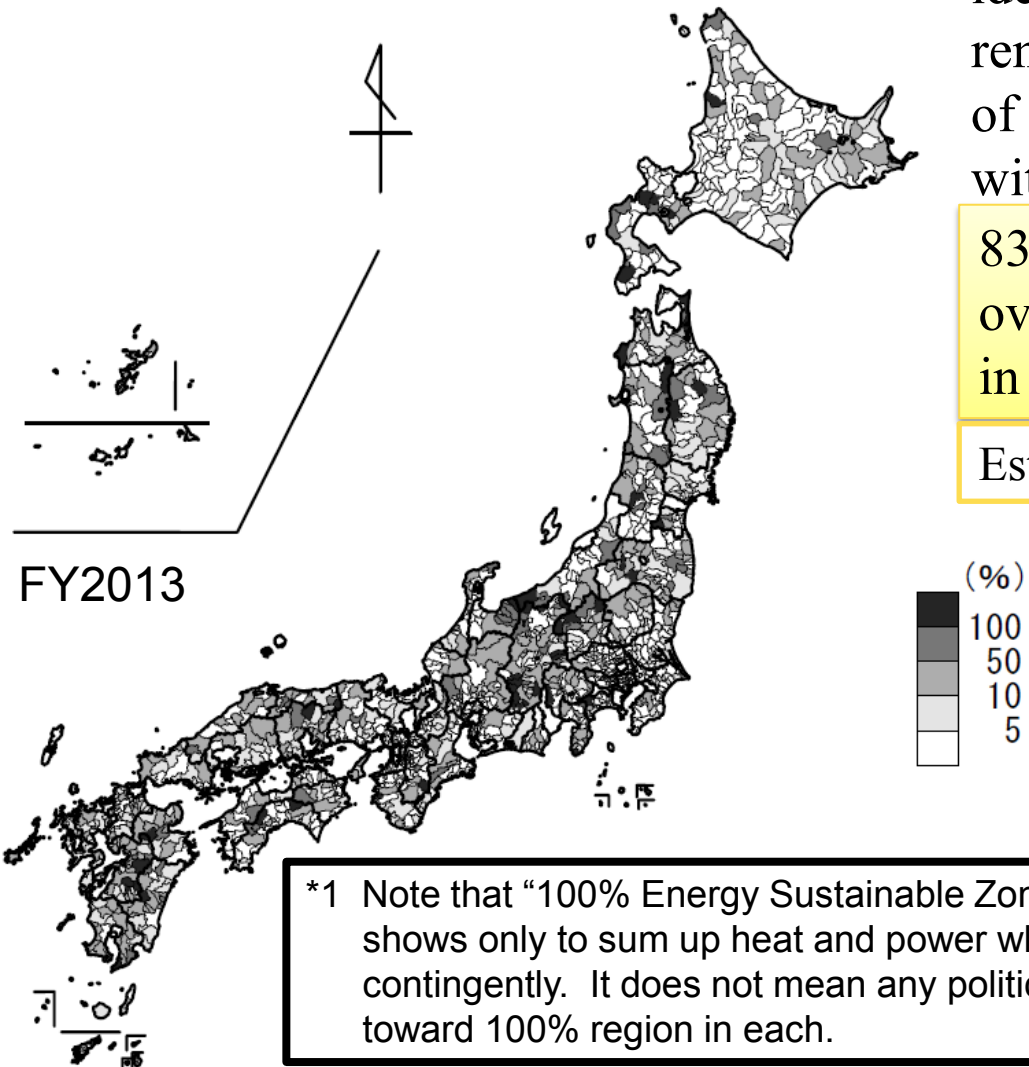
- More than two supply points.
- Large Scale (Min. Output 21GJ/h)

Output:
 more than 5.8MW
 Almost by Fossil Fuel



Sustainable Zone Study: 100% Renewable Energy Region in Japan

Japan “Energy Sustainable Zone”



*1 Note that “100% Energy Sustainable Zone” shows only to sum up heat and power where it is contingently. It does not mean any political will toward 100% region in each.

Energy Sustainable Zone (SZ) is an indicator to identify areas where local production of renewable energy exceeds local consumption of energy by residential and commercial sector with agriculture and forestry

83 towns and villages “can be” over 100% Energy Sustainable Zone in FY2016 *1

Estimated by ISEP and Kurasaka Lab. Chiba Univ.



Global 100% RE Platform

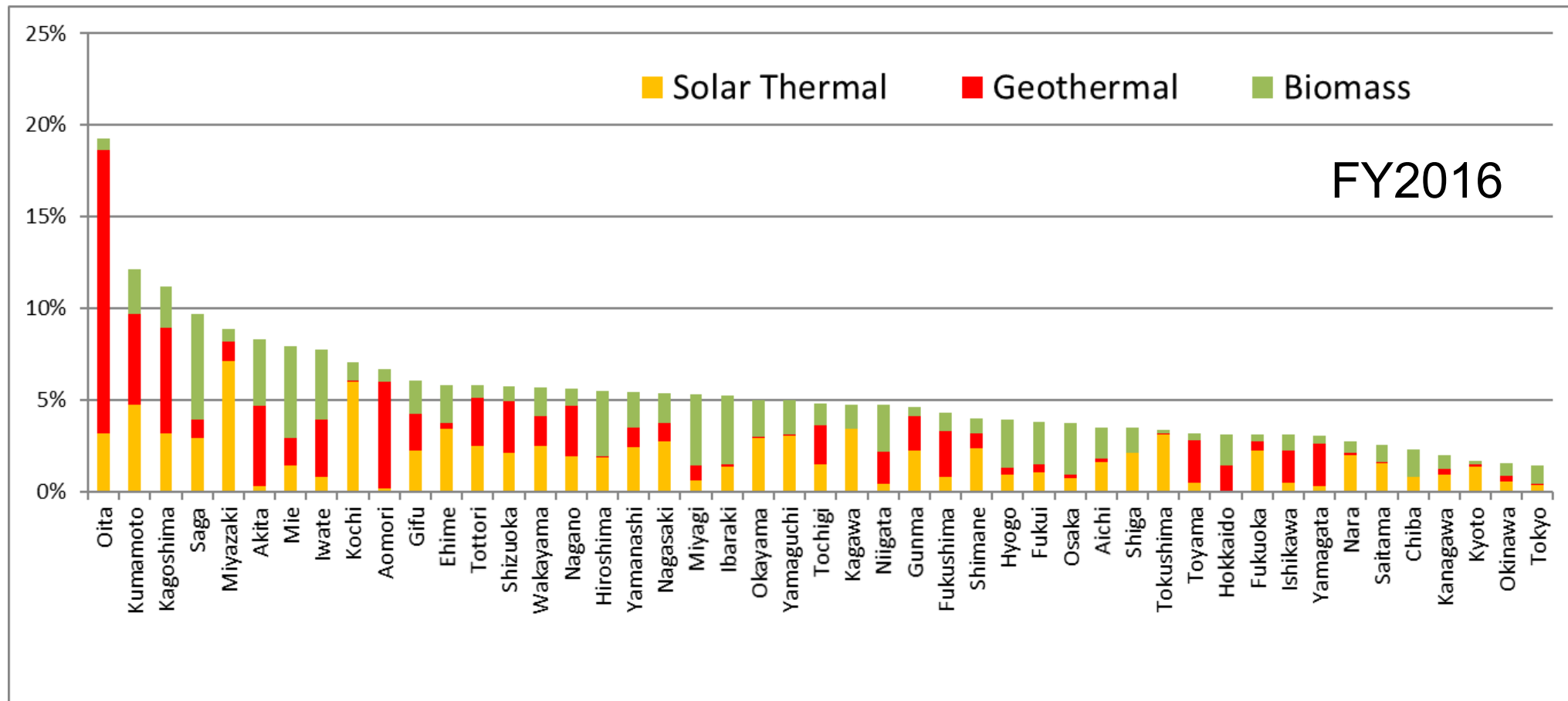
<http://www.go100re.net/>



100% RE Platform, Japan
<http://www.go100re.jp/>

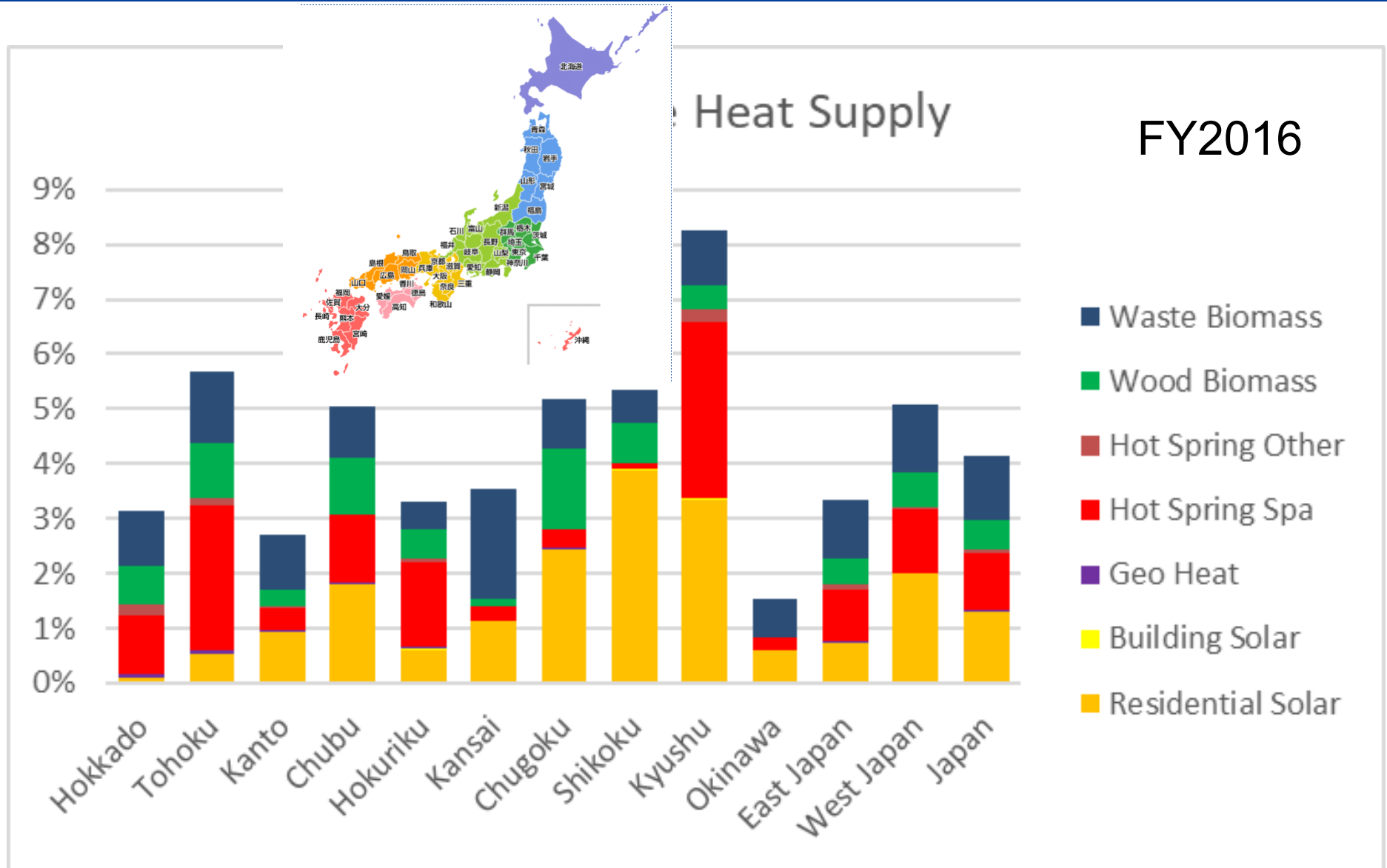
Sustainable Zone Study: Share of renewable heat supply in each prefecture of Japan

- Solar Thermal for residential house and office buildings
- Geothermal heat from hot spring resources and ground source heat pumps
- Biomass heat from wood biomass, biogas system and municipality biomass waste



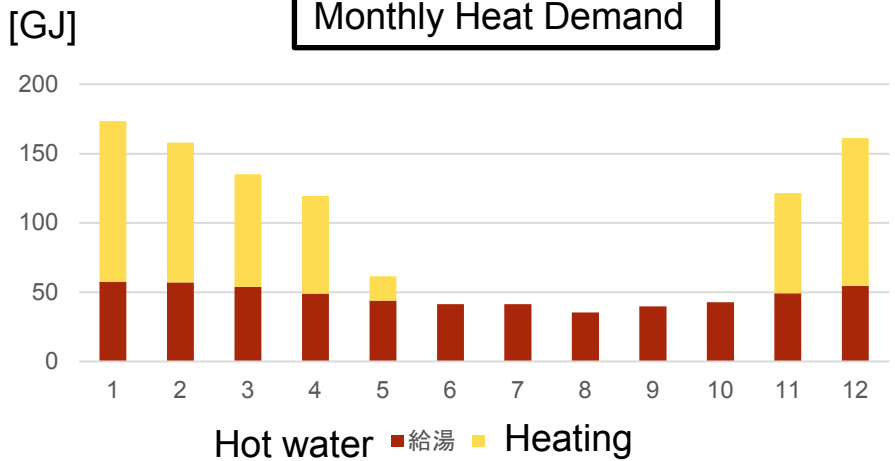
Source: Sustainable Zone Study

Share of renewable heat in each area of Japan (residential and commercial sectors with agriculture and forestry)

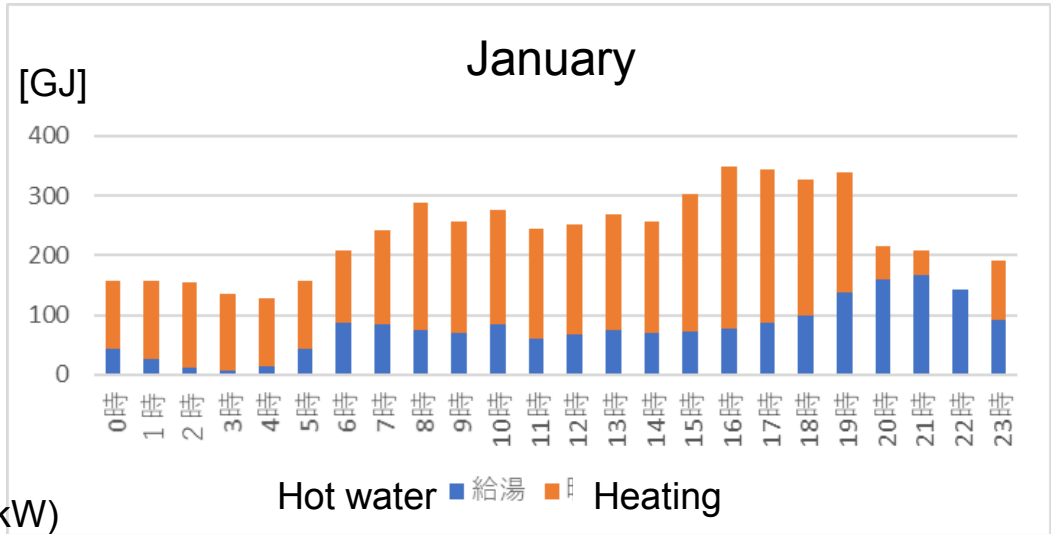


Case study: Small biomass boiler for hotel building in Tohoku area

Monthly Heat Demand



Hourly Heat Demand



LP Gas Boiler(460kW)



Wood Pellet Boiler (100kW)

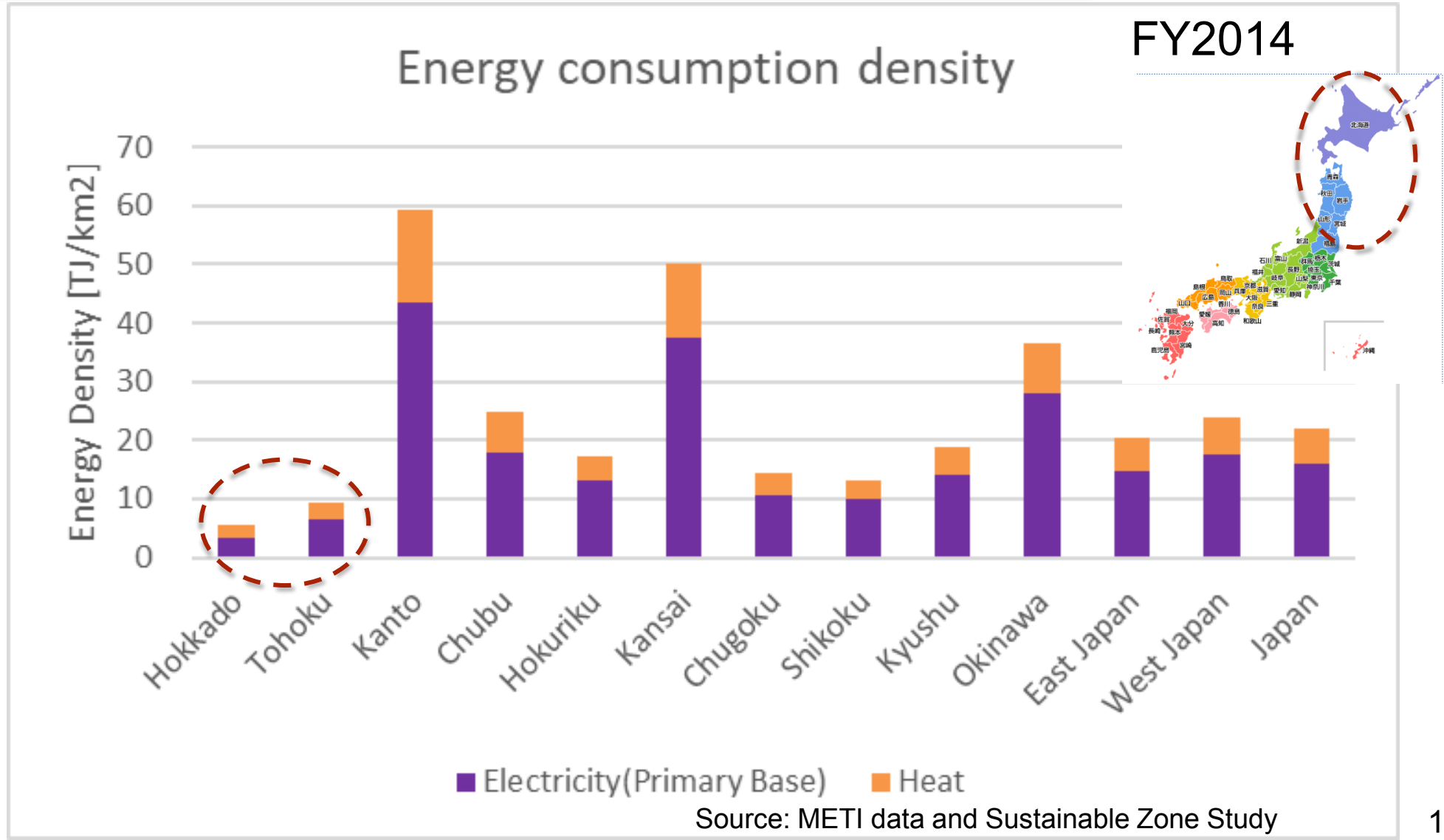


with 4m3 Buffer Tank



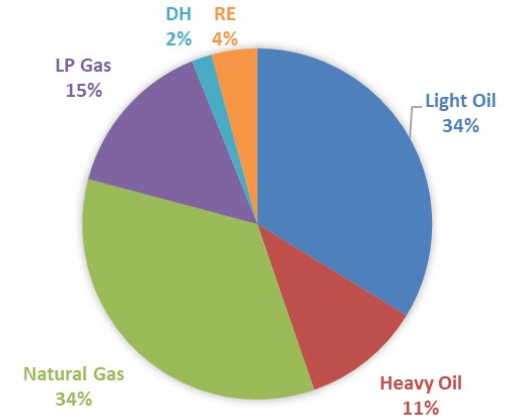
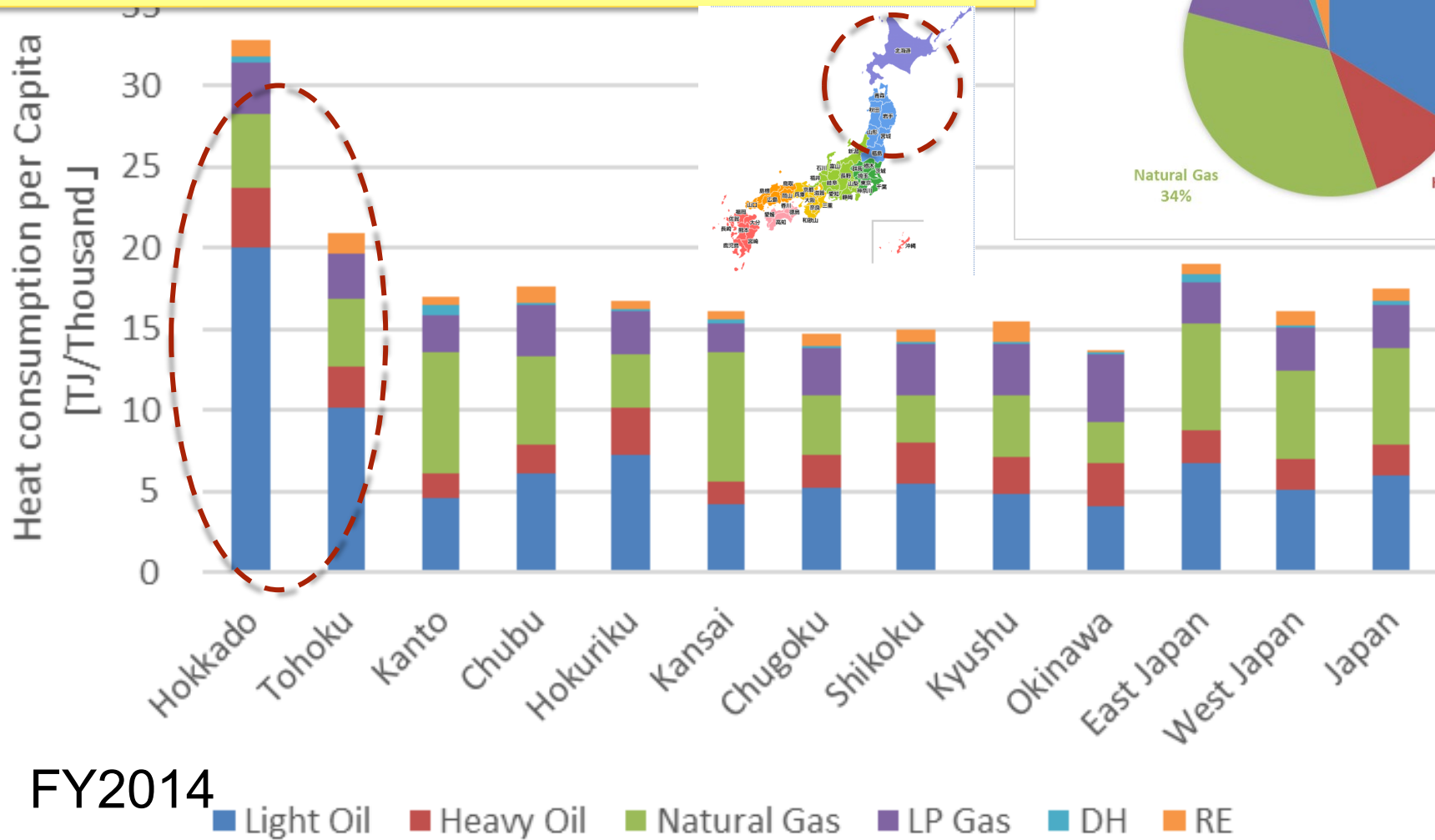
Energy consumption density of electricity and heat (residential and commercial sectors with agriculture and forestry)

Energy area density is very small in Hokkaido and Tohoku area



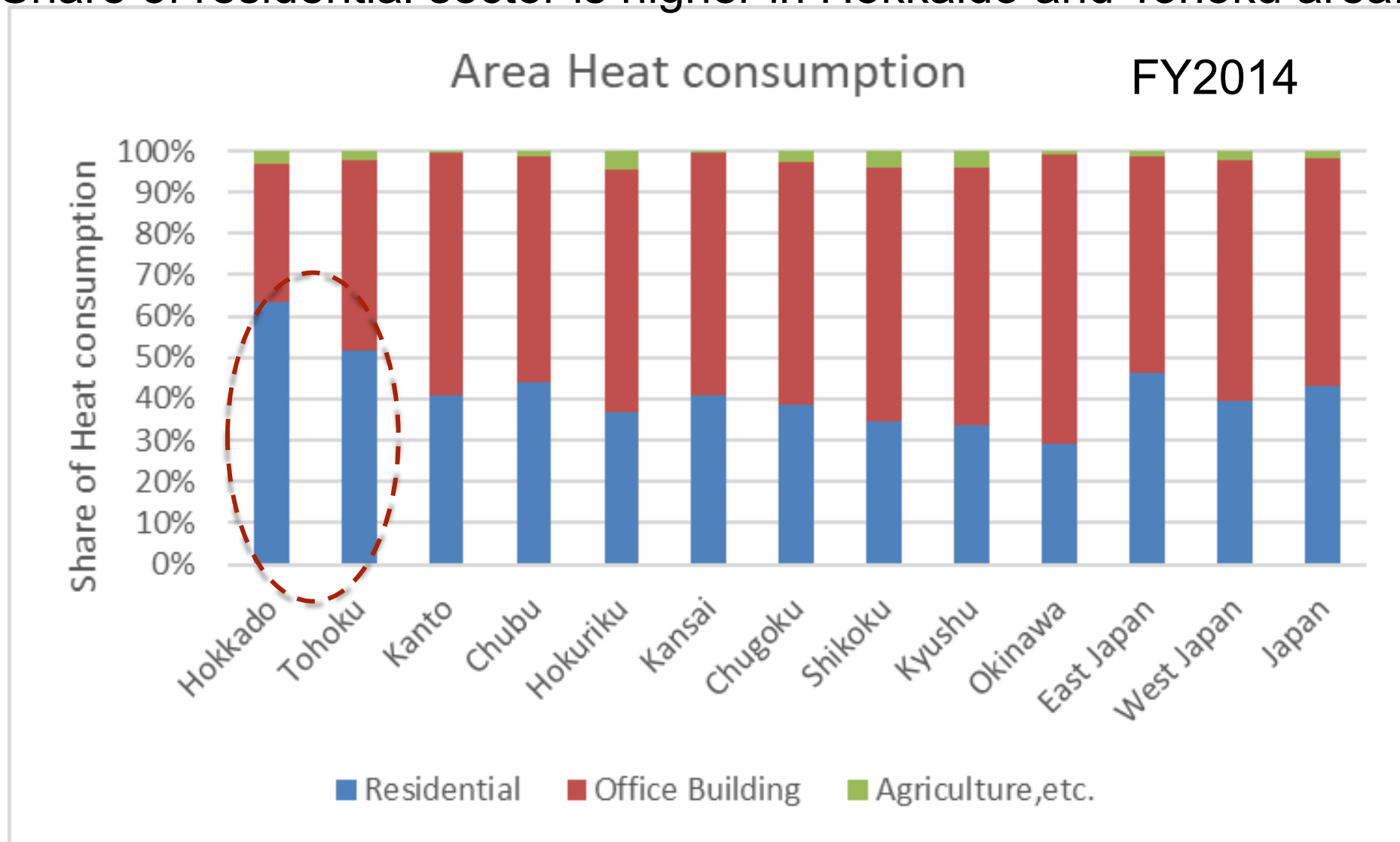
Heat consumption per capita in each area of Japan (residential and commercial sectors with agriculture and forestry)

Heat consumption per capita is higher in Hokkaido and Tohoku area because of large consumption of oil



Sector share of heat consumption in each area of Japan (residential and commercial sectors with agriculture and forestry)

Share of residential sector is higher in Hokkaido and Tohoku area.



Feasibility study of 4DH into Japan

- Adopting 4DH concept is found difficulty because of several hurdles of existing heat supply system.
- For adopting 4DH concept to DH system in Japan, heat policy and research plan should be revised in the future.

- Rice Husk Boiler
- Location and size of the Boiler
- Coverage of Heat demand by biomass
- Spec and Cost of Piping Network

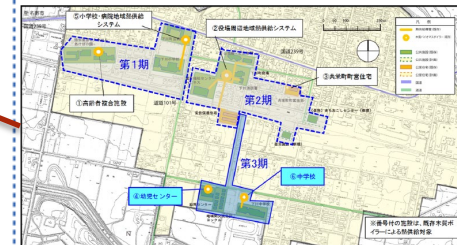
Case2: Ogata Village



Kushu



Case1: Shimokawa Town



- CHP operated by wood pellet
- Heat Storage
- Coverage of Heat demand with DH and existing biomass boiler
- Spec and Cost of Piping Network

Source: The 1st application of 4th Generation District Heating in Japan, its outcomes and lessons(2017)

Launching Japan 4DH Forum

- It is composed of related researchers, administrators, NGOs, etc. in cooperation with related organizations in Denmark as a place for research, discussion to promote heating energy policy for renewable energy and dissemination of heat use “4th Generation District Heating Forum” (Japan 4 DH Forum) was launched by ISEP in October 2018.
- In addition to trying to share knowledge and experiences of 4DH system based on the heating and cooling strategy for Europe and Heat Roadmap Europe 2050 based on the Paris Agreement, participating in conference, holding research workshop and symposiums, Aim for network formation to disseminate renewable energy heat utilization.

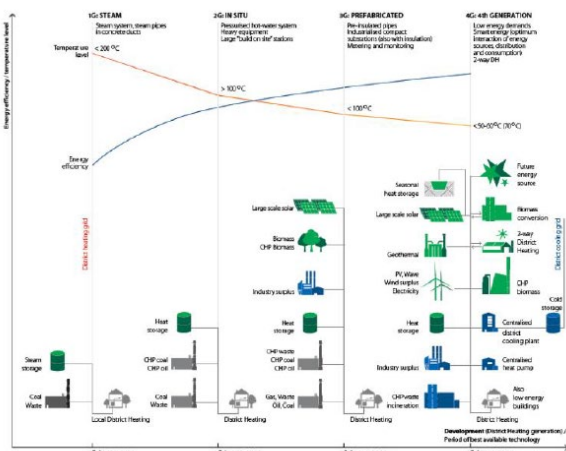


Fig. 2. Illustration of the concept of 4th Generation District Heating in comparison to the previous three generations.



Concluding remarks

- Since Feed-in Tariff Law for renewable electricity (FIT) has been introduced in 2011, come into effect in 2012 in Japan, Solar PV has been sharply increased. Solar PV supply 6% of total power supply in FY2017, however it supply over 80%, which require new grid management such as flexibility and so on.
- On the other hand, the use of renewable heat has hardly increased, estimated approx. 4% supply for residential and commercial sectors. This is because of historical lack of “heat policy” among Japan’s energy policy in addition to lack of renewable heat policy and less weigh on district heating policy.
- Renewable heat such as solar thermal, biomass and geothermal are mainly in each building separately although they has been gradually increased, because district heating is not popular in Japan.
- There are both chance and necessity to introduce district heating into North part of Japan, such as Hokkaido and Tohoku, where high heat consumption per capita especially for residential sector because of cold climate. However its low energy density would be challenging.
- ISEP has promoted feasibility study of 4DH into North part of Japan. The first findings are various barriers to introduce 4DH. In order to cope it and to promote 4DH, ISEP launched “4DH Forum” recently supported Danish collaborators.

Comparative analysis of regional heat demand and renewable heat supply in Japan

- Challenge for introduction 4DH into Japan -



Thank you !