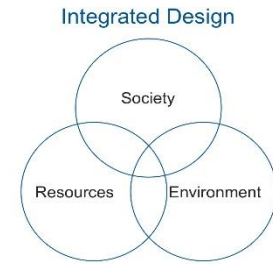


4DH Seminar
1 November 2019

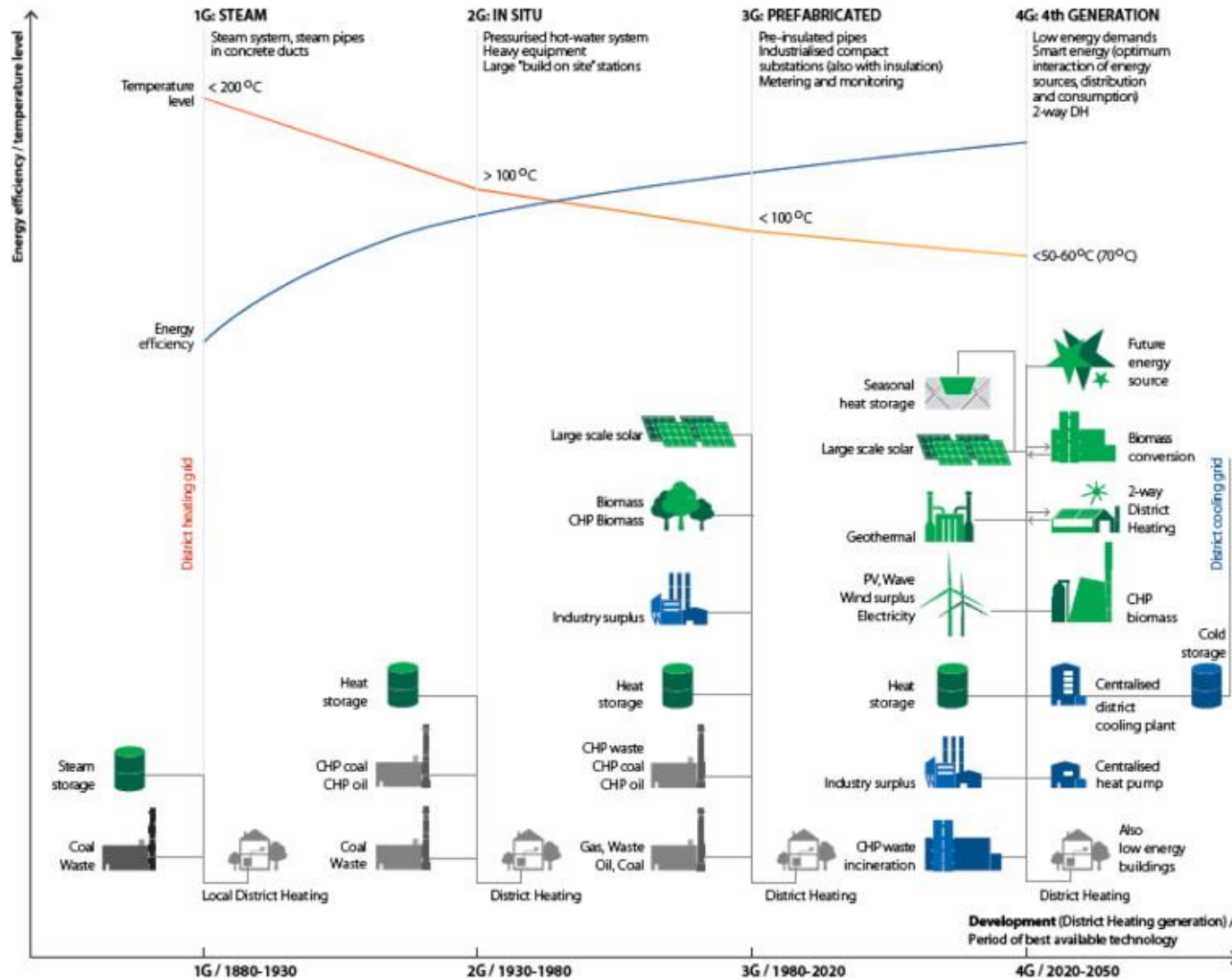


国内での地域熱供給普及の可能性

Possibility of widespread district heating system in Japan

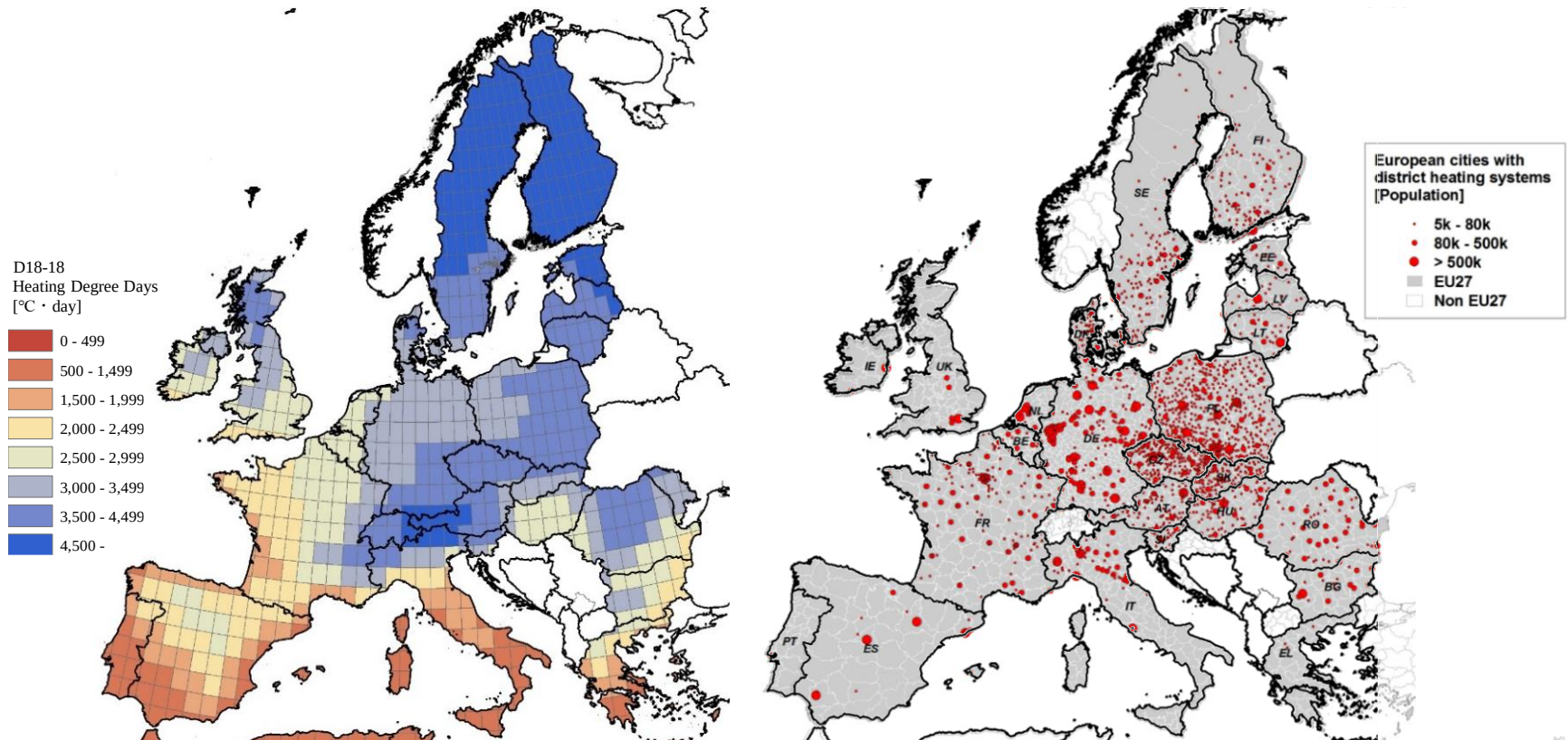
Toshiko Nakata and Shunya Ozaki

Transition of district heating system



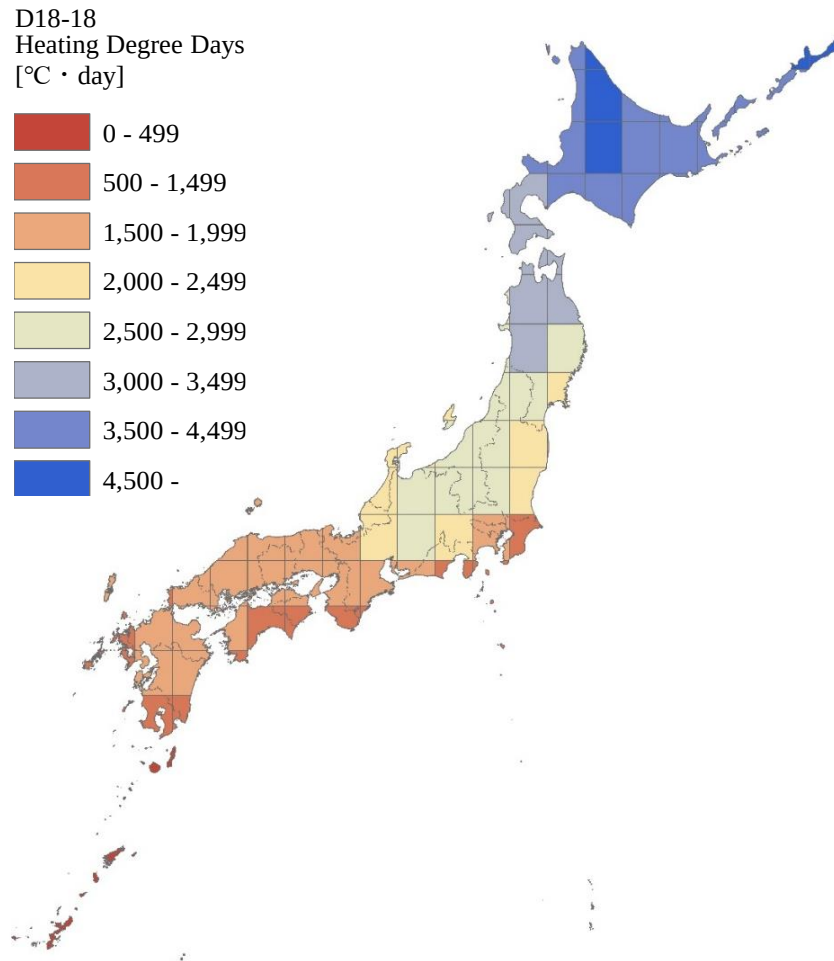
Ref. H. Lund *et al*, "4th Generation District Heating(4GDH). Integrating smart thermal grids into future sustainable energy systems.," *Energy*, vol. 68, pp. 1-11, 2014.

Relationship between district heating and heating degree day



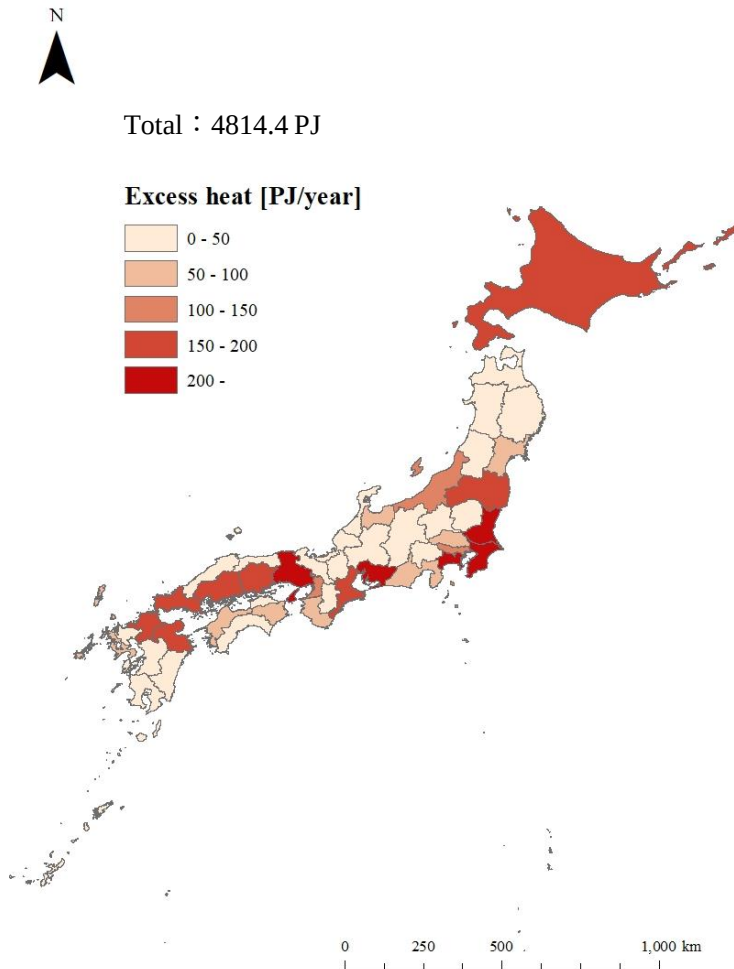
Ref. : Climate: monthly and annual average heating degree days below 18°C GIS data at one-degree resolution of the World from NASA/SEE, OpenEI
Heat Roadmap Europe 2 Maps, Halmstad & Aalborg Universities, 2013

Heating degree day in Japan



Ref. : Climate: monthly and annual average heating degree days below 18°C GIS data at one-degree resolution of the World from NASA/SEE, OpenEI

Comparison of excess heat with Europe



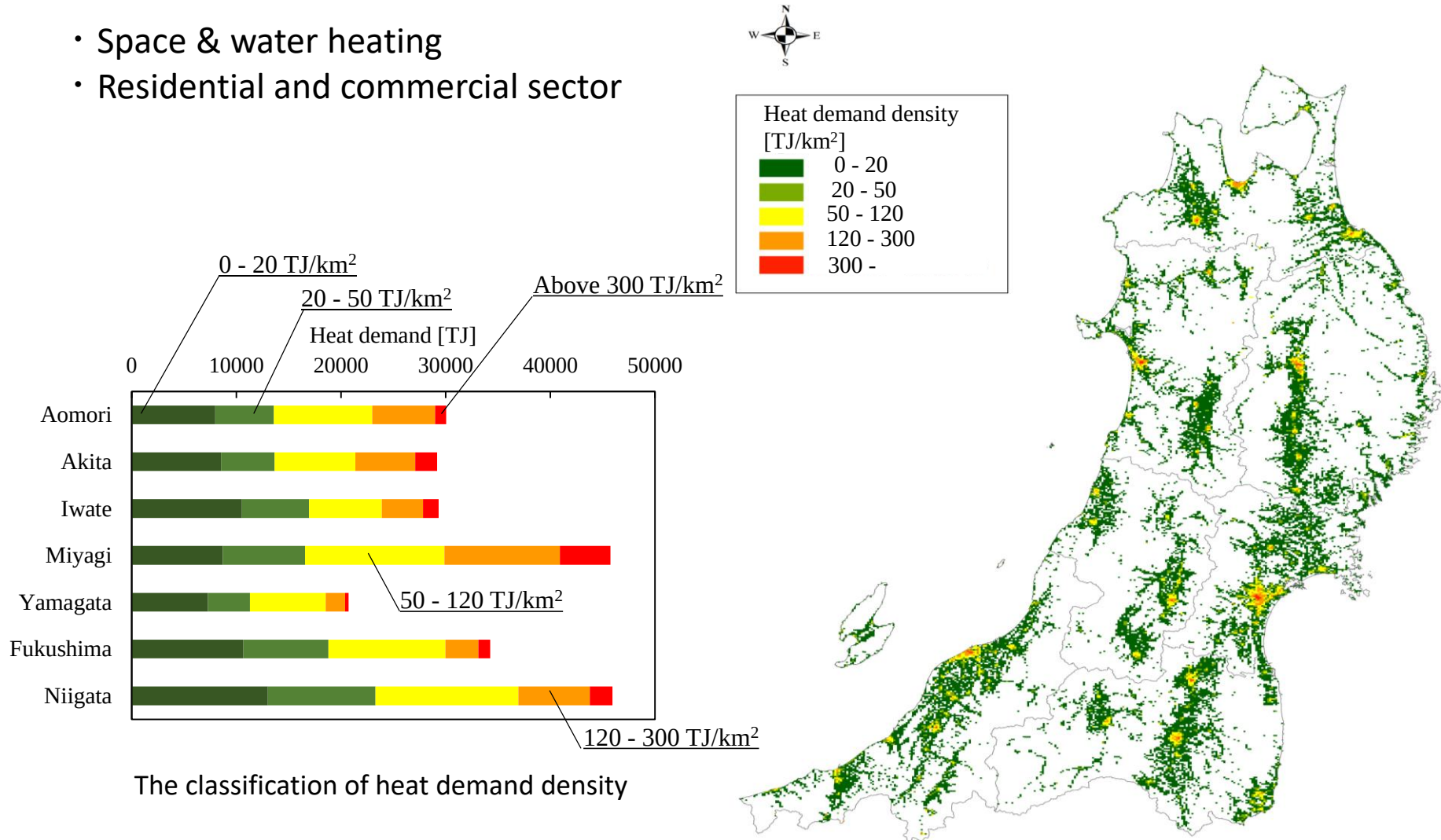
Country	Excess heat [PJ]
Japan	4814
Denmark	139
Germany	2707

Ref. : Heat Roadmap Europe, Background Report 7 – Potential for Excess Heat, 2015.

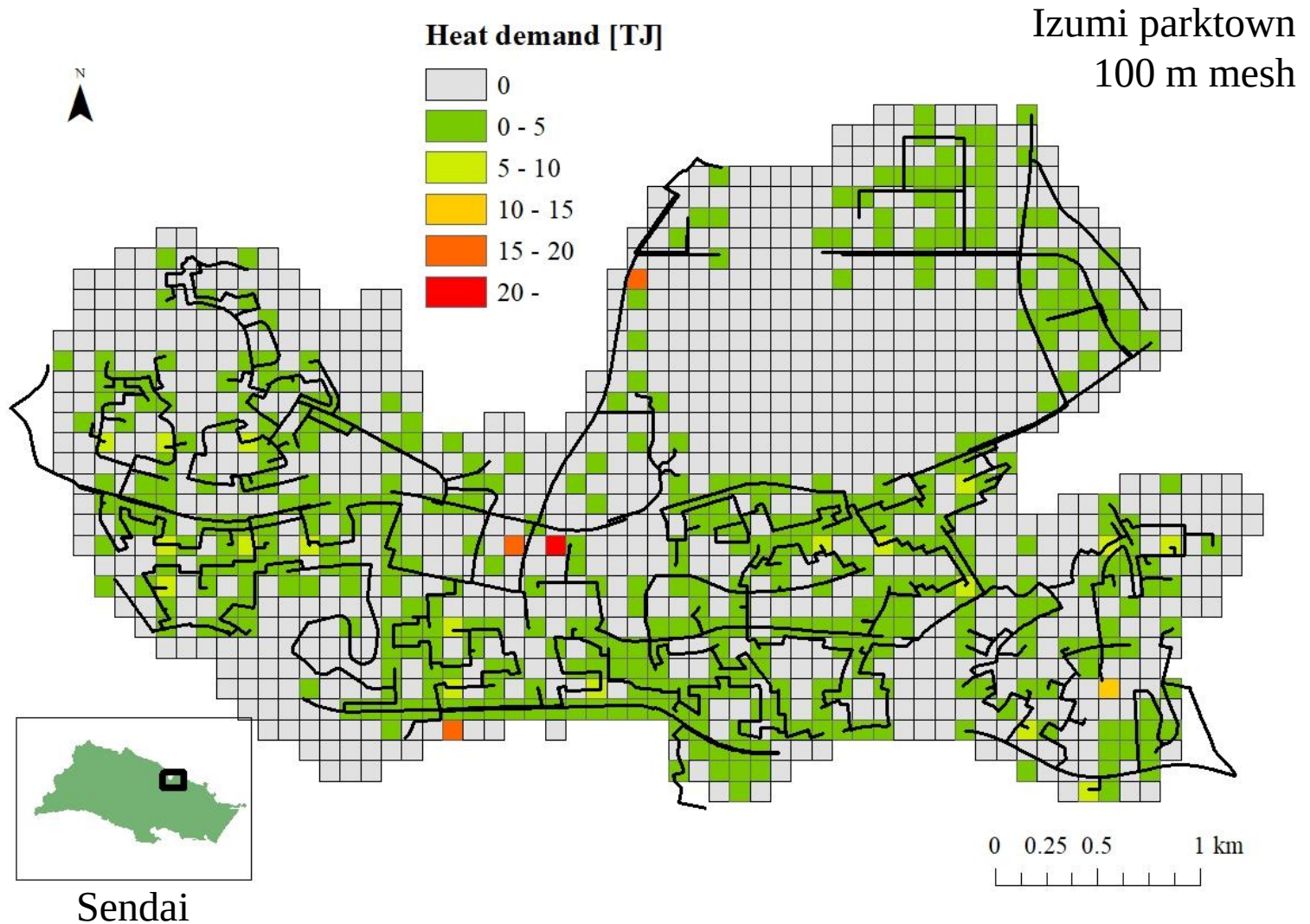
Heat demand density map in Tohoku region

Definition of heat demand

- Space & water heating
- Residential and commercial sector



Heat supply network



Comparison with other countries

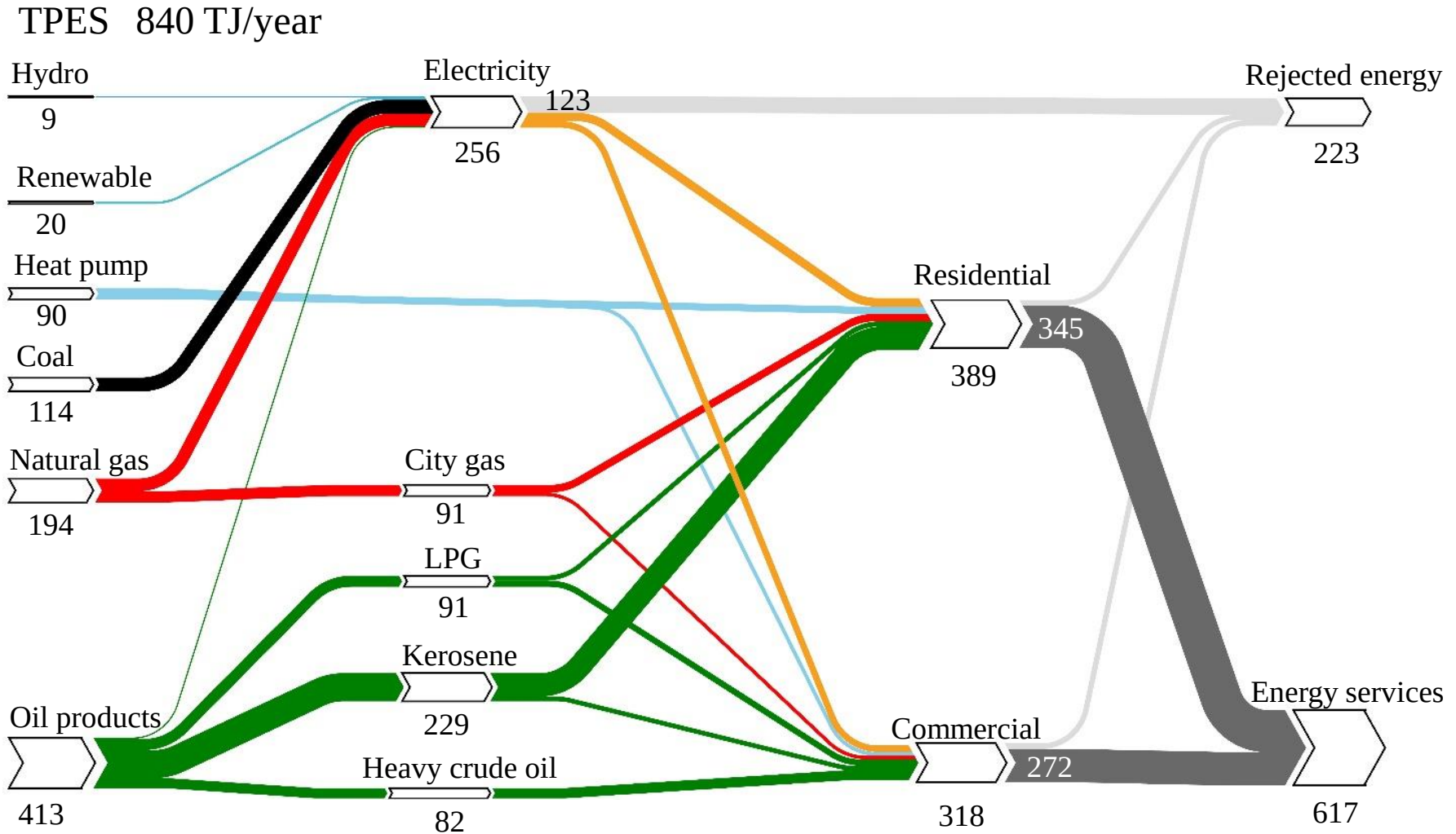
	Izumi parktown Sendai city	Japan	Denmark	Threshold
Heat density [TJ/ha]	1.42	2.04	5.05 ^[1]	1.4 ^[2]
Linear heat density [GJ/m]	7.62	14.3	3.73 ^[1]	3.6 ^[3]

Ref. [1] EUROHEAT & POWER, "Modele 6 – Energy Distribution:District Heating and Cooling – DHC." [Online]. Available: https://www.euroheat.org/wp-content/uploads/2016/04/UP-RES_M6_District_Heating_and_Cooling.pdf

[2] S.Frederiksen and S.Werner, *District Heating and Cooling*, Studentlitterature, 2013

[3] International Energy Agency, "District Heating. IEA-ETSAP Technology Brief E16," ETSAP – *Energy Technol. Anal. Program.*, no. January, p. 7, 2013.

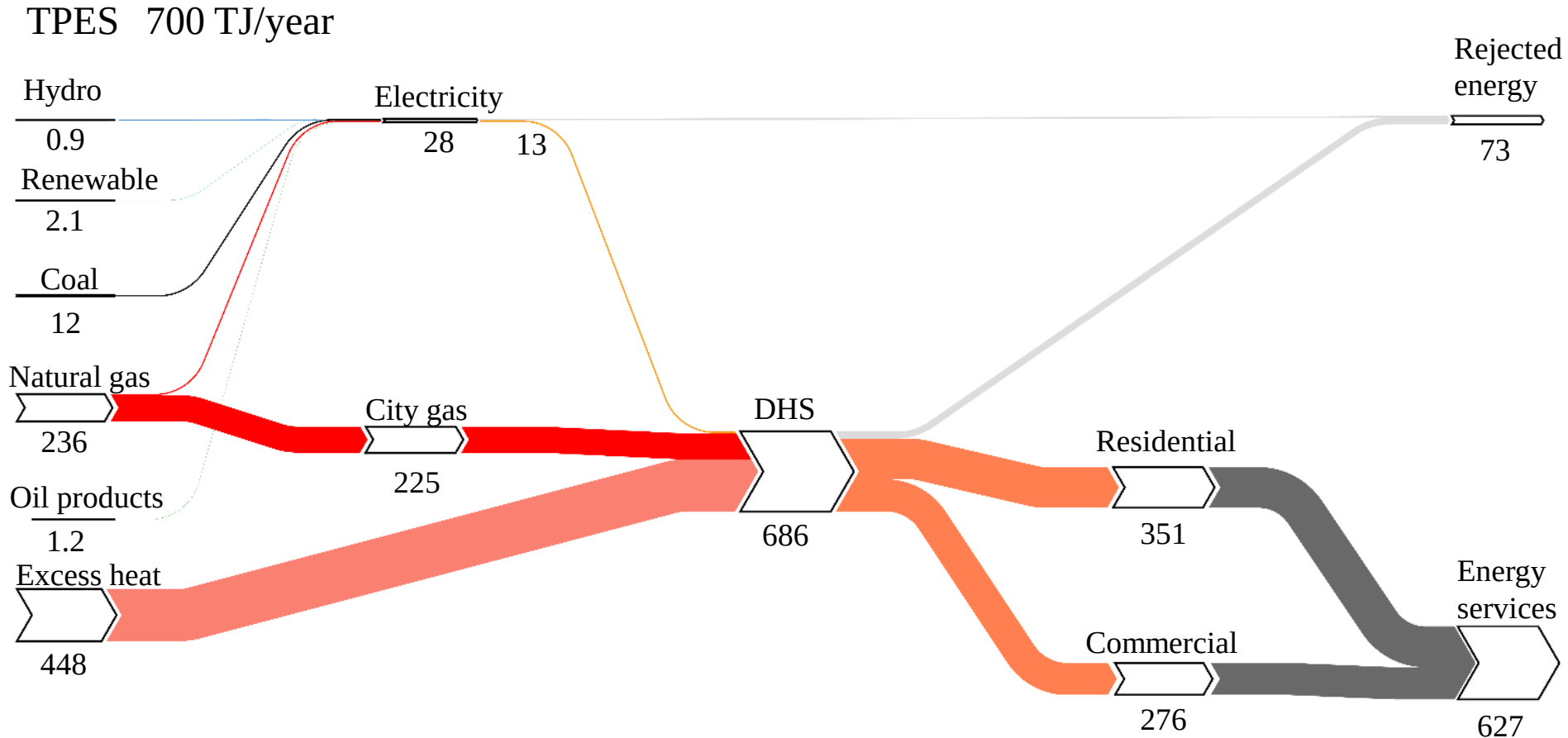
Energy flow in Izumi parktown (Individual)



Reference 東北電力, ファクトブック
環境省, 家庭からの二酸化炭素排出量の推計に係る実態調査
総務省, 平成27年度国勢調査
etc.

Feb. 23, 2019 S.Ozaki@Nakata lab.

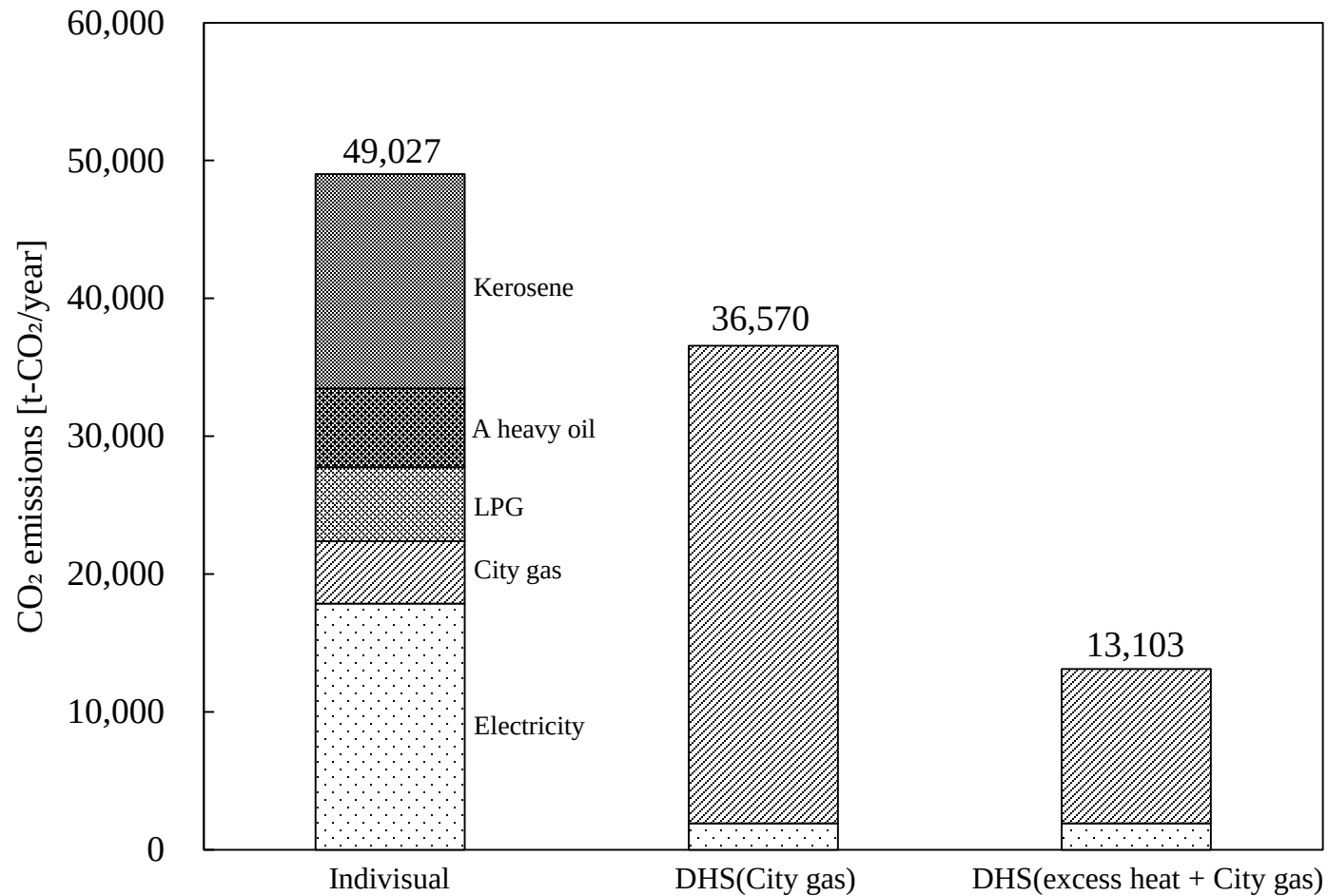
Energy flow in Izumi parktown (DHS excess heat and City gas)



Reference 東北電力, ファクトブック
環境省, 家庭からの二酸化炭素排出量の推計に係る実態調査
総務省, 平成27年度国勢調査
etc.

Feb. 23, 2019 S.Ozaki@Nakata lab.

Comparison of CO₂ emissions



Integrated design for smart energy systems

