



The 16th APEC Workshop on Energy Statistics
Tokyo, Japan, 10-12 July 2018

1.2 Should district cooling data be in the energy balance table?

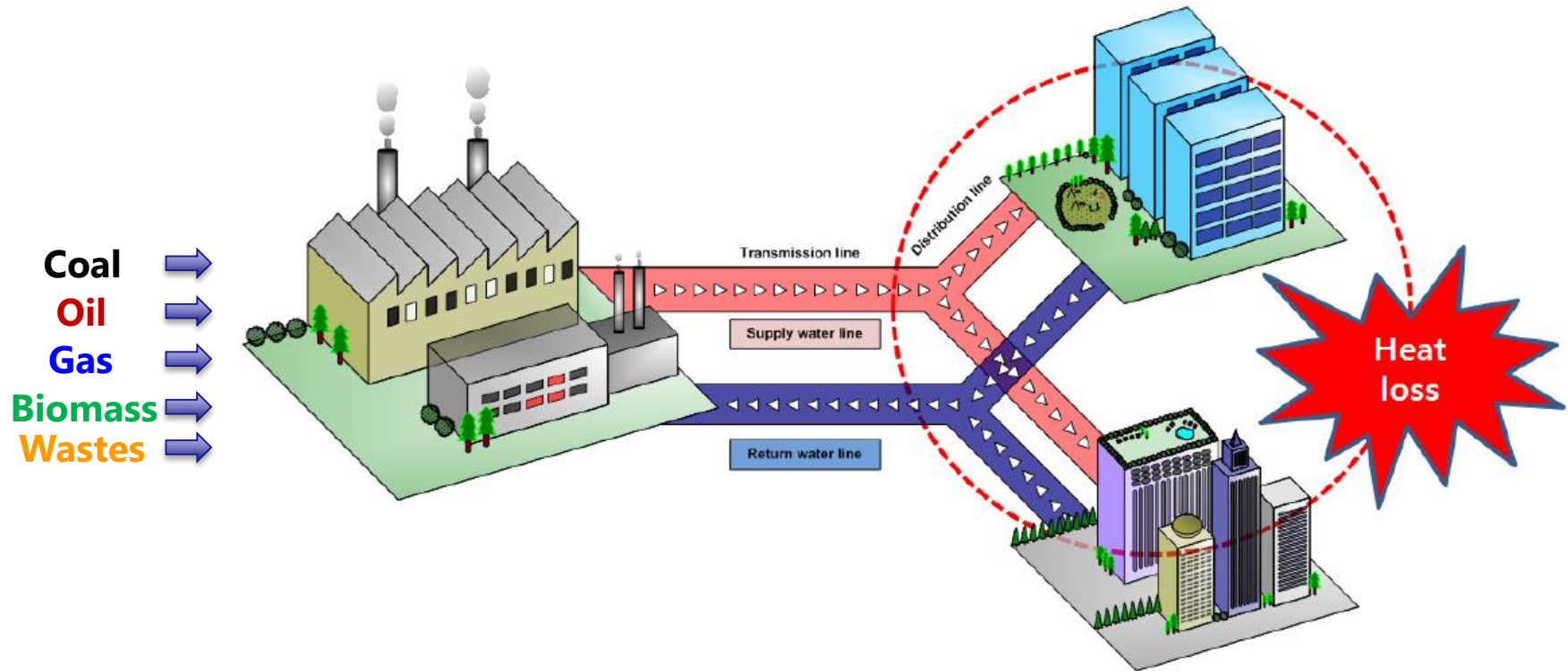
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Senior Research Fellow, APERC ESTO



Presentation outline

- District heating
 - What is district heating?
 - Heat data in energy balances
 - Auto-producer heat production
- District cooling
 - What is district cooling?
 - Is there delivery of energy in district cooling?
- Should district cooling be in the energy balances
- Benefits of having district cooling product in energy balances

District Heating



- A transformation process that produce heat that is delivered to customers
- With data on energy inputs and output (hot water or steam)
- Products delivered to consumers is measurable

Source of image: Byun, Jae-Ki, et.al.; Study on the Development of an Optimal Heat Supply Control Algorithm for Group Energy Apartment Buildings According to the Variation of Outdoor Air Temperature. Energies. 2012, 5, 1688.



District heating

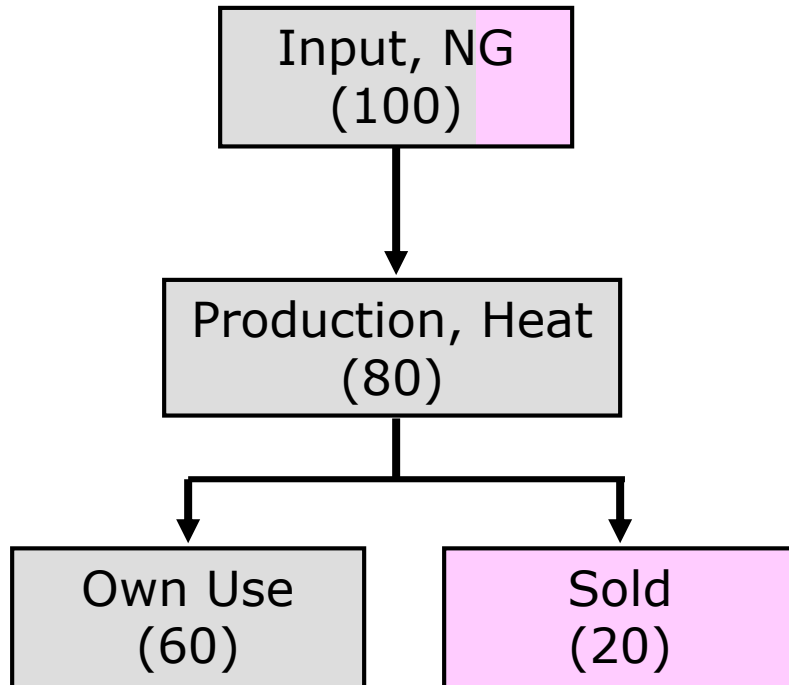
Heat in APEC energy balances

Energy Balance Table												
Japan												
2015												Unit: KTOE
	Coal	Coal products	Crude oil, NGL and condensate	Petroleum products	Gas	Hydro	Nuclear	Geothermal, solar, etc.	Others	Electricity	Heat	Total
Indigenous production	671	-	517	-	2409	7207	1162	6169	6270	-	-	24405
Imports	116057	1909	169499	45022	103544	-	-	-	-	-	-	436030
Exports	-	-439	-	-17206	-	-	-	-	-	-	-	-17645
Bunkers	-	-	-	-10563	-	-	-	-	-	-	-	-10563
Stock changes	-959	-	-785	392	-797	-	-	-	-	-	-	-2149
Total primary energy supply	115769	1470	169231	17645	105156	7207	1162	6169	6270	-	-	430078
Transfers	-	-	-239	241	-	-	-	-	-	-	-	2
Total transformation sector	-100204	22296	-169063	144494	-71909	-7207	-1162	-5726	-9410	90351	761	-106779
Main activity producer	-54723	-4417	-5223	-9891	-69322	-6523	-1162	-2094	-1538	75881	591	-78421
Autoproducers	-12276	-2606	-	-11720	-3928	-684	-	-3632	-7872	14470	170	-28078
Gas processing	-	-	-	-1279	1341	-	-	-	-	-	-	62
Refineries	-	-	-163840	168447	-	-	-	-	-	-	-	4607
Coal transformation	-33205	29319	-	-1064	-	-	-	-	-	-	-	-4950
Petrochemical industry	-	-	-	-	-	-	-	-	-	-	-	-
Biofuel processing	-	-	-	-	-	-	-	-	-	-	-	-
Charcoal processing	-	-	-	-	-	-	-	-	-	-	-	-
Non-specified transformation	-	-	-	-	-	-	-	-	-	-	-	-
Loss & own use	-548	-2929	-	-10423	-4395	-	-	-	-	-7335	-	-25630
Discrepancy	-275	-3022	71	-259	1236	-0	-	-	4856	-963	-75	1569
Total final consumption	14742	17815	-	151697	30089	-	-	443	1716	82053	686	299240
Total final energy consumption	14742	17815	-	148331	30089	-	-	443	1716	82053	686	295874
Industry sector	14742	17211	-	51633	15228	-	-	-	1694	32952	-	133459
Transport sector	-	-	-	72134	77	-	-	-	-	1867	-	74079
Other sector	-	605	-	24563	14783	-	-	443	22	47234	686	88336
Commerce and public services	-	596	-	7165	6271	-	-	117	-	23380	586	38115
Residential	-	9	-	13751	8512	-	-	253	22	23565	27	46139
Agriculture	-	-	-	2279	-	-	-	73	-	289	73	2714
Fishing	-	-	-	1368	-	-	-	-	-	-	-	1368
Non-specified others	-	-	-	-	-	-	-	-	-	-	-	-
Non-energy use	-	-	-	3366	-	-	-	-	-	-	-	3366
Electricity output in GWh	314181	-	-	80787	478343	89012	4459	39563	45248	-	-	1051593
Heat output in ktoe	-	-	-	9	466	-	-	-	115	-	-	591

Autoproducer heat data

- By convention, heat generated by auto-producers for own use is not to be reported
 - What should be reported is the fuel used to generate such heat as final consumption of that fuel
 - E.g: natural gas used in boilers to produce steam or hot water for space heating should be reported as final consumption of natural gas
- Autoproducer production of heat is only reported when heat is sold
 - For autoproducers that consumes the heat it produces and also sells a part of the heat has to report two data
 - The equivalent fuel consumed to generate the heat used as final consumption of that fuel
 - The amount of heat sold and the corresponding fuel used to generate the heat sold (heat produced is equal to heat sold)

Calculations for autoproducer heat production data



- In the example at the left, total production of heat = 80 TJ
- Fuel input is 100 TJ of NG
- Own-use of heat was 60 TJ and 20 TJ was sold

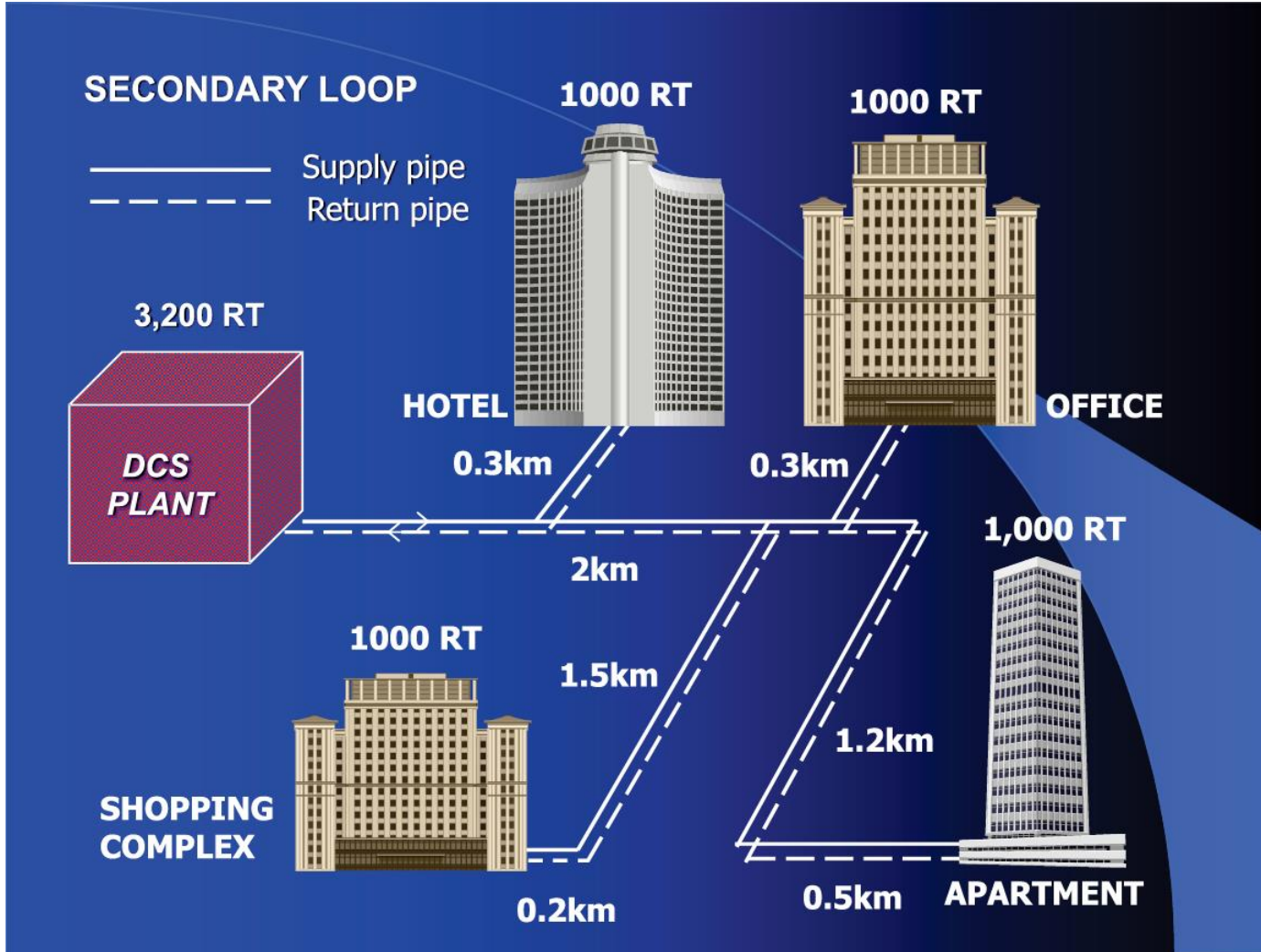
- Heat production to be reported = 20 TJ
- Fuel input to heat production (transformation sector)
= $100 \text{ TJ} * (20/80) = 25 \text{ TJ}$
- Final consumption of heat = 20 TJ
- Final consumption of NG
= $100 \text{ TJ} * (60/80) = 75 \text{ TJ}$



District cooling



What is district cooling?



- District cooling is the production and distribution of chilled water from a central source to facilitate air conditioning. This is done by producing chilled water at a central plant and then piping the water to customers through an underground insulated pipes network.*
- Data on energy inputs and output are also measurable
- Deliveries to customers are also measurable

Source: Image: <http://www.kenwisesb.com/wp-content/uploads/2014/03/1.jpg>

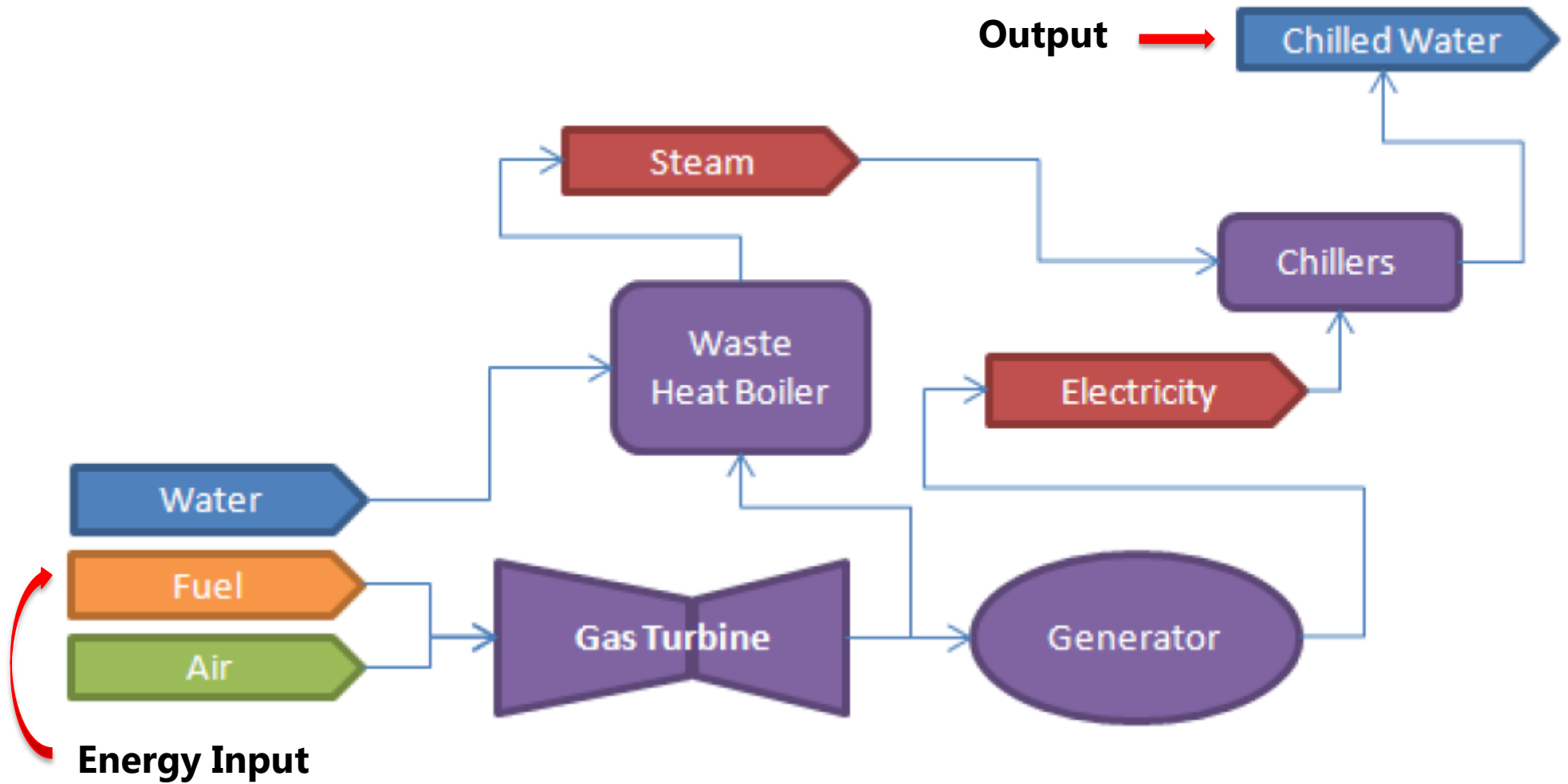
* Tabreed. <https://www.tabreed.ae/district-cooling/>. Accessed: 24 October 2017

Is there delivery of energy in district cooling?

- In district cooling, heat is removed from the inside of the building and transfers it to the outside
- Eurostat considers cooling “as not an energy supply but rather an energy removal¹”
- Questions:
 - If district cooling is not an energy supply, does it mean that the fuel used to generate chilled water is non-energy use of the fuel?
 - District cooling is not a transformation process?
- APERC ESTO would like to argue that this “technical issue” should be set aside for proper accounting of energy consumption
- APERC ESTO would also show that there are advantages in considering cooling as an energy product

¹ EUROSTAT, 2012, Reporting instructions for completing the district heating and district cooling template for data reporting under Article 24(6) of Directive 2012/27/EU, <http://ec.europa.eu/eurostat/documents/38154/42195/Reporting-instructions-DH-DC.pdf/0e62bb06-2a29-478f-87bd-b4625d2d8f40>

Typical cogeneration chilled water plant



Source: GDCP Sdn Berhad. 2016. Presentation to Suruhanjaya Tenaga and APERC visitors. October.

District cooling data in APEC energy balances

Energy Balance Table												
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Why should district cooling be an energy product?

- District cooling and district heating production and delivery of service are similar
 - Energy is also used to generate chilled water and heat production for district heating is considered a transformation process
- Building efficiencies are measured by energy use intensity (EUI) in kWh/m²
 - Excluding chilled water will result in lower (EUI) and understate the actual energy consumption of the building
- There is huge potential for the use of free cooling in the production of chilled water
 - If district cooling is considered an energy product, the use of free cooling can be considered renewable energy (RE) use increasing the share of RE in the energy mix
 - This would also encourage many economies/countries to use free cooling resulting in lower carbon energy supply

Autoproducer cooling data

- By convention, heat generated by auto-producers for own use is not to be reported; the same should apply to cooling (chilled water)
 - What should be reported is the fuel for cooling as final consumption of that fuel
 - E.g: natural gas used in chillers to produce chilled water for space cooling should be reported as final consumption of natural gas
- Autoproducer production of chilled water should only be reported when chilled water is sold
 - For autoproducers that consumes the chilled water that it produces and also sells a part of the chilled water has to report two data
 - The equivalent fuel consumed to generate the chilled water used as final consumption of that fuel
 - The amount of chilled water produced and sold and the corresponding fuel used to generate the chilled water sold
 - Calculation of final consumption of the fuel and corresponding fuel used for chilled water sold would be similar to that of heating

Should cooling be in the energy balance?

- Yes

- The transformation process is similar to district heating
- Not considering cooling as an energy product will result in understated EUIs in buildings using district cooling
- There is huge potential for the use of free cooling that would be spurred by the goal of doubling RE share in the energy mix
- Japan and Korea includes district cooling in the energy balance as a part of “heat”
- Collecting district cooling data might not be too difficult especially in economies that can be considered “new” in district cooling



Thank you for your kind attention

<http://aperc.ieej.or.jp/>