Asia-Pacific
Economic Cooperation

APERC
Asia Pacific Energy Research Centre

3-4. A Study on District Cooling System in APEC: The Final Report

APERC Workshop
The 59th Meeting of APEC Energy Working Group (EWG)
25 August 2020

Elvira Torres Gelindon, Research Fellow, APERC

Outline

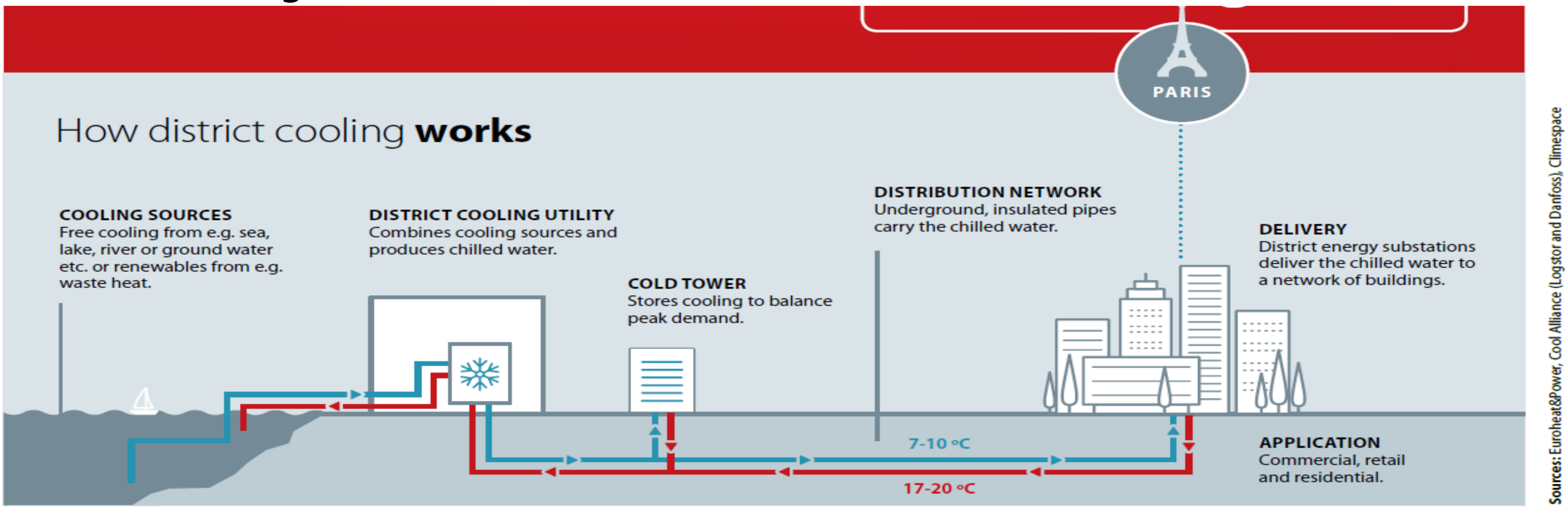
- ❑ Motivation/Objectives
- ❑ How district cooling works
- ❑ Progress since EWG 57?
  - International fora
  - Data gathering
- ❑ Why consider district cooling as energy product?
- ❑ Conclusion and recommendations

Motivation/Objective

- District cooling systems (DCS) are increasingly significant in a number of APEC economies; the space cooling data flow has not been clearly accounted for in energy statistics or energy balances.
- Question raised in APEC EGEDA workshop, how district cooling data can be reported.
- To assess DCS in selected APEC economies, and learn how the consumption in DCS is reported.

What is district cooling? (1)

District cooling



Source: Danfoss. (2016). *How District Cooling Works*. © Copyright Danfoss | Pravda.dk.

- *District cooling is the production and distribution of chilled water from a central source to facilitate air conditioning; done by producing chilled water at a central plant and then piping the water to customers through an underground insulated pipes network.*
- *District cooling can be run on electricity or natural gas, and can use either regular water or seawater. Along with electricity and water, district cooling constitutes a new form of energy service.*

Progress since EWG57 (1)

International fora

- International Energy Agency (IEA)
  - Encouraged IEA members to collect data on district cooling
  - EUROSTAT agreed on the importance; will start to collect
- Presented initial results at International District Energy Association (IDEA)
  - Interviewed experts on energy used in district cooling
- Submitted article/position paper to UN Statistics Division
  - Raised awareness on un-accounted energy consumption
- DCS Workshop (EGEDA/EGEEC)-postponed


UNSD – Energy Statistics Newsletter Number 21/22 (June 2020)

UNITED NATIONS STATISTICS DIVISION

Energy Statistics *Newsletter*

What's inside

ENERGY STATISTICS PUBLICATIONS – NEW EDITIONS

APERC Asia Pacific Energy Research Centre

Progress since EWG57 (2)

Data gathering- meeting

Economy	Description		Fuel use/ Technology
Canada	Cooling capacity	325,290.84 RT* (1,144 MWth, 39 systems)	Natural gas
	Annual energy supplied	1,202 GWh	Heat exchangers/ absorption chillers
	Floor space (cooling)	25 million m^2	
	No. of buildings	855	
The Philippines	Cooling capacity	58,775 RT 10,000 RT	Electricity
2 providers	No. of buildings/ energy supply	10 15 (42.2 MW)	Electric chillers

The system still requires electricity for cooling, although a lot less

APERC Asia Pacific Energy Research Centre

Progress since EWG57 (3)

Data gathering - websites

Economy	Description		Fuel use/ Technology
Hong Kong, China	Cooling capacity Floor space	80, 754.02 RT (284 MW) 1.95 million m^2	Electricity Electric chillers
Singapore	Cooling capacity Floor space	60,000 RT 4.72 million m^2	Electricity Electric chillers
US	Cooling capacity Floor space Energy supply	4,404,776 RT 613.12 million m^2 16 GWth	Electricity, natural gas, oil Heat exchangers/ absorption chillers

* ***Note***: *1 RT or refrigeration ton = 12,000 BTU per hour*
Refrigeration Ton is the unit of measure for the amount of heat removed and is defined as the heat absorbed by one ton of ice (2,000 pounds) causing it to melt completely by the end of one day (24 hours).

Primary energy is used efficiently, surplus heat e.g. from municipal waste incineration, industrial processes and power production may be utilized for cooling production

2. Why consider district cooling as energy product?

APERC
Asia Pacific Energy Research Centre

Cooling as an energy product (1)

- The production and delivery of the service of district cooling and district heating are similar
  - Energy is used to produce both chilled water and heat, and district heating is considered a transformation process, why not district cooling?
- All DCS technologies need a large amount of energy input
  - *Electric chillers* require electricity for cooling; *free cooling* (cold water from oceans, lakes, rivers or aquifers); natural gas and other fossil fuels; *absorption chillers* utilise surplus heat from waste incineration or industrial processes
- All energies are measurable
  - Energy or fuel inputs and the products are all measurable.
  - The products delivered to customers are also measurable
- Building efficiencies are measured by energy use intensity (EUI) in kWh/m^2
  - Excluding chilled water will result in lower (EUI) and understate the actual energy consumption of the building

Cooling as an energy product (2)

- Opens the possibility for free cooling to be considered renewable energy (RE)
  - Huge potential for the use of free cooling in the production of chilled water; increasing the share of RE in the energy mix;
  - Will also encourage the use free cooling resulting in lower carbon energy supply
- Environmental impacts are normally reduced
  - Higher efficiency of district cooling compared with individual building cooling systems;
  - Refrigerants and other chemicals can be monitored and controlled;
  - Free cooling reduces energy requirement in DCS
- Others
  - Reduced capital cost in buildings in terms of avoided cost of chiller and other air-conditioning equipment
  - Reduced electricity usage and maintenance cost
  - Space savings due to avoided space requirement for chiller and air-conditioning installations

3. Conclusion/recommendations

Final thoughts

- ❑ Most economies have already been collecting cooling consumption, but reported as heat in the statistics:
  - China; Japan; Korea;
  - Heat is overstated
- ❑ District cooling data are available in some organization (e.g.IDEA) but not reported/collected
  - Canada; US
  - Large amount of energy used in cooling is missing
- ❑ Need to find out which government agencies are collecting the data;
  - Administrative data
  - Survey
- ❑ Regulation is important in collection of data

Strong collaboration between government, energy statisticians., data users and providers

APERC
Asia Pacific Energy Research Centre

Proposed energy balance table

	Flow	Products							
		Coal	Oil	Gas	RE	Electricity	Heat	Cooling energy	Total
Supply	Production								
	Supply								
	etc								
Transformation	Main activity producer								
	Autoproducer								
	District cooling								
	Final consumption								
Final Consumption	Industry								
	Services								
	Residential								

Cooling energy should have a separate column in the products and district cooling plants will be included in the transformation flow to balance.

What data should be collected

Data collection is similar to heat

- Combined cooling and power plants or cogeneration
  - fuels such as natural gas, coal, oil, RE that are used to generate electricity
  - electricity produced
  - electricity used in electric chillers
  - chilled water output of electric chillers and of absorption chillers.
- District cooling only plants
  - energy inputs
  - chilled water output and sold.

Considering "district cooling" as transformation process and "cooling energy" an energy product would add to the tremendous benefits that district cooling has including achieving energy efficiency and sustainability, and now improving energy statistics.

APERC Asia Pacific Energy Research Centre

Thank you for your kind attention.

https://aperc.or.jp/

APERC
Asia Pacific Energy Research Centre