A STUDY ON DISTRICT COOLING SYSTEMS IN APEC: JAPAN AND MALAYSIA CASES

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Overview

In 2016 during the EGEDA (Expert Group on Energy Data and Analysis) workshop, it was noted that the district cooling systems (DCS) are increasingly significant in most Asia Pacific Economic Cooperation (APEC) member economies. This paper involves two member economies in APEC, namely Japan and Malaysia, with two different climate characteristics where DCS is widely used. In Japan, to mitigate air pollution, many local governments were accelerating the adoption of district heating and cooling systems as an effective measure. This approach is rapidly implemented most especially in metropolitan areas such as Tokyo (EMSD, 2011). In Malaysia, to help obtain energy security and economic efficiency goals, several important infrastructure developments were installed such as the Diamond Building in Putrajaya where a district cooling system was strategically designed to provide thermal comfort in the building (EPU, 2013).

While DCS are becoming popular in APEC, the space cooling data flow—that is, from supply to transformation and consumption—has not been clearly accounted for in energy statistics or energy balances. Space cooling is especially common in the commercial and residential sectors, and if the end use consumption can be accounted for, will give a balance on energy supply and demand.

This study assesses the energy flow of space cooling of these two APEC member economies and hopes to quantify them from supply to transformation and consumption. There's a need to understand where the energy input-output of district cooling is reported. If it is actually reported, maybe it was misallocated or if not, there's a large amount of energy missing in the balance table. Specifically, the study tries to: 1) understand the energy input and output of district cooling system and 2) determine the energy (or its equivalent) delivered to DCS customers; 3) formulate cooling as part of the statistics in energy balance table. And as a final output of the study, be able to propose in international fora to include such statistics in energy balances.

Methods

Primary Research

Interviews and site visit to district cooling facilities were also conducted to familiarize researchers with the DCS technology. Presentations from the DCS experts of the respective case studies were given before the actual site visit to the plants. Given that data on space cooling or consumption from district cooling system were not available in any statistics bodies, collection is done during site visit. Strong collaboration was established with the organization or association so that their reports or data are shared.

Secondary Research

Assessment of the space cooling demand in the economy was mostly done through secondary research. Information were collected from a number of publicly available reports and articles. Data sources include government offices, district heating/cooling associations, power utilities and sometimes through academic literatures.

Results

1) Japan case

Japan's energy balance table is quite detailed such that hot water and hot water supplied from district heating and cooling plants are disaggregated. However, when reporting the data to APEC, the total heating and cooling energy reported were lumped together, that is, heat reported by Japan includes both heating and cooling energy.

Implication:

- Energy efficiency due to cooling is not categorically captured, as cooling was only happening three to four months in a year; generally when temperature is high, specifically during summer;
- CO_2 emissions calculated due to heating is not also accurate.

2) Malaysia Case

While data exists in district cooling facilities in Malaysia, the information is not yet captured in the economy's energy balance table. Malaysia considers district cooling systems as cogeneration facilities, however, there is no specific row for co-generation in the energy balance table. The fuel input to DCS may have been aggregated in the electricity generation processes while the chilled water output is not captured elsewhere.

Implication:

- Energy consumption in commercial sector was over reported;
- As chilled water is not reported, there is large amount of cooling consumption not accounted for in the energy balance table.

Conclusions

Japan and Malaysia are two distinct economies in APEC in terms of climate. While Malaysia experiences warm temperature all year round, Japan experiences warm temperature four months at the most in a year. Nevertheless, demand for cooling in Japan is significant.

Japan consumed more than 60% of gas and 17% electricity for district cooling and 57% cold energy was distributed to its consumers. While these numbers were reported in the association's consumption record, these were lumped into heat consumption in the economy's energy balance table, which is already misleading.

Malaysia's district cooling provider has also records of its consumption. The co-generation plant uses gas and electricity to produce cooling to its consumers. At the height of summer period (May), district cooling plants consumed more than 90% gas and the rest electricity. However, there is no specific row for co-generation in the energy balance table. The fuel input to district cooling may have been aggregated in the electricity generation processes while the chilled water output is not captured elsewhere.

Given that the chilled water or cold water was not properly allocated in the energy balance table for both economies, energy efficiency efforts due for cooling is not actually captured and the consumption reported for heat was overstated. Similarly, CO_2 emissions due to heating or cooling is not properly allocated.

As a way forward, APERC researchers will continue to gather data on district cooling systems from ten other APEC member economies that expressed availability and willingness to share data on DCS, namely, Australia; China; Hong Kong, China; Republic of Korea; the Philippines; Mexico; New Zealand and the US, among others.

References

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