

# 立法會 *Legislative Council*

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## **Panel on Environmental Affairs**

**Meeting on 22 January 2020**

### **Background brief on development of district cooling systems prepared by the Legislative Council Secretariat**

#### **Purpose**

This paper provides background information on the development of district cooling systems ("DCSs") in Hong Kong, including the progress of providing district cooling services at the Kai Tak Development ("KTD"). It also gives a brief account of the views and concerns expressed by Members when the subject was discussed by relevant committees of the Legislative Council ("LegCo") from the 2013-2014 legislative session onward.

#### **Background**

##### Environmental benefits of using district cooling systems

2. A DCS is a centralized air conditioning system of a very large scale. It consists of one or more chiller plants to produce chilled water, and a closed-loop network of underground pipes for chilled water distribution. Chilled water is pumped to individual buildings for use in their air conditioning systems and is then returned to the central chiller plant for re-chilling.

3. According to the Administration, DCSs are a very energy-efficient cooling solution as they take full advantage of economy of scale, diversity in cooling demand of different buildings, and high standard of plant operation and maintenance. Although actual energy savings arising from DCSs vary according to their configurations, a typical saving of around 35% and 20% can be achieved when compared with traditional air-cooled air conditioning systems and individual water-cooled air conditioning systems using cooling towers respectively. The use of DCSs can also bring about other environmental

benefits such as reduced noise pollution, reduced refrigerant usage, and mitigation of heat island effects in the areas serviced. The technology has been widely adopted in other parts of the world, such as the Mainland, Europe, Singapore and the United States.

### Provision of district cooling services at Kai Tak Development

#### *Existing district cooling system*

4. The first-of-its-kind DCS in Hong Kong is being developed in three phases at KTD since 2011, at an estimated total project cost of \$4,945.5 million in money-of-the-day ("MOD") prices.<sup>1</sup> An outline of the scope of works under the three phases is set out in **Appendix I**. The system will support about 1.73 million sq m of non-domestic air-conditioned gross floor area, which requires about 284 MW of refrigeration capacity. The construction works of Phases I, II and III (Package A) were completed in 2013, 2014 and 2017 respectively. The last phase of works (i.e. Phase III) was expected to be completed by end 2025. The operation of the DCS commenced in 2013.<sup>2</sup>

5. The Administration estimated that the maximum annual saving in electricity consumption arising from the entire DCS project would be 85 million kWh, or about 35% reduction compared with the original estimated electricity consumption of 243 million kWh without the DCS. The corresponding reduction of carbon dioxide ("CO<sub>2</sub>") emission is 59 500 tonnes per annum.

#### *Proposed additional district cooling system*

6. As announced in the 2017 Policy Address, the Administration decided to increase the development intensity of KTD. As a result, there will be additional commercial floor area of about 400 000 sq m, a change in the design of the Kai Tak Sports Park with cooling for the stadium having a retractable roof, and an increase in the scale of the New Acute Hospital. The cooling capacity of the existing DCS was designed during the initial development of KTD in 2008, and will not be able to meet the increase in the projected cooling demand. The Administration therefore proposes constructing an additional DCS at KTD at an estimated capital cost of \$4,269.3 million in MOD prices. A preliminary

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<sup>1</sup> The latest estimate was provided in PWSC(2018-19)30 in October 2018 and was in line with the Administration's previous estimates of the total project cost.

<sup>2</sup> District cooling services are currently provided to the Kai Tak Cruise Terminal, Ching Long Shopping Centre, the Trade and Industry Tower, two schools, the Electrical and Mechanical Services Department Headquarters, Hong Kong Children's Hospital, Kai Tak Station and Sung Wong Toi Station.

schedule for the provision of district cooling services through the additional DCS is at **Appendix II**. The relevant financial proposal was endorsed by the Public Works Subcommittee on 15 May 2019.<sup>3</sup>

7. It is estimated that upon full utilization, the additional DCS can save about 53 million kWh of electricity annually, with a corresponding reduction of CO<sub>2</sub> emission of 37 000 tonnes per annum.

#### District Cooling Services Ordinance

8. The District Cooling Services Ordinance ("DCSO") (Cap. 624) was enacted on 27 March 2015. It provides for, among other things, the imposition of charges for the district cooling services provided by the Government. The key components of the charges are (a) capacity charge, which is calculated based on the contract cooling capacity (i.e. an estimation of the maximum designed cooling capacity for a subscribing building), and (b) consumption charge, which is calculated based on the actual monthly cooling energy consumption of the building. The charging arrangements apply to non-government buildings using DCSs specified in Schedule 1 to DCSO.<sup>4</sup> Government buildings using district cooling services are not subject to the charging regime provided in DCSO. The utility costs arising from the provision of district cooling services to user departments are recovered in the form of allocation warrants.

#### Construction of district cooling systems in new development areas

9. In the Chief Executive's 2018 Policy Address, it was announced that in line with the Government's commitment to low-carbon development, the Government would explore the feasibility of providing DCSs in new development areas such as Tung Chung and Kwu Tung North.

#### **Major views and concerns expressed by Members**

10. The Panel on Environmental Affairs ("EA Panel") discussed the charging arrangements for district cooling services in July 2014 and raised issues related to DCSs at its other meetings in connection with the discussions on promoting energy efficiency. A Bills Committee was formed to scrutinize the District Cooling Services Bill, which was passed by LegCo and enacted as DCSO in 2015. Subsequently, the Panel on Development, Public Works

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<sup>3</sup> The Administration has yet to submit the proposal to the Finance Committee.

<sup>4</sup> At present, only the existing DCS at KTD is included in Schedule 1 to DCSO. The charging arrangements may be applied to other DCSs, if any, in future through amending the schedule.

Subcommittee and Finance Committee had considered several financial proposals relating to the provision of DCSs at KTD at various meetings. Members' major views and concerns are summarized in the ensuing paragraphs.

### District cooling services at Kai Tak Development

#### *Environmental benefits*

11. Members enquired about the actual energy savings arising from the use of the existing DCS at KTD. The Administration advised that as at early 2019, the existing DCS was running at about 10% of its designed maximum cooling capacity to meet the prevailing demand for cooling services. Based on the annual cooling service consumption of the existing nine users, the Administration estimated that about 7 million kWh of electricity had been saved in the 2018-2019 financial year through the use of the existing DCS in lieu of traditional air-cooled air conditioning systems. From the commencement of the DCS's operation in 2013 to 2018-2019, the estimated total electricity saved was about 10.08 million kWh. In addition to energy savings, administrators of the two schools using the district cooling services indicated that they had benefited from a quieter teaching and learning environment.

#### *Cost competitiveness of district cooling services*

12. Members sought information on the financial position and investment recovery period of the existing DCS at KTD; the respective construction unit costs of the existing DCS and the proposed additional DCS in terms of serviceable area and cooling capacity; and the construction unit costs of similar systems in other jurisdictions. Some Members expressed concern that advancement in energy-efficient air conditioning technologies would undermine the cost advantage of the DCS technology and dampen the subscription of district cooling services.

13. The Administration advised that:

- (a) the financial model of the existing DCS at KTD had already envisaged negative net revenue during the initial stage of operation. While the net revenue up to 2017-2018 was negative, the amount was smaller than the forecast. The Electrical and Mechanical Services Department would review the actual costs and revenues of the DCS at least once every five years and estimate whether the target of recovering the costs in 30 years could be achieved as planned;<sup>5</sup>

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<sup>5</sup> The first review was conducted in 2019.

- (b) the construction unit costs at the 2018 price level of the existing and proposed additional DCSs were \$19.7 million and \$19.1 million per MW cooling capacity respectively. Given the different building uses, it might not be meaningful to compare the unit costs of the two DCSs by serviceable area. According to a report released by the United Nations Environment Programme in 2015 entitled "District Energy in Cities", the levelized unit cost of cooling production of DCSs in general was about US\$68 per MWh.<sup>6</sup> The unit cost of the proposed additional DCS at KTD in 2013 prices was within 10% difference from that amount. Nevertheless, as the scope, design, technical complexity, cost factors and service requirements of DCSs varied widely from one place to another, the Administration considered that a simple comparison of the unit construction costs without a comprehensive expert analysis could be misleading; and
- (c) the charges for the district cooling services at KTD were set at a competitive level compared to the cost of individual water-cooled air conditioning systems using cooling towers (which was one of the most energy-efficient air conditioning systems available in the international market). Due to the energy efficiency of the existing DCS, developers of private non-domestic developments in KTD were keen on exploring the use of the services.

*Promoting wider use of the services*

14. Members asked how the Administration would promote the district cooling services at KTD so that more private commercial buildings would use the services; whether private residential developments would be allowed to connect to the existing DCS at KTD; and whether the existing DCS could also meet the demand for district cooling services in neighbouring areas such as To Kwa Wan and Kowloon City.

15. The Administration responded that developers of private commercial buildings at KTD were required by provisions in the conditions of land sale to connect their buildings to the existing DCS. It might not be cost effective for residential buildings to use district cooling services, given that there was generally considerable fluctuation in residential units' cooling demand throughout a year. Nevertheless, the Administration would adopt an open attitude towards providing district cooling services to residential buildings at KTD. It should be noted that the existing DCS at KTD had been designed to

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<sup>6</sup> The levelized unit cost of cooling production takes into account the total capital costs and the project life operating costs in terms of cost per unit MWh.

cater for additional cooling capacity of about 10% in future, which might not be sufficient for service provision to areas outside the planned scope. Moreover, service provision to neighbouring areas would require additional installations, such as underground chilled water distribution pipes in those areas, which might undermine the cost effectiveness of the DCS.

#### Feasibility of constructing district cooling systems in other areas

16. Noting that the existing DCS at KTD was seawater-cooled, Members asked whether new development areas located far from the coast would meet the criteria for DCS development; and whether the Administration had plans to implement DCS projects in developed areas.

17. The Administration advised that according to overseas experiences, it was technically possible to develop DCSs at locations far from the coast by installing large-scale water towers. However, such DCSs might have lower energy efficiency compared to seawater-cooled DCSs. As regards adoption of DCS in developed areas, the Administration pointed out that there were technical difficulties, site constraints and greater cost implications associated with laying chilled water distribution pipes in such areas where there were existing underground public utilities. Adopting DCS technology in developed areas might also give rise to environmental problems, such as the premature disposal of existing air conditioning systems to make way for cooling supply with DCS in the premises concerned.

#### **Latest development**

18. At the meeting of EA Panel on 22 January 2020, the Administration will seek members' views on a proposal of creating a permanent directorate post of Chief Building Services Engineer to oversee the implementation of DCS projects in various new development areas.

#### **Relevant papers**

19. A list of relevant papers is set out in **Appendix III**.

## Appendix I

### District cooling system ("DCS") at Kai Tak Development ("KTD")

#### Scope of works under various phases

Phases	Period	Scope of Works
<p><b>Phase I –</b> Works contract for the pipe laying work for part of KTD Package I</p>	2010-11 – 2012-13	<ul style="list-style-type: none"> <li>• pipe laying from northern chiller plant room for provision of chilled water to Ching Long Shopping Centre under the Hong Kong Housing Authority to meet the roadwork programme in the North Apron.</li> </ul>
<p><b>Phase II –</b> DCS core services under Design, Build and Operate arrangement</p>	2010-11 – 2014-15	<ul style="list-style-type: none"> <li>• design for the whole DCS;</li> <li>• building and engineering works, the northern chiller plant room, southern underground chiller plant room and the seawater pumphouse to support the operation of the entire DCS;</li> <li>• laying of chilled water distribution pipes not covered in Phase I for Package I users (Kai Tak Cruise Terminal building);</li> <li>• electrical and mechanical ("E&amp;M") equipment for KTD Package I users; and</li> <li>• operation of DCS up to 2027-28.</li> </ul>
<p><b>Phase III (Package A) –</b> E&amp;M installations and pipe laying for part of KTD Packages II and III</p>	2013-14 – 2017-18	<ul style="list-style-type: none"> <li>• pipe laying works to match with the programme of road construction and upcoming building developments including Trade and Industry Tower and Hong Kong Children's Hospital; and</li> <li>• provision of E&amp;M equipment for the above building developments and two schools.</li> </ul>

Phases	Period	Scope of Works
<p><b>Phase III (Package B)</b> – E&amp;M installations and pipe laying for part of KTD Packages II and III</p>	<p>2015-16 – 2018-19</p>	<ul style="list-style-type: none"> <li>• pipe laying works to match with the programme of road construction and upcoming building developments including the Electrical and Mechanical Services Department Headquarters, Sung Wong Toi Station (previously named as To Kwa Wan Station) and Kai Tak Station of the Shatin to Central Link, and the Kowloon East Regional Headquarters and Operational Base cum Ngau Tau Kok Divisional Police Station;</li> <li>• provision of E&amp;M equipment for the above building developments; and</li> <li>• consultancy services for pre-construction stage (design) of the remaining Phase III works to tie in with the ongoing and upcoming programmes on the developments and infrastructure works carried out by the Civil Engineering and Development Department.</li> </ul>
<p><b>Phase III (Package C)</b> – Pipe laying for part of KTD Packages II and III</p>	<p>2016-17 – 2019-20</p>	<ul style="list-style-type: none"> <li>• pipe laying works to match with the programme of road construction of Road D1 (Part) and Road L7.</li> </ul>
<p><b>Remaining Works under Phase III</b> – E&amp;M installations and pipe laying for remaining KTD Package III</p>	<p>2018-19 – 2025-26</p>	<ul style="list-style-type: none"> <li>• pipe laying works to match with the programme of Roads L10 &amp; L18.</li> <li>• pipe laying works at Station Square, Lam Chak Street and waterfront promenade; and</li> <li>• provision of E&amp;M equipment for remaining building developments in KTD under Phase III.</li> </ul>

[Source: Enclosure 1 to [PWSC\(2018-19\)30](#) provided by the Administration.]



## Appendix II

### Provision of an additional district cooling system ("DCS") at Kai Tak Development

#### Schedule of Provision of DCS

Site	Usage	Year of DCS Provision
2A-4, 2A-5(A), 2A-5(B), 2A-10	Commercial	2023
2D1	Kai Tak Sports Park	2022
3A1	Animal Management and Animal Welfare Building Complex of the Agriculture, Fisheries and Conservation Department	2022
3A6, 3B1, 3B2, 3B3, 3B4	Commercial	2025-2028
Part of 3C-1 (A)	New Acute Hospital	2024
3C-1 (B)	New Acute Hospital	2024

[Note: Year of DCS provision to commercial sites is subject to the development schedule of the sites.]

[Source: Enclosure 2 to [PWSC\(2019-20\)1](#) provided by the Administration.]

## Development of district cooling systems

## List of relevant papers

Date	Event	Paper
17 July 2014	Special meeting of the Panel on Environmental Affairs ("EA Panel")	<p>Administration's paper on "Collection of Charges for District Cooling System at the Kai Tak Development" (LC Paper No. <a href="#">CB(1)1785/13-14(01)</a>)</p> <p>Minutes of meeting (LC Paper No. <a href="#">CB(1)179/14-15</a>)</p> <p>Administration's follow-up paper (LC Paper No. <a href="#">CB(1)1903/13-14(01)</a>)</p>
15 October 2014	The District Cooling Services Bill ("the Bill") was introduced into the Legislative Council ("LegCo")	<p><a href="#">The Bill</a></p> <p>LegCo Brief (<a href="#">File Ref.: ENB CR 4/2061/08</a>)</p> <p>Legal Service Division report (LC Paper No. <a href="#">LS5/14-15</a>)</p>
November 2014 to February 2015	The Bills Committee on District Cooling Services Bill	Report of the Bills Committee (LC Paper No. <a href="#">CB(1)649/14-15</a> )
27 March 2015	The Bill was passed by LegCo	<a href="#">Bill passed</a>
28 April 2015	Meeting of the Panel on Development ("DEV Panel")	<p>Administration's paper on "45CG — District Cooling System at the Kai Tak Development" (LC Paper No. <a href="#">CB(1)759/14-15(05)</a>)</p> <p>Minutes of meeting (LC Paper No. <a href="#">CB(1)1107/14-15</a>)</p> <p>Administration's follow-up paper (LC Paper No. <a href="#">CB(1)932/14-15(01)</a>)</p>

Date	Event	Paper
16 June 2015	Meeting of the Public Works Subcommittee ("PWSC")	Administration's paper on "Head 705 — Civil Engineering — Multi-purpose — 45CG — District Cooling System at the Kai Tak Development" ( <a href="#">PWSC(2015-16)29</a> )  Minutes of meeting (LC Paper No. <a href="#">PWSC240/14-15</a> )
14 July 2015	Meetings of the Finance Committee ("FC")	Minutes of meetings (LC Paper No. <a href="#">FC50/15-16</a> ) (LC Paper No. <a href="#">FC51/15-16</a> )
23 February 2016	DEV Panel meeting	Administration's paper on "45CG — District Cooling System at the Kai Tak Development" (LC Paper No. <a href="#">CB(1)559/15-16(05)</a> )  Minutes of meeting (LC Paper No. <a href="#">CB(1)931/15-16</a> )  Administration's follow-up paper (LC Paper No. <a href="#">CB(1)669/15-16(01)</a> )
13 April 2016	PWSC meeting	Administration's paper on "Head 705 — Civil Engineering — Multi-purpose — 45CG — District Cooling System at the Kai Tak Development" ( <a href="#">PWSC(2015-16)62</a> )  Minutes of meeting (LC Paper No. <a href="#">PWSC195/15-16</a> )  Administration's follow-up paper (LC Paper No. <a href="#">PWSC190/15-16(01)</a> )
29 April 2016	FC meeting	Minutes of meeting (LC Paper No. <a href="#">FC287/15-16</a> )
26 June 2018	DEV Panel meeting	Administration's paper on "702CL — Kai Tak development — remaining infrastructure works for developments at the former runway and south apron" (LC Paper No. <a href="#">CB(1)1133/17-18(05)</a> )

Date	Event	Paper
		<p>Minutes of meeting (LC Paper No. <a href="#">CB(1)222/18-19</a>)</p> <p>Administration's follow-up paper (LC Paper No. <a href="#">CB(1)1356/17-18(01)</a>)</p>
7 November 2018	PWSC meeting	<p>Administration's paper on "Head 705 — Civil Engineering — Multi-purpose — 45CG — District Cooling System at the Kai Tak Development (<a href="#">PWSC(2018-19)30</a>)</p> <p>Minutes of meeting (LC Paper No. <a href="#">PWSC40/18-19</a>)</p>
4 January 2019	FC meeting	<p>Minutes of meeting (LC Paper No. <a href="#">FC229/18-19</a>)</p>
26 February 2019	DEV Panel meeting	<p>Administration's paper on "Kai Tak development — infrastructure at north apron area of Kai Tak Airport, provision of an additional district cooling system at the Kai Tak development and progress report on Kai Tak development" (LC Paper No. <a href="#">CB(1)593/18-19(03)</a>)</p> <p>Minutes of meeting (LC Paper No. <a href="#">CB(1)1335/18-19</a>)</p> <p>Administration's follow-up paper (LC Paper No. <a href="#">CB(1)834/18-19(01)</a>)</p>
14 and 17 May 2019	PWSC meetings	<p>Administration's paper on "Head 705 — Civil Engineering — Multi-purpose — 50CG — Provision of an Additional District Cooling System at the Kai Tak Development (<a href="#">PWSC(2019-20)1</a>)</p> <p>Letter from Dr Hon KWOK Ka-ki (LC Paper No. <a href="#">PWSC169/18-19(01)</a>) (Chinese version only)</p>

<b>Date</b>	<b>Event</b>	<b>Paper</b>
		Administration's written response to letter from Dr Hon KWOK Ka-ki (LC Paper No. <a href="#">PWSC190/18-19(01)</a> )  Minutes of meetings (LC Paper No. <a href="#">PWSC289/18-19</a> ) (English version to follow) (LC Paper No. <a href="#">PWSC240/18-19</a> ) (English version to follow)
27 May 2019	EA Panel meeting	Administration's paper on "Promotion of Energy Efficiency and Conservation as well as Renewable Energy through Innovation and Technology" (LC Paper No. <a href="#">CB(1)1083/18-19(03)</a> )  Minutes of meeting (LC Paper No. <a href="#">CB(1)1306/18-19</a> )