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Review of the Fifth Technical Memorandum for Allocation of Emission Allowances for Power Plants

PURPOSE

This paper seeks Members' views on our proposal to reduce emission allowances for power plants starting from 1 January 2021 by way of issuing a new Technical Memorandum (TM) (i.e., the Sixth TM) under Section 26G of the Air Pollution Control Ordinance (Cap. 311) (APCO).

BACKGROUND

2. APCO empowers the Government to cap the emissions of power plants for improving air quality. Its Section 26G provides for the Secretary for the Environment (the Secretary) to allocate emission allowances for three specified pollutants, i.e., sulphur dioxide (SO2), nitrogen oxides (NOx) and respirable suspended particulates (RSP), for power plants by way of a TM.

3. Five TMs were issued in 2008, 2010, 2012, 2014 and 2015 respectively. The First TM set the emission allowances for the emission years between 2010 and 2014. The Second one took effect from 1 January 2015 while the Third, Fourth and Fifth TM will take effect from 1 January 2017, 1 January 2019 and 1 January 2020 respectively.

4. The emission allowances in the Fifth TM were determined with due regard to the Government's plan announced in March 2015 to increase the local gas generation to around 50 per cent of the total fuel mix for electricity generation by 2020 ("Fuel Mix Target") so as to meet the Government's pledged environmental

targets for 2020[1]. The Hongkong Electric Company, Limited (HEC) is now building a new gas-fired electricity generating unit (gas-fired unit) of 380 MW, scheduled for completion by the end of 2019. With this new gas-fired unit, HEC will be able to meet the electricity demand arising from the scheduled retirement of old coal-fired generating units (coal-fired units). CLP Power Hong Kong Limited (CLP) is still making preparation for additional gas-fired units at its Black Point Power Station. It will endeavour to continue importing 80 per cent of nuclear output from the Daya Bay Nuclear Power Station (DBNPS).

5. The emission allowances under the Fifth TM are at the **Annex**. The TM's allocation of emission allowances in respect of each of the specified pollutants for new electricity works was based on the emission performance of a new gas-fired unit adopting the best practicable means (BPM) for emission reduction.

6. When setting the emission allowances under the Fifth TM last year, we committed to reviewing the TM in 2016 to take account of the latest developments on the capacity and timing of new gas-fired units at CLP's Black Point Power Station, which will affect the fuel mix for electricity generation and hence emissions in future years. If we are able to promulgate a new TM within 2016, the new emission allowances will take effect from 1 January 2021 pursuant to Section 26G(4) of the APCO, which requires a TM to be issued at least four years before the commencement of the emission year that it takes effect.

THE REVIEW

7. Under Section 26G(2) of the APCO, the Secretary, in making the emission allocations, shall:

(a) have regard to the best practicable means (BPM) for preventing the emission of that type of pollutant;

(b) have as his purpose the attainment and maintenance of any relevant air quality objective ; and

(c) have regard to whether the emission of that type of pollutant would be, or is likely to be, prejudicial to health.

[1] The pledged environmental targets for 2020 are to reduce the carbon intensity by 50-60% by 2020 when compared to 2005; and to reduce the emissions of sulphur dioxide (SO_2) by 35-75%, nitrogen oxides (NO_x) by 20-30% and respirable suspended particulates (RSP) by 15-40% by 2020 when compared to 2010.

8. To meet the emission allowances set under the TM, the power companies should continue to use low emission coal and uphold the performance of the emission control devices while maximising the use of existing gas-fired units and prioritizing the use of coal-fired units equipped with advanced emission control devices.

9. The extensive retrofits that the power companies have undertaken in the past to reduce their emissions, rendering it impracticable to conduct further retrofits. Revamping the fuel mix for power generation is the only practicable way to significantly reduce their emissions. Furthermore, surplus electricity from renewable energy (RE) sources has been used to help reduce emissions from coal-fired units. The Government is also prepared to consider developing more RE, and will also enhance efforts to promote energy saving.

10. When determining the emission allowances for the two power companies under the new TM, we have also taken account of the following –

(a) the progress of implementing the fuel mix plan for 2020, including the construction of new gas-fired units and replacement of some old power generating units, which are scheduled for retirement after reaching the end of their service life in the coming years;

(b) the practicability to maintain the current import of 80% of nuclear output from DBNPS to CLP after 2018; and

(c) the projected local electricity consumption for 2021.

11. Based on the above considerations, our assessment for HEC is as follows –

(a) HEC is working to build another new gas-fired unit of 380 MW for operation in 2022 to meet the Fuel Mix Target;

(b) the electricity demand for Hong Kong Island is forecasted to reduce by around 2.4% in 2021 as compared to that of 2020 when setting the Fifth TM. The lower load forecast mainly reflects the potential impact of the various Energy Efficiency and Conservation (EE&C) initiatives, e.g. the Mandatory Energy Efficiency Labelling Scheme, Buildings Energy Efficiency Ordinance, Incandescent Light Bulbs Charter and the "Energy Saving Plan for Hong Kong's Built Environment 2015-2025+" released by

the Government in May 2015;

(c) as gas-fired units will continue to take up the base electricity load, the reduced electricity demand forecast in 2021 will imply less electricity generation from their old coal-fired units. As a result, HEC's emission allowances in 2021 could be reduced by 8% for SO2, 2% for NOx and 10% for RSP as compared to the levels in the Fifth TM; and

(d) the commencement of operation of the new gas-fired unit in 2022 would provide scope for further reducing the emission allowances in due course.

12. As for CLP, the assessment is as follows –

(a) although CLP has obtained an environmental permit (EP) under the Environmental Impact Assessment Ordinance (Cap. 499) for its construction and operation of a new gas-fired unit at its Black Point Power Station, the proposal of constructing the new gas-fired unit is being reviewed by both the Government and CLP. There are thus uncertainties as to whether it could be ready for operation in 2021;

(b) DBNPS would continue to supply 80% of its annual nuclear power output to CLP beyond 2018;

(c) the electricity demand for CLP is forecasted to reduce by around 1.4% in 2021 as compared to that of 2020 when setting the Fifth TM. The projected load reduction is attributable to the Government's Energy Saving Plan launched in May 2015, which sets a target of reducing energy intensity in Hong Kong by 40% by 2025 when compared to 2005; and

(d) as the gas-fired units will continue to bear the base load, the reduction in the forecast of CLP's demand is expected to impact mostly on coal-fired generation. It is estimated that its emission allowances could be reduced by 7% for SO2, 4% for NOx and 5% for RSP in 2021 as compared to the levels in the Fifth TM.

13. The projected emissions for the electricity works of the two power companies in 2021 and beyond are presented in Table 1 below, together with the reductions relative to the respective Fifth TM levels -.

Table 1: Projected Emissions for Electricity Works in 2021 and beyond (tonnes per year)

		Sulphur dioxide	**Nitrogen oxides** [@]	**Respirable suspended particulates**
HEC	Lamma Power Station and Lamma Power Station Extension (mixed fuel)	2 870 [-8%]	6 220 [-2%]	130 [-10%]
CLP	Black Point Power Station (gas-fired)	278 [0%]	4 063 [0%]	108 [0%]
	Castle Peak Power Station (coal-fired)	3 930 [-8%]	10 245 [-6%]	311 [-6%]
	Penny's Bay Gas Turbine Power Station (oil -fired)	2 [0%]	2 [0%]	1 [0%]
	Total of CLP's Stations	4 210 [-7%]	14 310 [-4%]	420 [-5%]
Electricity sector		7 080 [-8%]	20 530 [-3%]	550 [-6%]

[@] Expressed as nitrogen dioxide

Note: The figures in square brackets are the percent reduction comparing with the emission allowances stipulated in the Fifth TM.

14. Based on the above projected emissions, in ascertaining the emission allowances for HEC and CLP (paragraphs 15 and 16 below), we will also follow the established mechanism in the Fifth TM by taking into account the actual intake of the electricity generated from RE and the unit emission factors of coal-fired units[2]. For RE facilities, the Lamma Winds of HEC and its photovoltaic system at Lamma Power Station will continue to supply RE of about 2 GWh per year in total to HEC's power grid. CLP will have additional RE power from Phase 1 of Environmental Protection Department's (EPD) new Organic Waste Treatment Facilities in Siu Ho Wan, North Lantau, which will be commissioned in 2017, apart from EPD's Sludge Treatment Facility in Tuen Mun, which started operation in 2015. These two facilities will supply about 32 GWh of surplus electricity to CLP's power grid per year. Besides, EPD's Integrated Waste Management Facility in Shek Kwu Chau is also a potential RE facility and is expected to start providing RE by 2023. Further

[2] Unit emission factors of coal-fired units are the averaged emission of specified pollutants (i.e. SO_2, NOx and RSP) owing to the generation of 1 GWh electricity from coal-fired generation units in the power plant, expressed in Tonne/GWh.

assessment will be conducted in our next review of TM when more details are available.

PROPOSED EMISSION CAPS FOR NEW TM

Emission Allowances for Existing Electricity Works

15. Based on the above review, we propose to promulgate a new TM to allocate the emission allowances from 2021 onwards to each of the existing power plants by the following method, as adopted in the Fifth TM -

Emission allowances to be allocated and ascertained	
=	Emission allowances that are required with the use of BPM (i.e., those presented in Table 1 above)
plus/minus	Emission allowances to be added/deducted owing to deviation of the actual intake of RE from the anticipated intake (i.e., 2 GWh and 32 GWh for HEC and CLP respectively) in accordance with the unit emission factors of coal-fired units

16. The formulae for allocating the emission allowances to the four electricity works are presented in the tables below –

Table 2(a): Lamma Power Station and Lamma Power Station Extension

	Quantity of Emission Allowance for 2021 and thereafter
SO2	2 870 + (2 – A) × 0.529*
NOx [@]	6 220 + (2 – A) × 0.938*
RSP	130 +(2 – A) × 0.017*

Table 2(b): Black Point Power Station

	Quantity of Emission Allowance for 2021 and thereafter
SO2	278
NOx [@]	4 063
RSP	108

Table 2(c): Castle Peak Power Station

	Quantity of Emission Allowance for 2021 and thereafter
SO2	3 930 + (32 – B) × 0.407[#]
NOx [@]	10 245 + (32 – B) × 1.062[#]
RSP	311 + (32 – B) × 0.031[#]

Table 2(d): Penny Bay's Gas Turbine Power Station

	Quantity of Emission Allowance for 2021 and thereafter
SO2	2
NOx [@]	2
RSP	1

[@] Expressed as nitrogen dioxide

* Unit emission factors of coal-fired units in Lamma Power Station in 2021

\# Unit emission factors of coal-fired units in Castle Peak Power Station in 2021

where –

A is the aggregate of total net sent-out electricity output (in GWh) from individual RE to the electricity grid of Lamma Power Station and Lamma Power Station Extension in the emission year; and

B is the aggregate of total net sent-out electricity output (in GWh) from individual RE to the electricity grid of Castle Peak Power Station in the emission year.

Emission Allowances for New Electricity Works

17. In the event that there will be new electricity works[3], we will, as in the past, allocate emission allowances based on the emission performance of a new gas-fired unit having adopted BPM for emission reduction. We also propose to retain the mechanism in the Fifth TM to cater for the possible intake of RE by new electricity works. Accordingly, the formulae for allocating and ascertaining the emission allowances in respect of each of the specified pollutants for possible new electricity

[3] "New electricity works" refers to new entrant (i.e. in addition to HEC and CLP) coming into the electricity generation industry after the commencement of the proposed TM. The use of coal in new electricity generation plants was banned since 1997. New generation units shall be gas-fired units.

works, with respect to the same reference installed capacity adopted in the previous TM, i.e., 300 MW, for emission years starting from 1 January 2021 would be as presented in the table below.

Table 3: New Electricity Works

	Quantity of Emission Allowance for 2021 and thereafter
SO2	36 × (C/300) × (D/12) – E × 0.018^
NOx [@]	55 × (C/300) × (D/12) – E × 0.028^
RSP	14 × (C/300) × (D/12) – E × 0.007^

[@] Expressed as nitrogen dioxide

^ Unit emission factors of gas-fired units equipped with latest emission control device

where –

C is the total installed capacity (in MW) of the New Electricity Works; or 300 (i.e., reference installed capacity), whichever is smaller;

D is the total number of months in the emission year after the commencement of operation of the New Electricity Works and part of a month is taken as a full month in the determination; and

E is the aggregate of total net sent-out electricity output (in GWh) from individual RE to the electricity grid of the New Electricity Works in the emission year.

Next Review

18. HEC is planning to build a new gas-fired unit for commissioning in 2022 to meet the Fuel Mix Target. CLP is also preparing to build a new gas-fired unit at its Black Point Power Station. Since the addition of new gas-fired units will affect the fuel mix for electricity generation and hence emissions in future years, we will review the TM again in 2017 when more information on the timing of their availability is available.

Commencement Date of New Emission Caps

19. If the proposed new TM commences before the end of 2016, the new emission allowances will take effect starting from 1 January 2021, having regard to the statutory requirement in Section 26G(4) of the APCO that an allocation of emission allowances made by the TM in relation to an emission year could only take effect at least four years after the commencement of the TM making the allocation.

Special Events

20. The emission allowances to be allocated under the proposed new TM are premised on the availability of 80% nuclear energy import from DBNPS to CLP in 2019 and beyond. Should there be any uncontrollable factors that affect the additional nuclear power supply, we will deal with them under the existing mechanism of the APCO when the power companies invoke the special event provision under Section 26K of the APCO to adjust their emission caps. We will not lightly adjust the emission caps under the special event mechanism unless the incidents are proven to be outside the control of power companies and they have proven to have made their best endeavour to avoid such happenings.

ENVIRONMENTAL IMPLICATIONS

21. As compared with the emission allowances for 2020 set under the Fifth TM, the proposed Sixth TM will see a further tightening of 8% for SO2, 3% for NOx as well as 6% for RSP for the electricity sector. The reduction will help improve air quality, given that emissions from the electricity sector account for 53%, 33% and 17% respectively of the territory-wide emissions of these pollutants in 2014.

TARIFF IMPLICATIONS

22. Achieving the proposed 2021 emission caps does not involve new capital investment by the power companies. As for fuel costs, while the Sixth TM will not have any major impact on the fuel mix of power companies, actual fuel costs would be subject to then international market prices. The power companies will present their tariff assessment to the Government in accordance with the relevant regulatory mechanism under the new Scheme of Control Agreement (SCA) should there be a new SCA.

CONSULTATION

23. We have consulted the two power companies about the proposal to further tighten the emission caps. Both companies consider the proposed new emission allowances extremely challenging. Nevertheless, they are supportive of the new energy efficiency and conservation initiatives proposed by the Government in the "Energy Saving Plan for Hong Kong's Built Environment 2015-2025+" and Hong

Kong's new fuel mix plan for 2020 with a view to cutting emissions from electricity generation. They are committed to working closely with the Government to ensure compliance while maintaining a reliable supply of electricity to the customers. They also agree to another review of the TM next year when more details about their new gas-fired generation projects are available.

24. Both power companies also see the compliance of the emission allowances contingent upon availability of fuels of the right quality. They have also put forward that any forced outages or a drop in the performance of the generating units or emission control equipment due to ageing problem or natural deterioration will jeopardize their compliance with the new emission allowances. Should their operation encounter events that are beyond their control and with significant emission implications (e.g., cessation or insufficient supply of low emission coal, unexpected increase in power demand, increase in sulphur content of the natural gas supplied, less than expected nuclear energy made available to CLP for 2021, and/or other related issues falling outside their control), they may have to resort to the special event provision under Section 26K of the APCO to adjust their emission allowances accordingly. When necessary, we will handle these special events in accordance with the APCO.

WAY FORWARD

25. We plan to submit the Sixth TM to the Legislative Council under Section 37B(1) of the APCO for negative vetting in late October 2016. Our target is to commence the Sixth TM before the end of 2016, thus fulfilling the statutory requirement to provide the power companies with at least four years' lead time for the tightened emission allowances to take effect from 1 January 2021.

Environmental Protection Department
October 2016

Annex

Emission Allowances for Existing Electricity Works under the Fifth TM (tonnes per year)

(a) Lamma Power Station and Lamma Power Station Extension

	2020 and thereafter
Sulphur dioxide	3 130 + (2 – A) × 0.563
Nitrogen oxides [@]	6 350 + (2 – A) × 0.928
Respirable suspended particulates	145 +(2 – A) × 0.019

(b): Black Point Power Station

	2020 and thereafter
Sulphur dioxide	279
Nitrogen oxides [@]	4 074
Respirable suspended particulates	108

(c): Castle Peak Power Station

	2020 and thereafter
Sulphur dioxide	4 259 + (32 – B) × 0.422
Nitrogen oxides [@]	10 844 + (32 – B) × 1.073
Respirable suspended particulates	331 + (32 – B) × 0.033

(d): Penny Bay's Gas Turbine Power Station

	2020 and thereafter
Sulphur dioxide	2
Nitrogen oxides [@]	2
Respirable suspended particulates	1

[@] Expressed as nitrogen dioxide

Where –

A is the aggregate of total net sent-out electricity output (in GWh) from individual RE to the electricity grid of Lamma Power

Station and Lamma Power Station Extension in the emission year; and

B is the aggregate of total net sent-out electricity output (in GWh) from individual RE to the electricity grid of Castle Peak Power Station in the emission year.