Submission to the Subcommittee on Issues Relating to Air, Noise and Light Pollution on "Air Pollution Modelling in Hong Kong"

We welcome the Subcommittee's review of "Air Pollution Modelling in Hong Kong". Hong Kong's air quality is a topic of great public concern. The lack of progress in improving air quality has led many to question the effectiveness of our air quality management system. Most people understand that air quality modelling is important for our air quality management system because of its role in air quality impact assessment. However, not many people understand the details of air quality modelling as modelling is relatively technical and complicated. Hence, most people prefer to treat it as a black box. People don't like black boxes, particularly when our air quality management system does not seem to be working. Therefore, there have been growing concerns about of the accuracy and application of air quality models in Hong Kong.

By definition, modelling is an approximation of reality. Hence, we should not expect models to match point-to-point air quality observations. Even the most advanced air quality models cannot do that. However, when used properly, models can be very useful. They can help us understand the causes of air pollution events, assess the relative contribution of different emission sources to our air pollution problems, and forecast short-term air quality variations. Most importantly, air quality modelling is the only credible tool for assessing the impact of different control policies on future air quality, so it plays a central role in policy formulation and environmental impact assessment (EIA).

In particular, air quality modelling has been used regularly in the United States and Europe to support policy formulation to help achieve local air quality standards for protection of public health. Air quality modelling is an integral component of policy development and assessment for the full range of spatial scales from national, regional, urban, and down to specific local areas. In addition, air quality models are often used in conjunction with assessment models to provide cost-benefit analyses for discussion and development of air quality legislations.

For example, the UK National models have been used routinely to assess the impact of a whole range of policy options including electricity production strategies, reductions of sulphur in fuel, varying percentage of diesel vehicles, introduction of different EURO standard vehicles, control of volatile organic compounds (VOCs) emission from small plants, etc. To gauge the impact of a specific control option, the normal procedure is to project the change in emissions as a result of the policy option and then use the models to estimate the resultant pollutant concentrations and the associated health and economic impacts.

Air quality modelling is also used around the world for air quality impact assessment in the EIA process. Here, air quality models are used to assess, for the life-cycle of a proposed project, whether the air pollutant concentrations at selected sensitive receivers will exceed the concentration limits set by the local authorities. In particular, the air quality models need to estimate the total (i.e. background plus project-related) concentrations of the pollutants at the sensitive receivers.

Coming back to Hong Kong, the Air Quality Objectives (AQOs) are our reference concentrations for approving or rejecting EIAs. Since the EIA Ordinance came into effect in 1998, many projects have successfully passed the air impact assessments of the EIA process. In other words, for each of these projects, it was predicted that the air quality (at nearby sensitive receiver sites) will comply with our AQO. However, looking at the air quality monitoring data from the Environmental Protection Department (EPD), Hong Kong has never been able to fully achieve our AQOs since its establishment in 1987.

So, we have a peculiar situation: for the past 15 years, the air quality models used in the EIAs are projecting compliance with the AQOs, while observations by EPD showed continual non-compliance for Hong Kong. ***This apparent contradiction is an important reason why many are skeptical about the EIA process in general, and lost trust in the air quality models in particular.***

To better understand the situation, let's first look at the air quality models used in Hong Kong. Similar to the US and Europe, Hong Kong EPD recommends a suite of models for different EIA applications, ranging from the simple single source Gaussian plume models to the sophisticated PATH modelling system (developed by EPD). Looking at them component by component, we see that all these models are standard tools used around the world for similar purposes. ***Their formulations are scientifically sound, and they should be adequate for their purposes.***

Nevertheless, the accuracy of the models depends not only on their formulation, but also on the input and boundary conditions used to drive the models. For EIA, the most important part is the accuracy of the estimated future emissions. This is not just the future emissions from the proposed project. Both the project-related emissions and the background (non-project related) emissions are important since the acceptance of EIA depends on the total (i.e. project plus background) concentration. Given that the air quality models are adequate for EIA application, the fact that they had been predicting better air quality than what has been observed may be related to under-estimation of project related emissions, under-estimations of non-project related background emissions, or both.

However, it is difficult for us to pinpoint the problem as there are only very limited amount of information available in the EIA reports regarding the projected emission inventory in future years, or the assumptions taken to arrive at those projections**.** ***For the EIA process to be effective, the control assumptions used in the EIAs for future years must be broadly consistent with the control policies being pushed by the government and adopted by society*****.**

It is unclear to us whether the control assumptions used in the earlier EIAs has successfully been adopted. If not, why not? Are the assumptions realistic or are they too generous in its emission reductions? Are there corresponding government policy actions being pushed for adoption of these control measures? Or more basically, what are the requirements for accepting specific policy assumptions for their use in EIAs, and how can the government assure the public that these control policies will be implemented in a timely manner consistent with the EIA assumptions? Just as an example, the future energy fuel mix is an important factor affecting local air quality. What is the future fuel mix assumed in the current EIAs, and are there corresponding and timely policy actions pushing for such fuel mix combinations?

Transparency is critical. To allow better understanding and appreciation of our air modelling system, EPD should make available online documentations, program codes and gridded emission and meteorological data so that anyone interested in understanding the air quality modelling process can do so. Future emission scenarios and assumptions, as well as the corresponding policy actions, should be made explicit (similar documentation, source codes and data are readily available in the US). For the EIA reports, instead of (or in addition to) having pages after pages of model results, a crisp but detailed summary of the model emission assumptions, with relevant figures showing the spatial changes of these emissions, should be provided as it is critical for improving the credibility of the EIA reports.

In summary, air modelling is an essential part of any air quality management system. In Hong Kong, to enhance public trust and support, **the government needs to improve the transparency of our air quality modelling system and its applications in the EIA process**. Even more important, the government needs to make sure the control assumptions used in the EIA air quality models are closely supported by timely policy actions.

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