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The Role Science Plays in Reducing Policy Uncertainties: Collaborative Governance for Shipping Emissions Control in Hong Kong and the Greater Bay Area

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Key points

- Substantive uncertainties, strategic uncertainties, and institutional uncertainties are major obstacles to policy development of emissions regulation.
- Extensive and reliable scientific research is indispensable to reducing or eliminating substantive uncertainties.
- The involvement of civil society actors and key stakeholders is essential to reducing or eliminating strategic and institutional uncertainties.
- Policy collaboration can be escalated gradually and the spectrum of stakeholders involved widens as uncertainties are increasingly reduced or eliminated.

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Policy Focus

Before the implementation of shipping emissions control, Hong Kong produced the second-highest shipping pollutant emissions levels among cities worldwide. Exhaust emissions from ocean-going vessels (OGVs) near ground level within a few kilometers of densely populated residential areas were devastating to ambient air quality and public health (Lau et al., 2005). Effective policy tackling shipping emissions, requires collaboration among various stakeholders across the private sector, the public sector, and multiple government agencies. Lacking precise information about the various aspects of shipping emissions pollutants, however, can generate uncertainties that substantially undermine incentives for taking collaborative action.

In the context of policymaking, uncertainties can be decomposed into three categories (Koppenjan & Klijin, 2004):

1. Substantive uncertainties: insufficiency of relevant information or lack of consensus about how policymakers should interpret information regarding a complex policy issue.
2. Strategic uncertainties: unpredictable decisions made by various stakeholders and the variabilities caused by interaction between these decisions and the policy environment.
3. Institutional uncertainties: discordance between stakeholders and policymakers because of misaligned institutional regimes and behaviors.

This bulletin introduces a paper written by Chow et al. (2022) which examines how these three categories of uncertainties have hindered the development of shipping emissions regulations in Hong Kong and how scientific research has facilitated collaboration among civil society actors, private sector stakeholders, and public policymakers by reducing these uncertainties.

Study Methodology

An in-depth case study approach was applied to investigate how and why the current shipping emissions policy was developed first in Hong Kong and subsequently in mainland China. The case study comprehensively analyzed the policy-development process based on three information sources. The first was a scientific literature review of all English-language empirical studies published between 2000 and 2019, in academic journals and grey literature related to shipping air pollution in Hong Kong. The second was a review of public consultation documents produced by the Hong Kong government during public consultations for vessel fuel regulations. The third was a series of semi-structured interviews with 17 key informants conducted between August 2020 and August 2021. Anonymity was guaranteed. The interviews were organized mainly via online video conferencing, providing first-hand information regarding the air-quality science and policymaking process in Hong Kong and the Greater Bay Area (GBA). Based on the findings of the case study, this paper offered recommendations pertaining to similar policy issues.

Findings and Analysis

The case study divided the development of policy to regulate shipping emissions into four stages. Although these stages could overlap, policy collaboration and formulation at later stages depend on the outcomes of previous stages.

Stage I: Scientific research has reduced substantive uncertainties

Before 2000, shipping emissions received insufficient attention because of a lack of scientific evidence of their pernicious impacts on ambient air quality and public health. For instance, during that period, cargo vessels were permitted to use fuels with sulphur content up to 4.5%, compared with the 0.005% content permitted for road vehicles. Nevertheless, a sequence of scientific studies published between 2003 and 2013 confirmed that the shipping industry was one of the main sources of ambient air pollution in Hong Kong (e.g., Lau et al., 2007). During this period, the Hong Kong Environmental Protection Department (HKEPD) was motivated to implement comprehensive studies of local shipping emissions, notably constructing, in 2008, the city's first maritime emissions inventory (Ng et al., 2012). Scientific studies carried out during the first stage significantly reduced the substantive uncertainties policymakers faced.

During this stage, Civil Exchange, an independent think tank, also took an initial step to resolve strategic and institutional uncertainties, e.g. by stipulating who could serve as the regulator and whether the regulation would be feasible, by surveying shipping emissions control policies worldwide.

Stage II: Collaboration among stakeholders resolved substantive, strategic and institutional uncertainties

In response to accumulating scientific evidence of shipping emissions' impact on local air quality and public health, Civic Exchange began serving as an unbiased mediator between scientists, the government, and the private sector, summarize and disseminate scientific findings, organize dialogues, and convene stakeholders to take collaborative measures (Ng, 2018). In 2011, the Fair Winds Charter (FWC), a voluntary industry-led voluntary agreement to switch to low-sulphur fuel, was initiated. The FWC exemplified the economic and political feasibility of regulating shipping emissions in Hong Kong. It also provided evidence that shipping emissions control could improve air quality. From 2012 to 2013, multiple studies indicated the detrimental impacts of marine emissions on public health (e.g. Lai et al., 2013). Collaborative efforts taken by a wider range of stakeholders during the second stage substantially reduced the substantive, strategic, and institutional uncertainties that various interest groups had identified.

Stage III: The enactment of shipping emissions regulation in Hong Kong

Extensive scientific and economic evidence validating the need to control shipping emissions cleared the way for the government to take decisive action. In 2012, a controlled laboratory experiment jointly implemented by government officials, local vessel operators' representatives, and academics showed that high-and-low sulphur diesel fuels performed only slightly differently with respect to fuel consumption, engine power, and engine durability, demonstrating the technological feasibility of regulatory control shipping emissions (Leung & Cheng, 2013). In the same year, the government initiated the three-year Port Facilities and Light Dues Incentive Scheme. The scheme halved the port facility dues for OGVs that transitioned to low-sulphur fuel at berth. On 1 July 2015, the Air Pollution Control (Ocean Going Vessels) (Fuel at Berth) Regulation was enacted following approval by the Legislative Council. Thereafter, low-sulphur marine fuel became compulsory for OGVs at berth in Hong Kong. The regulation, however, restricts sulphur content to 0.5% instead of 0.05% because lower-sulphur fuels were costly and less readily available for smaller carriers in the region (Zhang et al., 2018).

Stage IV: Policy collaboration in the GBA developed shipping emissions regulations into national-level policy in China

Effective environmental regulation requires coordination between jurisdictions because OGVs sail from port to port. Although Hong Kong reduced various uncertainties and eventually enacted the shipping emissions regulation, these uncertainties remained in mainlaind China. Based on Hong Kong's experience, scientists conducted similar empirical studies focusing on shipping pollution in the GBA. In 2013, Civic Exchange published a review report that elaborated on shipping emissions quantities and the corresponding public health impacts in the GBA (Ng et al., 2013). In 2016, Civic Exchange developed a thorough emissions inventory covering most types of vessels traveling in the entire GBA (Ng et al., 2016). Hong Kong government officials also actively engaged with scientists as well as national environmental and transportation ministries in China to share the city's experience and assist in policy formulation (Zhang et al., 2018). In the same year, three domestic emissions control areas (DECAs) limiting the surphur content of fuel to 0.5% in the GBA, the Yangtze River Delta, and the Bohai Rim were formalized.

From Stage 1 through Stage 4, as uncertainties were increasingly reduced or eliminated, shipping emissions regulation transitioned gradually from a conceptual plan to a legal regulatory regime in Hong Kong. Eventually, the policy was developed into a national-level regulation. Table 1 presents a summary of the policy development process.

Recommendations

Scientific research is indispensable to reducing or eliminating substantive uncertainties

Substantive uncertainties related to the sources, quantities, environmental impacts, and health impacts of shipping emissions, as well as the technical feasibility and benefits of shipping emissions control were critical obstacles to policy development in early stages. Facing substantive uncertainties, there was insufficient incentive for key stakeholders to take concrete action. Scientific research played an indispensable role in unravelling substantive uncertainties and provided the fundamental rationale for subsequent collaborative actions and policy formulation.

Involvement by civil society actors and key stakeholders is essential to reducing or eliminating strategic and institutional uncertainties

Even when scientific evidence supporting a policy issue was clear, relevant stakeholders may not have been aware of or understood the technical findings. Moreover, whether a policy would prove practical or gain sufficient political support has often been unclear. Civil society played a significant role in raising public awareness of the relevant policy issues. Interested actors could also organize dialogues to resolve disagreements and misunderstandings between scientists, the private sector, and government agencies. In addition, industry-led voluntary agreements, e.g., the FWC, could test the economic and political feasiblility of new regulations (Ng, 2018; Zhang et al., 2018).

Escalating policy collaboration among stakeholders as uncertainties are reduced or eliminated

In the process of formulating shipping emissions regulations, initial actions were undertaken predominately by scientists and civil society actors to settle substantive uncertainties. Next, the government and industry groups were motivated to exchange ideas and participate in the policymaking process to reduce strategic and institutional uncertainties. The government then formally submitted a policy proposal to the legislative council for discussion and amendment,

Table 1 Key steps in the four stages of policy development regarding shipping emissions in Hong Kong and mainland China

Stage 1	Stage 2	Stage 3	Stage 4
Reducing substantive uncertainties: • Scientific evidence confirmed the detrimental impacts of shipping emissions on ambient air quality and public health in Hong Kong. • In response to extensive scientific evidence, HKEPD carried out comprehensive studies of shipping emissions. **Reducing strategic and institutional uncertainties**: • Civil society actors took an initial step to survey shipping emissions-control policies worldwide.	**Reducing substantive uncertainties**: • Multiple studies indicated the detrimental impacts of shipping emissions on public health. **Reducing strategic uncertainties**: • Civil society actors convened stakeholders to take collaborative action. **Reducing substantive, strategic, and institutional uncertainties**: • The industry-led FWC exemplified the air-quality improvement effect as well as the economic and political feasibility of shipping emissions regulation in Hong Kong.	**Reducing substantive uncertainties**: • A joint laboratory experiment revealed only slight differences between high- and low-sulphur diesel fuels with respect to fuel consumption, engine power, and engine durability. **Reducing strategic and institutional uncertainties**: • The government initiated the three-year Port Facilities and Light Dues Incentive Scheme to halve the port facility dues for OGVs that transited to low-sulphur fuel at berth. **City-level policy enactment**: • The Air Pollution Control (Ocean Going Vessels) (Fuel at Berth) Regulation was enacted in Hong Kong.	**Reducing substantive, strategic, and institutional uncertainties**: • Based on Hong Kong's experience, similar scientific studies and policy collaborations were implemented in Mainland China. **National-level policy formalization**: • Because of the scientific evidence gathered and policy collaboration undertaken in the GBA, three domestic emissions control areas (DECAs) limiting the sulphur content of fuel to 0.5% in the GBA, the Yangtze River Delta, and the Bohai Rim were formalized.

following which regulations were enacted. Eventually, when regulations proved successful in Hong Kong and the institutional uncertainties were reduced or eliminated, city-level policy evolved into a Chinese regulatory regime involving various national-level government agencies. This approach could prevent policy errors and increase political acceptability by gradually escalating the intensity and scope of policy collaboration (see the typology in Magerum (2008)).

Fostering an inclusive collaborative policy framework with more diverse and balanced views

In the case of shipping emissions regulations, despite the active participation of scientists and civil society, the shipping industry was still the most critical stakeholder, exerting considerable influence on the policymaking process. To maximize the welfare of a wider spectrum of interest groups, an inclusive policy framework with a more influential civil society is crucial.

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