

By Post & Email

Legislative Review Unit
Water Supplies Department
46/F, Immigration Tower
7 Gloucester Road
Wan Chai, Hong Kong

2 February 2021

Dear Members of the Legislative Review Unit,

Civic Exchange’s Submission to the Public Consultation on the Proposed Amendments to Waterworks Ordinance (Cap. 102)

Population and economic growth, competition for water resources, and climate change risks have put Hong Kong’s fresh water supply increasingly under pressure. Civic Exchange examined the inefficiencies and shortcomings of water management in Hong Kong in our recent two-part research on “Modernising Hong Kong’s Water Management Policy” and made comprehensive recommendations for actionable measures on water demand and supply.^{1,2}

We thus welcome that the Water Supplies Department (WSD) in conjunction with the Development Bureau (DevB) is now taking steps to enact legislative changes to improve demand side water management, reduce loss and wastage of valuable freshwater resources, and assure adequate quality of drinking water with the *Proposed Amendments to Waterworks Ordinance (Cap. 102)*, which include:

- Regulation of plumbing works and control of plumbing materials
- Safeguarding drinking water safety
- Control of drinking water dispensers and fountains
- Mandating the Water Efficiency Labelling Scheme (WELS)
- Maintenance of communal part of internal plumbing system and water loss rectification

¹ Lin, Jonathan. *Modernising Hong Kong’s Water Management Policy - Part I: Conservation and Consumption: Towards a Water-Smart Hong Kong*. 2019, <https://civic-exchange.org/report/conservation-and-consumption-towards-a-water-smart-hong-kong/>

² von Eiff, David. *Modernising Hong Kong’s Water Management Policy - Part II: Sustainable Water Infrastructure: Towards a Diversified Water Supply*. 2019, <https://civic-exchange.org/report/modernising-hong-kongs-water-management-policy-part-ii-sustainable-water-infrastructure-towards-a-diversified-water-supply/>

The captioned changes broadly cover two main sections: (A) amendments aimed at ensuring water quality; and (B) amendments aimed at improving water conservation. This response to the public consultation will address each proposed change holistically rather than point-by-point, considering not only WSD's mission and goals, but how the proposed change aligns with the Government's efforts to improve long-term sustainability, climate resilience, and resource conservation, as well as to reduce carbon emissions on the way to reach net-zero emissions by 2050.³

The Water Supplies Department (WSD) is responsible for supplying reliable and quality water supplies to Hong Kong. Since the enactment of the Waterworks Ordinances (WWO) and Regulations (WWR) in 1974, WSD has managed changes in technology and system complexity through administrative means, without legislative amendments to their regulatory frameworks. In response to the lead contamination incident in 2015, WSD started to review its regulatory framework, prioritizing updates for plumbing materials and trade practices, which were enacted in 2018.

The newly proposed amendments advance this response by targeting issues with the control of plumbing materials to prevent metal leaching and by explicitly defining roles and responsibilities of stakeholders, including who is eligible to perform certain works which may affect water safety. The amendments further capture drinking water fountains, which have remained mostly unregulated, as well as changes to the Water Efficiency Labelling Scheme (WELS), communal services, and sub-divided units as part of WSD's goal to reach a 10% reduction in water use.

While these suggestions represent for a large part good first steps, they fall short of fundamentally addressing water conservation, the impacts of climate change, and the WSD's and Hong Kong Government's stated long-term goals to enhance water supply resilience and to decarbonize the economy. WSD is one of the largest energy consumers within the Government and emissions associated with the use of water (including water provision, water heating, and sewage treatment) are significant, on-par with those generated from waste in Hong Kong. Water conservation efforts would therefore also have a significant impact on our city's greenhouse emissions.

We continue to urge the Government to develop a more holistic water strategy with a long-term vision and aspirational targets, which align with broader economy-wide goals of maximizing resource efficiency and minimizing energy intensity. Such a water blueprint, coupled with public engagement and policy support, will galvanize our society to join hands in conserving precious freshwater resource and in ensuring the sustainable development of our city. Civic Exchange believes that Hong Kong needs to make larger strides in reducing consumption, diversifying sources, and improving the long-term climate resilience of our water supply.

³ Lam, Cheng Yuet-ngor. *The Chief Executive's 2020 Policy Address*. 2020, <https://www.policyaddress.gov.hk/2020/eng/policy.html>

Enclosed, we provide our recommendations for the consideration of WSD and DevB, addressing the main areas of the proposed amendments.

We would be pleased to offer further elaboration on any of our points, and we look forward to an opportunity to meet with you to explore our recommendations further.

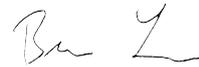
Yours sincerely,



Evan Auyang
Chair of the Board
Civic Exchange



Dr David von Eiff
Associate Researcher
Civic Exchange



Dr Berto Lee
Programme Manager
Civic Exchange

Visit us at: www.civic-exchange.org

CIVIC EXCHANGE IS A COMPANY WITH LIMITED LIABILITY AND A REGISTERED CHARITY IN HONG KONG

23/F, CHUN WO COMMERCIAL CENTRE, 23-29 WING WO STREET, CENTRAL, HONG KONG.

香港中環永和街 23-29 號俊和商業中心 23 樓

TEL 電話：(852) 2893 0213 FAX 傳真：(852) 3105 9713

Civic Exchange's Submission to the Public Consultation on the Proposed Amendments to Waterworks Ordinance (Cap. 102)

(A) Enhancing Water Quality

A1. Regulation of Plumbing Works

Recommendation

The proposed regulation on minor plumbing works in light of the lead in water incidents may be too lax, although reducing regulatory burden would free up WSD's manpower for deployment in more important sectors. As WSD makes ample reference to international standards for guidance and best practices, **we suggest WSD to more closely follow the Australian model and sub-divide minor works** into "Do It Yourself" and "Notifiable Work".

WSD suggests that the replacement of pipes or fittings < 3m in length within a building as well as the replacement and repair of taps and pipe fittings in individual flats/shops/offices can be carried out by any person. The aim of this is to lower notification permitting requirements and to reduce costs to home and shop owners. Considering that the lead in water incident was caused by improper use of solder, allowing owners to replace up to 3 meters of their own piping could present public health hazards, particularly in rental situations where pipe conditions and prior pipe replacements would be difficult to identify or retrace.

Following the Australian approach, *Notifiable Works* would require a qualified plumber or drainer, but without the need for a local government permit or mandatory inspection. This would include any modifications to bathroom and plumbing works, altering pipe works, or replacing hot water heaters. *Do It Yourself works* are more minor, such as changing taps, and have no personnel requirements as they are much less likely to cause any public health impacts.

A2. Control of Plumbing Materials

Recommendation

Strong internal standards should be adopted for the General Acceptance (GA) system, and sufficient **capability for oversight, robust surveillance, and collaboration** across government agencies must be ensured. **GA standards should also apply to minor works** instead of being exempted.

WSD has recognized the importance of strong regulatory controls on the use of plumbing materials by creating a General Acceptance (GA) system for plumbing materials, following the lead in drinking water incident in 2015, which was related to the misuse of soldering materials in internal plumbing systems.

We believe that the adoption of strong internal standards, such as those adopted by Singapore and Australia, will be highly effective in improving public trust in the safety of the drinking water system. The WSD's GA scheme will lower the burden on installers, as suppliers will be issued with the WSD

letter of compliance for plumbing materials and their acceptable uses. However, the program should come with significant oversight capability and a robust surveillance program with periodic inspections to ensure public support and public trust, and with enhanced cross-agency collaboration, i.e. involving the Food and Environmental Hygiene Department (FEHD) and the Customs and Excise Department (CED), to guarantee that materials are genuine, properly installed, and not switched out or tampered with.

The exemption of minor works from the GA standards should be reconsidered. The lack of applying the same standard combined with decreased minor works reporting and increased scrutiny on prescribed works may have unintended sidestepping consequences or cause confusion amongst suppliers.

Although WSD surveyed 34 non-GA parts for metal leaching, this is neither comprehensive enough nor sufficiently fail-safe to ensure public safety. Also, there are no provisions for a phase-in period or advice for suppliers on how to handle non-GA certified parts.

We however recognize WSD's wish to curtail regulatory burden on performing minor works as a trade-off by reapportioning responsibilities on ensuring the adequacy of supplied parts and materials to the suppliers.

A3. Drinking Water Dispensers and Fountains

Recommendation

WSD should be given the authority of **regulation over drinking water dispensers and fountains (DWDFs), regardless of their type.**

DWDFs commonly installed in restaurants, schools, sport centres, and pantries are either directly connected to internal plumbing systems or come as stand-alone units (i.e. units not connected to internal plumbing systems with water fed to the units by other means, such as via flexible hoses from taps).

In the proposed amendments to the WWR, WSD only intends to regulate DWDFs which directly feed from the internal plumbing system to protect public health, as these have not been explicitly addressed in the past. Other (especially stand-alone) units are considered out of scope of the WWO and WWR, even if they are fed via flexible hoses from taps, and it is unclear what other regulations should apply to these types.

Regardless of the connection type, WSD should assume the authority over any DWDF receiving water from a public main as it would appear most logical to a common user that they would all fall under WSD regulation. WSD should liaise with the designated agencies currently in charge of non-internally connected units to ensure that the same standards for metal leaching and other public-health related concerns are applied across the whole range of DWDFs.

If WSD is to assume regulation, the standard to which it will regulate should be clearly stated. The international WELL Building Standard¹ would provide a good starting point, addressing fundamental

¹ International WELL Building Institute, WELL Building Standard version 2, <https://v2.wellcertified.com>

water quality, periodic water testing, record keeping and response, and drinking water promotion. Notable measures include suggested standards for water taste and access to promote its use, as well as the deployment of legionella prevention teams to protect water quality.

Water filters are commonly parts of DWDF units, and their frequency of exchange are highly relevant to efficient and safe operation: disposal of water filters before the end of their effective lifetime has significant environmental impacts, while exceeding their service life will pose public health issues. WSD should mandate the installation of flow metering and prescribe maintenance schedules based on water flow to ensure that both sustainability goals and public health goals are met.

Having a more centralized oversight on DWDFs will substantially increase public confidence in dispensers and align with the goal to enhance their popularity, which is central to reducing the consumption of bottled water and to counter waste- and energy-intensive single-use beverage containers.²

(B) Enhancing Water Conservation

B1. Water Efficiency Labelling Scheme (WELS)

Recommendation

Prior to mandating the Water Efficiency Labelling Scheme (WELS), WSD should consider harmonizing the Hong Kong WELS standard with those of similar international schemes to create a level playing field for international companies and to reduce implementation burdens.

Apart from saving precious water resources, reducing the amount of water usage also substantially contributes to lowering energy intensity and achieving greenhouse gas emission reductions.

WSD initially launched its Water Efficiency Labelling Scheme (WELS) as a voluntary labelling program for plumbing fixtures and water consuming devices in 2009. The scheme has been implemented over the course of six phases with the goal of providing consumers with information on water consumption, promoting public awareness of water efficiency, and achieving water savings. Labelling programs have been proven effective in increasing consumer awareness and achieving long-term water conservation behaviours with permanent water savings.

WSD notes that other countries are also pushing to move WELS programs from voluntary to mandatory participation. Australia, Singapore, Taiwan, and China are explicitly referred to in the consultation brief, and we further consider the US Water Sense Program as a notable model scheme. It is vital that WSD take into account the extent of these schemes and their standards prior to making Hong Kong's WELS mandatory. This will help create a level playing field for international suppliers or

² Drink Without Waste (DWW) Ltd., <https://drinkwithoutwaste.org/wp-content/uploads/2020/05/2020-05-24-DWW-submission-to-LegCo-EA-panel-management-of-waste-plastics-final.pdf>

companies with international operations and centralized procurement processes, prevent market fragmentation and would substantially reduce implementation burdens.

For example, in Australia a three-star rated shower head would consume between 6.0 and 7.5 L/min, with the highest rated shower heads consuming as low as 4.5 L/min.³ Singapore has a similarly low value for its highest ratings, and the US Water Sense Program allows a maximum of 7.6 L/min. Many of these programs also have allocations for spray coverage and pressure as part of their rating systems, which allow slightly higher flows to still achieve high ratings. Under Hong Kong's WELS, the highest standard for showers requires a flow < 9.0 L/min, which exceeds all previously mentioned international standards by 20-35%.

While WSD includes a chart on their website that allows consumers to determine if the flow from a WELS rated shower or fixture will be compatible with their water heater⁴, the provided information is insufficiently transparent and requires additional efforts, knowledge, and work on the part of the consumer. Further tightening of water conservation standards is hampered by allowing older water heaters with higher flow requirements to become a limiting factor. The WELS label should include all necessary information in one place, while initiatives should be put in place to actively remove barriers which may prevent low flow devices from being adopted.

Beyond the implementation of a mandatory WELS scheme, WSD should continuously monitor the adoption of water efficient products to assess whether further barriers exist, and whether more cross-governmental efforts are needed to address these issues.

Reducing the amount of energy consumption in buildings, including energy required for water use such as showering, laundry and space cooling, is important for meeting Hong Kong's climate goal of net-zero emissions by 2050.⁵ 19% of the total Towngas and LPG consumption in Hong Kong is used for water heating, while 17% of the electricity consumed in communal areas of a typical public housing bloc is for water pumping.

Based on the Electrical and Mechanical Services Department (EMSD) energy-end use data as well as electricity data from WSD and the Drainage Services Department (DSD), annual greenhouse gas emissions from the provision of fresh- and sea-water, sewage treatment, and heating of water across sectors were estimated to amount to almost 2.5 megatons of annual CO₂e emissions.⁶ With further expected contributions from water-related energy uses (e.g. space cooling, laundry), this would put water use on par with emissions from the generation of waste (3 megatons of annual CO₂e emissions).

More granular data were available for residential water use in public housing with total annual greenhouse gas emissions of 0.6 megatons of CO₂e.⁴ A significant reduction in water consumption would therefore directly contribute to the efforts of lowering Hong Kong's greenhouse gas emissions as well.

³ WELS Regulator, Government of Australia, <https://www.waterrating.gov.au/>

⁴ WSD, <https://www.wsd.gov.hk/en/plumbing-engineering/water-efficiency-labelling-scheme/wels-on-showers-for-bathing/wels-on-showers-for-bathing-advisory-notes/index.html>

⁵ Jiang, Xiaoqian, et al. Towards a Better Hong Kong: Pathways to Net Zero Carbon Emissions by 2050. 2020, <https://civic-exchange.org/report/towards-a-better-hong-kong/>

⁶ See appendix.

B2. Communal Water Systems – Water Loss Charge

Recommendation

The **proposed level of water loss to initiate action to be taken by WSD (15%) is far too high** to encourage conservation. Based on WSD's current data, **a lower target of 5 to 7% would be more appropriate** for private mains and progressive target adjustments should be included.

Each year, approximately 33% of the water produced by WSD is unmetered, i.e. remains unaccounted and unpaid for despite the significant annual expenditure of WSD to produce this water. 23% is lost in public and private mains, 2% is lost due to inaccurate metering, and 2% is lost due to unauthorized withdrawals. As leakage in public mains has been reduced to an estimated 15%⁷, which remains high in comparison with similar cities, the remainder of 8% is lost in the private mains of communal water systems.

Increasing the coverage of master meters in buildings built before 2006 is a strong and positive first step in ensuring quick detection of leaks, which consume large amounts of freshwater. To motivate building management to arrange for timely repairs, introducing a communal water loss charge as proposed in the amendments is a reasonable and fair measure, similar to how electricity or natural gas use in communal spaces are managed.

However, the 15% *Actionable Level* is far too high and should be revised downward substantially. According to WSD, a high level is needed due to the inaccuracy of metering and the difficulty of achieving 0% water loss. Based on the previously mentioned data, metering accuracy is approximately 98%, with potential for further improvement through smart metering, and private mains loss is already <10%. Thus, it is unlikely that current leaks would be effectively reported under the newly proposed system. Further, based on the current per capita water use of 134 L/day, a 1,000-person block would be allowed to leak 6,633 cubic meters of water per year (equivalent to an annual water supply for 150 people). WSD currently targets a 10% goal for its public mains which are more complex and costly to maintain. Thus, for private mains, a substantially lower *Actionable Level* of 5 to 7% should be targeted. Furthermore, the suggested notification and repair periods are far too long, based on this leak rate, to truly encourage active leak detection and repair.

WSD also needs to ensure that sufficient resources for enforcement and investigation can be made available to ensure the agency is sufficiently empowered to enforce the regulations. Turning off water supply in communal spaces would have significant impacts on the public, and financial penalties must be sufficient to encourage building management to make required repairs, which can represent significant miniatous expenses. While WSD provides some guidance on leak detection and water savings, these efforts have not been aimed at regular domestic users. WSD should provide clear guidance to average users on how to detect, identify, and report leakages in a timely manner.

⁷ WSD (2019) by personal communication

B3. Water Charge in Subdivided Units

Recommendation

More accurate metering and billing of subdivided units will alleviate the burden of occupants while providing more accurate information on usage to WSD to enable more targeted conservation policies and programs, informing occupants of their actual usage and opportunities to reduce consumption, and adhering to the user pays principle.

Sub-divided flats present a unique challenge and opportunity for water conservation. More than 90,000 low-income households currently live in such arrangements in Hong Kong, and tenants of these housing arrangements are often overcharged by landlords for water use due to the lack of separate water meters in the flat. This has given rise to extraordinary overcharging for water: in 2017, the median water price paid by surveyed tenants was HK\$12 per cubic meter which is significantly higher than the most punitive water rate set by WSD which is only HK\$9.05 per cubic meter.⁸ By contrast, more than 56% of ordinary domestic accounts pay HK\$4.16 or less per cubic meter.⁹ Although this practice is illegal, installing water meters has remained entirely optional for landlords. Due to their high costs, tenants may not be able to afford installing separate meters on their own, which is why WSD recommends residents to coordinate meter installation with neighbours to potentially split costs.

At a conservation level, WSD only holds information related to government water mains leading to a specific building. Household usage on a composite level (i.e. how much water is sent to the toilet, dishwasher, sink, shower etc.) within a residential unit cannot be deduced from current systems. Thus, the proposal of allowing smart meters to be installed in each unit is a positive step in line with a conservation minded water strategy. More accurate metering and billing of the subdivided units will curb illegal practices on overcharging and thus will be beneficial to current tenants. It falls in line with the user pays principle and will further allow WSD to develop suitable, targeted conservation policies and programs to occupants, and inform occupants of their usage and opportunities to conserve water.

B4. Conversion to Salt Water for Flushing

Recommendation

Instead of seawater flushing, WSD should consider adoption of reclaimed water.

Hong Kong is one of few coastal cities that maintains a dual-reticulation plumbing system to deliver both fresh and seawater, of which the latter is used exclusively for toilet flushing. For the last 60 years, this system has been considered an integral part of ensuring Hong Kong's water security by offsetting a significant proportion of freshwater use. The economics of its further expansion and future use are, however, doubtful. While reducing the amount of freshwater for flushing is important, expansion of

⁸ HKSAR Government, LCQ19: Collection of electricity and water charges by landlords from tenants of inadequate housing", <https://www.info.gov.hk/gia/general/201701/11/P2017011100395.htm>

⁹ WSD Annual Report, 2018-2019, https://www.wsd.gov.hk/filemanager/common/annual_report/2018_19/pdf/Finance_and_Water_Charges.pdf

seawater flushing should be examined holistically, i.e. with due consideration of energy use and future water supply opportunities. WSD has begun to address this issue by looking into alternative flushing water supplies, such as harvested rainwater and reclaimed water, for areas in the New Territories which are too far inland for seawater flushing to be economically feasible. These options would also provide WSD with greater flexibility, as they can be leveraged to cover non-potable demand beyond flushing.

With the increasing adoption of green building standards, including the installation of dual flush toilets, the overall demand for flushing water can be expected to decrease. WSD estimates that on average Hong Kong residents used 93.3 L/day for flushing their toilets in 2019, based on both seawater and freshwater usage. If Hong Kong adopts a level of technology equivalent to that of Singapore or Macau, which use 28.8 and 35 L/day respectively, WSD would only need to supply approximately 100 million cubic meters of seawater for flushing to end users. At this rate, the unit cost of seawater flushing would potentially be as high as HK\$7.87, due to the increasing proportion of capital cost in each unit and would make alternative water supplies more cost-effective for WSD. Additionally, this would bring external benefits to building owners as corrosion of appliances from seawater use could be avoided.

Thus, in lieu of seawater flushing, WSD should consider adoption of reclaimed water. Based on WSD estimates, reclaimed water can be provided for non-potable uses in Hong Kong for about HK\$6.5-7 per cubic meter, which is 35% cheaper than the current cost of imported raw water from the Dongjiang river, and less expensive than cost estimates for future seawater use scenarios. By investing in technologies to harvest and supply reclaimed water for a wide range of non-potable uses, Hong Kong can secure a low-cost water resource that is drought-resilient and provides environmental benefits in terms of both reduced energy usage and improved local water quality.

WSD should also consider pursuing or encouraging the development of less centralized solutions, such as water reclamation at the community level. Producing water more locally would minimize energy use required for transportation while also reducing leakage risks. Although lack of space has been considered as a challenge, advancements in technology are beginning to make this approach more practical and could substantially reduce the footprint of such systems.

In contrast to seawater, which is exclusively for flushing, the much-expanded potential of reclaimed water can substitute freshwater in further use cases and lower the need for energy- and thus cost-intensive solutions such as desalination. It is important to take into account how technology for alternative water resources aligns with wider goals of sustainable development, as the Hong Kong 2030+ Plan not only calls for an adequate water supply, but for a “smart, green and resilient infrastructure that should be well-integrated for better synergy and land efficiency”.

Visit us at: www.civic-exchange.org

CIVIC EXCHANGE IS A COMPANY WITH LIMITED LIABILITY AND A REGISTERED CHARITY IN HONG KONG

23/F, CHUN WO COMMERCIAL CENTRE, 23-29 WING WO STREET, CENTRAL, HONG KONG.

香港中環永和街 23-29 號俊和商業中心 23 樓
TEL 電話：(852) 2893 0213 FAX 傳真：(852) 3105 9713

Civic Exchange's Submission to the Public Consultation on the Proposed Amendments to Waterworks Ordinance (Cap. 102)

Appendix

List of data for the estimation of water use related greenhouse gas emissions

Greenhouse gas emissions per annum in terms of CO₂e for all sectors were calculated based on 2018 annual or 2018-19 financial year data, unless unavailable in which case the closest year with relevant data was taken for reference:

- Volume of water provided – freshwater and seawater **[WSD]**¹
- Purchased electricity – CLP and HKE **[WSD]**²
- Energy intensity – freshwater and seawater **[WSD]**²
- Total energy used for hot water – electricity and Towngas + LPG **[EMSD]**³
- Carbon intensity of unit electricity production **[CLP, HKE]**^{4,5}
- Carbon intensity of unit Towngas production **[The HK and China Gas Co. Ltd.]**⁶
- Scope 1 gas emissions from Towngas combustion **[EPD/EMSD]**⁷
- Global warming potential of greenhouse gases **[IPCC]**⁸

Greenhouse gas emissions for public housing were based on above data, and the following 2018 annual or 2018-19 financial year data, unless unavailable in which case the closest year with relevant data was taken for reference:

- Population by housing type **[THB]**⁹
- Residential energy use of electricity and Towngas + LPG by housing type for hot water and laundry **[EMSD]**³
- Communal energy use in public housing **[HA]**¹⁰
- Share of water pumping among communal energy use in public housing **[ENB]**¹¹
- Average daily residential water use by housing type **[WSD]**¹²

Uncertainties in the estimation may arise from the following assumptions:

- Mix of electricity used for water production by WSD is identical to WSD's mix of total reported electricity consumption.
- DSD's electricity mix is similar to that of WSD.
- Non-electric water heating was assumed to be all-towngas due to the lack of carbon intensity data for the production of LPG.
- Overall carbon intensity of electricity represented by composite of the share of sold electricity and carbon intensity of individual suppliers.

Figures

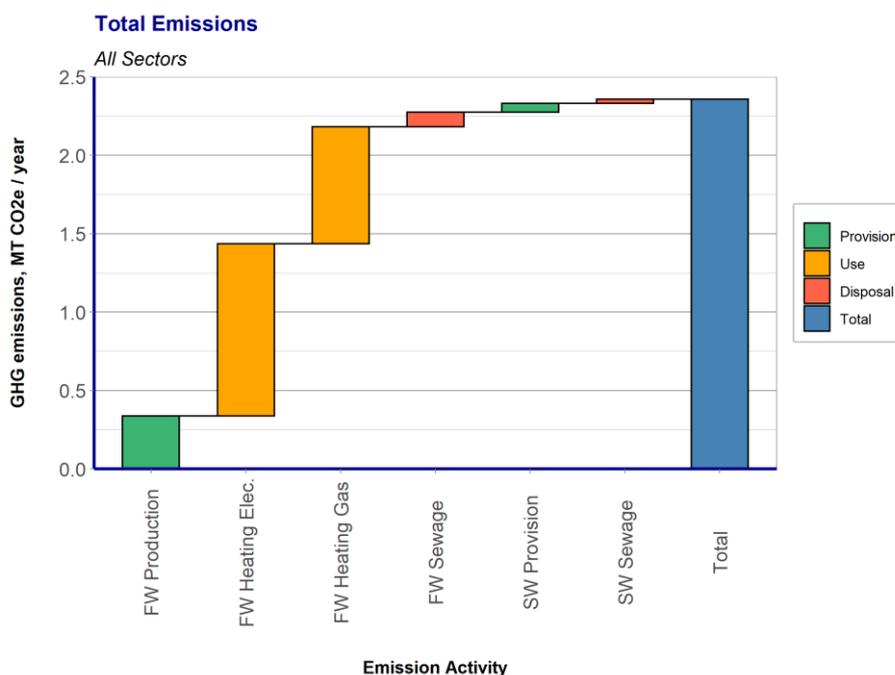


Figure A1. Annual greenhouse gas emissions in megatons (MT) as CO₂ equivalent, estimates for 2018 for all sectors including supply of freshwater (FW) and seawater (SW), sewage treatment and energy for water heating.

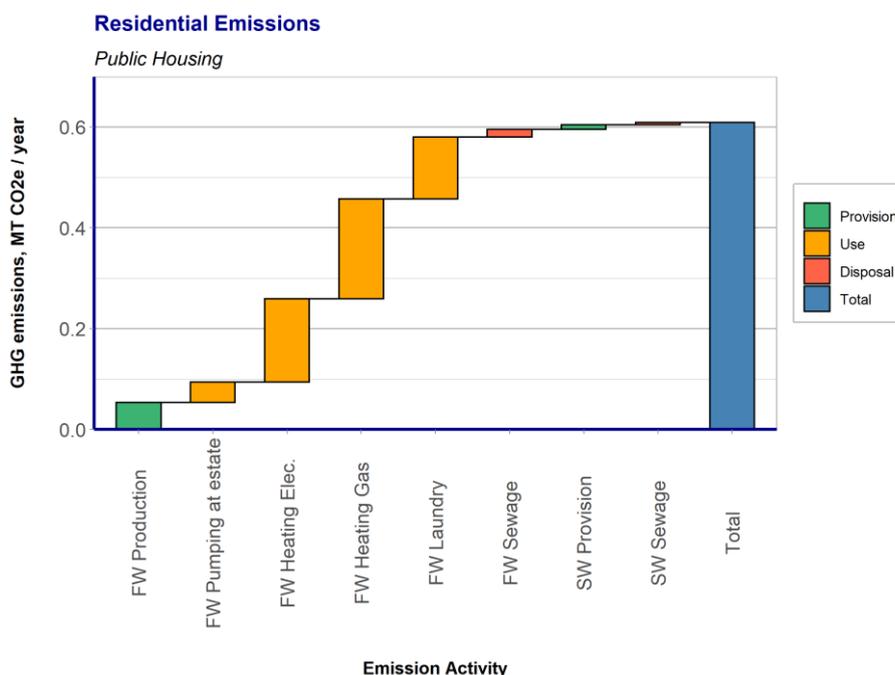


Figure A2. Annual greenhouse gas emissions in megatons (MT) as CO₂ equivalent, estimates for 2018 for Public Housing including supply of freshwater (FW) and seawater (SW), sewage treatment and energy for water heating, laundry, and pump operation at housing estates.

References

1. Water Supplies Department. Annual Fresh Water Consumption (by Sector) in Million Cubic Metres (MCM) and Percentage of Total. data.gov.hk. Published 2020. <https://data.gov.hk/en-data/dataset/hk-wsd-wsd5-annual-fw-consumption-by-sector>
2. Water Supplies Department. *Annual Report 2018/19.*; 2019. https://www.wsd.gov.hk/filemanager/common/annual_report/2018_19/pdf/WSD_AR2018-19_20200327_R1.pdf
3. Electrical and Mechanical Services Department. *Hong Kong Energy End-Use Data 2020.*; 2020. doi:10.18356/de48b538-en
4. CLP Holdings Limited. *CLP Sustainability Report 2019.*; 2019. <https://sustainability.clpgroup.com/en/2019/pdfondemand/printpdf?docId=140594>
5. HK Electric Investments Limited. *Sustainability Report 2018.*; 2019. https://www.hkelectric.com/en/CorporateSocialResponsibility/CorporateSocialResponsibility_CDD/Documents/SR2018E.pdf
6. The Hong Kong and China Gas Company Limited. *Sustainability Report 2018.*; 2019. https://www.towngas.com/getmedia/32d64b10-3678-4e11-b338-56ea2753e4c5/Towngas_SR_2018_EN.pdf.aspx?ext=.pdf
7. Environmental Protection Department, Electrical and Mechanical Services Department. *Guidelines to Account for and Report on Greenhouse Gas Emissions and Removals for Buildings (Commercial, Residential or Institutional Purposes) in Hong Kong.*; 2010. https://www.epd.gov.hk/epd/sites/default/files/epd/gn_pdf/GN2014P097-2014c-e.pdf
8. Myhre G, Shindell D, Bréon F-M, et al. *Anthropogenic and Natural Radiative Forcing. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.*; 2013. https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf
9. Transport and Housing Bureau. *Housing in Figures 2019.*; 2019. <https://www.thb.gov.hk/eng/psp/publications/housing/HIF2019.pdf>
10. Hong Kong Housing Authority. *Sustainability Report 2018/19.*; 2019. https://www.housingauthority.gov.hk/mini-site/hasr1819/en/common/pdf/HA_SR1819_EN_200325.pdf
11. Environment Bureau. *Energy Saving Plan For Hong Kong's Built Environment 2015-2025+.*; 2015. <http://www.enb.gov.hk/sites/default/files/pdf/EnergySavingPlanEn.pdf>
12. Water Supplies Department. *Domestic Water Consumption Survey (2015).*; 2016. https://www.wsd.gov.hk/filemanager/en/content_1472/factsheet_e_2015.pdf

Visit us at: www.civic-exchange.org

CIVIC EXCHANGE IS A COMPANY WITH LIMITED LIABILITY AND A REGISTERED CHARITY IN HONG KONG

23/F, CHUN WO COMMERCIAL CENTRE, 23-29 WING WO STREET, CENTRAL, HONG KONG.

香港中環永和街 23-29 號俊和商業中心 23 樓

TEL 電話：(852) 2893 0213 FAX 傳真：(852) 3105 9713