Title
Disentangling the worldwide web of e-waste and climate change co-benefits

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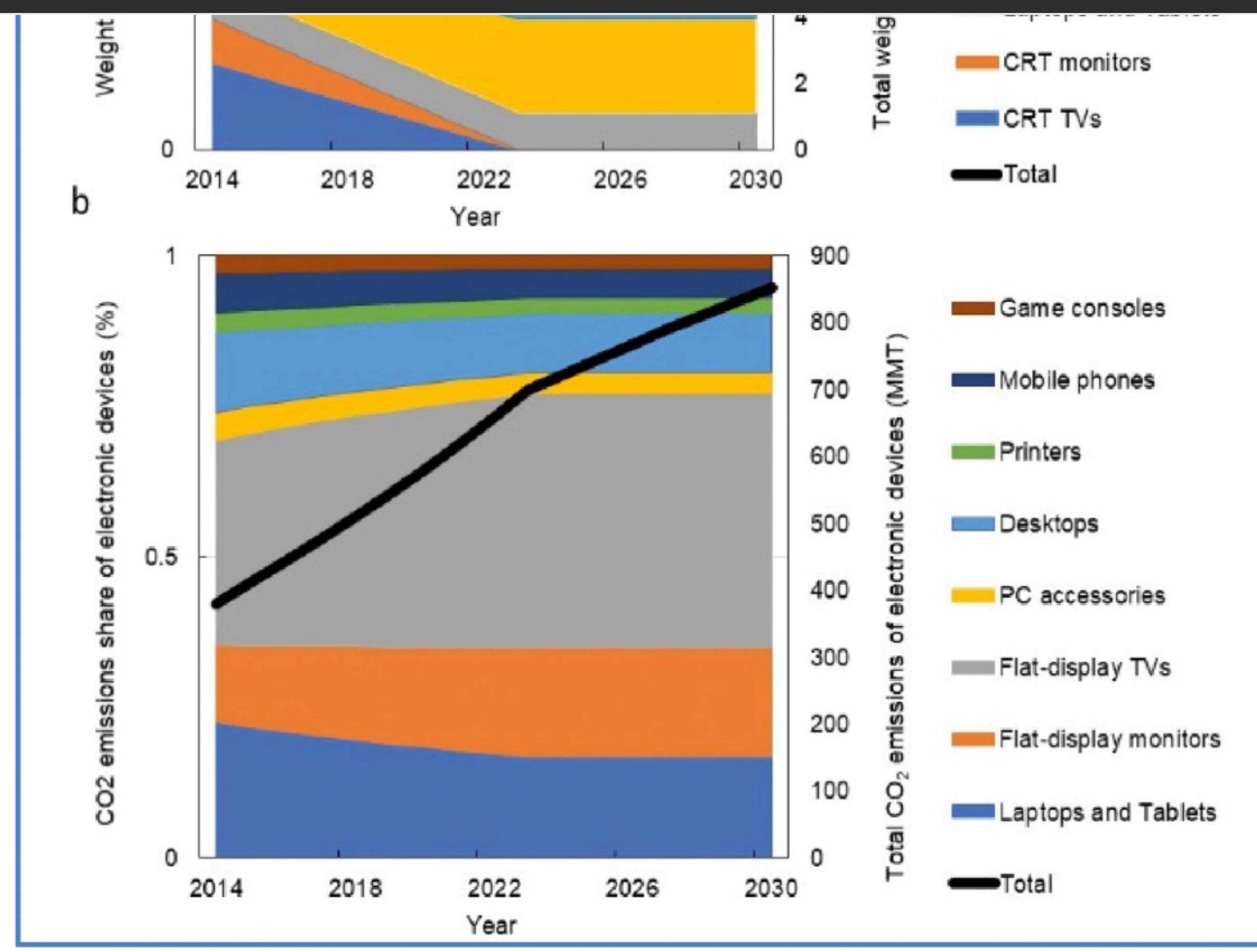

Fig. 1. Estimated quantity of greenhouse gas emissions and e-waste generation of ICT devices worldwide. (a) Weight percent share of individual e-waste device and the total amount of waste from selected electronics, (b) total and share percent of embodied greenhouse gas emissions in each e-waste of ICT device (Note: greenhouse gas emissions of CRT monitors and televisions are not calculated in this study due to their replacement by the new flat display.). The emissions from telephones devices are also excluded due to the lack of embodied carbon footprint data (Note: it should be noted that there could be an incremental error (±10%) for future emissions due to the uncertainty in the reported data, see Tables S31–S35 in the ESM).

2014, the total contribution of embodied GHG emissions from selected electronic devices was ~380 MMT of CO_2e. This quantity increased to a cumulative total 2962 MMT in 5 years from 2015 to 2020 and our modelling results indicate an expected increase to 3444 MMT from 2021 to 2025, and 4051 MMT from 2025 to 2030, in the BAU scenarios. We note that these quantities could be avoided if the current lifetime of the gadgets can be extended through the implementation of strategies for repair, reuse, and recycle. For example, ~978 to 1481 MMT of CO_2e emissions would have been avoided if the useful life of electronic devices were extended from 50% to 100%. In futuristic scenarios, if the current useful life of devices last more than 50%–100%, 1136 to 1722 MMT of CO_2e of GHG emissions can be avoided by 2025, and ~1337 to 2026 MMT of CO_2e of GHG emissions avoided by 2030 (Fig. 2(b)). Strategies that address the rapidly declining useful life of digital devices, therefore, offer the best prospect for reductions in e-waste and GHG emissions.

The data presented in Fig. 3 show the global embodied GHG emissions from selected e-waste generated from ICT devices with the top 20 countries' GHG emissions modelled from 2020 to 2030, and their mitigation scenarios based on source reduction of e-waste by extension of the useful lifetime of the ICT devices. The results show that ~580 MMT of embodied CO_2e of GHG emissions was associated with ICT devices in 2020. The results of BAU scenario modelling show an increase to ~7495 MMT of embodied CO_2e of GHG emissions from 2021 to 2030. China would contribute the highest quantity of embodied GHG emissions from 2021 to 2030, representing ~19% of total global emissions, followed by the United States, India, Japan, and Brazil, which accounted for about 13%, 6%, 5%, and 4% of total global emissions, respectively. At the regional level, Asia would contribute the most about 46% of total global emissions, followed by the Americas (25%), Europe (23%), Africa (5%), and Oceania (1%). The quantity of CO_2 emissions from wasted ICT devices in 2020 was equivalent to removing about 8.5% of total GHG emissions in the USA annually (EPA, 2021). The mitigation scenarios based on source reduction by the extension of the useful life of electronics on individual country shows that ~647 to 708 MMT of CO_2 emissions from 2021 to 2030, could be avoided by the