Emissions Inventories of Plastic Pollution: A Critical Foundation of an International Agreement to Inform Targets and Quantify Progress

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As plastic emissions increase globally,1 the voices calling for an international agreement2 have diversified and amplified. This year, in February 2022, economies have agreed to begin negotiating an agreement at UNEA-5. An international agreement on plastic pollution can take many shapes. At its core, must be a focus on shifting the linear plastic economy to a circular economy. And, similar to the Paris Agreement, it should aim to reduce emissions. The agreement should set emissions reduction targets for plastic pollution and call on economies to use diverse tools to reduce local emissions and report regularly.

LESSONS FROM CLIMATE CHANGE

A Paris-style agreement on plastic pollution must first set targets to reduce emissions. For this, we must first establish a baseline. Current estimates of global emissions are coarse1 and to the best of our knowledge, comprehensive finer-scale emissions inventories do not exist. To fill this gap, we need frameworks for measuring plastic emissions across geographic scales. Only then can economies begin accounting exercises of plastic emissions at the national, provincial/state, and municipal levels. Such accounting exercises would quantify and sum plastic emission sources, creating a baseline and enabling reporting of measurable change.

There is precedent for emissions inventories. They are used to measure greenhouse gases (GHGs) globally under the Paris Agreement. Signatories of the current Paris Agreement (i.e., countries) must submit emissions inventories of GHGs

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annually using established protocols. Emissions inventories track GHG emissions over time and determine whether collective efforts will keep global average temperature rise below 1.5–2 °C to mitigate the worst effects of climate change.

Likewise, emissions inventories can be compiled for plastic pollution to determine the effort needed to keep pollution levels below an irreversible threshold and to quantify progress toward protecting wildlife, people, and the planet.

### A FRAMEWORK FOR PLASTIC POLLUTION

Compiling an emissions inventory begins with identifying important sources that generate plastic pollution for a given political boundary (e.g., city, province). The next step is to calculate emissions by multiplying activity data—the amount of pollution-generating activity that occurs over a period of time—with emission factors—the amount of plastic shed per unit of activity—for each source. Finally, emissions are summed to obtain total annual emissions within that boundary. The overall emissions of plastic pollution are reported along with an uncertainty estimate.

Emissions inventories should be compiled and reported at different scales (i.e., a city, province/state, or country). Inventories at the city- or state-level quantify the relative importance of different sources to inform local action.

Policymaking for plastic waste reduction and litter mitigation is sometimes most relevant at a local scale, which is exemplified by the variety of plastic-reducing policies implemented, and replicated, in cities around the world. Inventories also enable quantitative assessments of the effectiveness of various policies, for example, bans or taxes on single-use plastic items. Local inventories can be summed to inform national and global inventories, which are required to quantitatively set emissions reduction targets and track progress toward achieving those targets. Inventory compilation at local and national levels are fundamental pillars that inform policy and support any commands delivered at the international level.

Internationally harmonized guidelines to create and report emissions inventories will be a critical piece of an international agreement on plastic pollution (Zhu et al., in prep), and should be informed by those that already exist for GHGs. Harmonized guidelines ensure inventories are comparable across geographies and time, allowing the comparison of mitigation efforts to identify leaders and laggers.

### DEALING WITH DATA GAPS

Some of the data needed to build emissions inventories is not freely available. For example, activity data for a given source—such as total road surface area or number of plastic industries—may not exist because administrations do not mandate reporting of this type of data, the data is not available to the public, or the data is confidential. Overall, these data gaps and shortages must be addressed. Some ways to overcome this barrier include building capacity for more research, mandating transparency of critical data, creating a public repository for data, and collaborating with industry to gain access to confidential data while ensuring anonymity.

### LOGISTICS: WHO COMPILES INVENTORIES, HOW OFTEN, AND HOW DO WE PAY FOR THIS?

The valuable lessons learned from how GHG emissions inventories are compiled should be used to inform logistics for plastic pollution. In the Global North, the compilation and reporting of national GHG emissions is generally self-funded. In the Global South, financial support is available through the UNFCCC. Mirroring this, high-income countries can self-fund...
their inventories and financially support low-income countries by contributing to funds managed by an international body similar to the UNFCCC. Alternatively, funds could be generated through a plastic tax. For example, if $0.01 was provided for every pound of plastic produced, we could produce a fund of >$6 billion USD annually to compile inventories and support mitigation strategies for reducing plastic pollution.

**SIGNIFICANCE AND SUMMARY**

Plastic pollution is a global issue that is increasing in severity. Because plastic pollution transcends geographic boundaries, an international agreement is needed to foster global collaboration.

A global agreement on plastic pollution must facilitate a circular economy. All plastic cannot be easily banned due to its extensive integration into society. We need a fundamental change in plastic material flows that maximizes retention of plastic in the system and minimizes waste produced. As circular solutions become implemented in cities, states, and countries, emissions inventories can measure progress to document the transition of economies from linear to circular and quantify emissions reductions.

Just as the climate community uses emissions inventories to measure the effectiveness of carbon interventions over time, the plastic community can use emissions inventories to measure the effectiveness of a necessary transition of the plastics economy. Comprehensive and rigorously assembled emissions inventories are critical to the success of an agreement to effectively reduce plastic emissions (Figure 1). From this moment onward, it is time to stop simply discussing and start setting baseline levels, targets, and quantitative goals with some formal accounting.

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**Notes**
The authors declare no competing financial interest.

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Chelsea Rochman is an Assistant Professor in Ecology at the University of Toronto and a cofounder of the U of T Trash Team. Chelsea has been researching the sources, sinks, and ecological implications of plastic debris in marine and freshwater habitats for more than a decade. She has published dozens of scientific papers in respected journals and has led international working groups about plastic pollution. Chelsea Rochman routinely provides testimony on Parliament Hill and is a scientific advisor to the United Nations, G7, and European Union.

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**REFERENCES**


