Technical Note: Great Lakes-St. Lawrence Emissions Inventory ('20 & '21)
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October 13, 2023

Background

In 2022, ICCT published a detailed emissions inventory for the Great Lakes St. Lawrence Seaway (GL-SLS) region. The analysis concluded that ships in the GL-SLS emitted approximately 1.6 million tonnes (Mt) of carbon dioxide (CO_2) emissions in 2019, about two-thirds of which were emitted in U.S. waters. Bulk carriers were responsible for more than 60% of the CO_2 emissions, and U.S.- and Canada-flagged vessels emitted 80% of the total, split roughly evenly between the two. More recently, ICCT was selected to lead a consortium of researchers to assess future fuel and power options for Great Lakes shipping. That project has generated an updated GL-SLS inventory for the years 2020 and 2021. This technical note summarizes the high-level findings of that modeling.

Methods

The 2022 study applied ICCT's Systematic Assessment of Vessel Emissions (SAVE) model to estimate emissions in from maritime shipping in 2019 in both the full GL-SLS region and on the Great Lakes (GL) only. Operational data, in the form of satellite and terrestrial Automatic Information Service (AIS) data was provided by exactEarth (now Spire). Ship specification data was provided by IHS Fairplay.

In the updated inventory, updated methods derived in part from IMO's Fourth GHG Study were applied. Two changes were significant and influence the revised findings. First, a smaller buffer outside of the official GL-SLR land boundary was introduced in order to capture missing AIS signals when ships are berthing at ports. This change increased the number of activity hours captured in the GL-SLS by about 70% and fuel by 16%, the latter being lower because most of the added hours were at berth, a low fuel consumption condition.

Second, IHS revised its Fairplay database to include a more accurate estimate of the maximum speed of ships. This lowered the modelled engine load factors and therefore reduced estimated of fuel use and emissions. In sum, these two changes led contributed to modest reduction in the estimated fuel use and emissions in 2020 compared to 2019.

High-level results

Overall, we estimate that ships operating in the GL-SLS region emitted about 1.5 and 1.6 million tonnes of CO_2 in 2020 and 2021, a slight decrease from 2019 values. Ships flagged to the U.S. and Canada were responsible for three-quarters of those emissions, or 1.17 million tonnes (Mt) of CO_2 in 2021 (Figure 1). This is equivalent to emissions

from about 250,000 U.S. passenger vehicles. U.S. vessels tended to operate within the GL and most emissions were from bulk carriers (67%) and tugs (25%). Canadian flagged ships were more active in the SLS with a somewhat more diverse ship profile. In addition to with bulk carriers and tugs, chemical and oil tankers, ferries, and general cargo ships were also significant sources of CO_2.
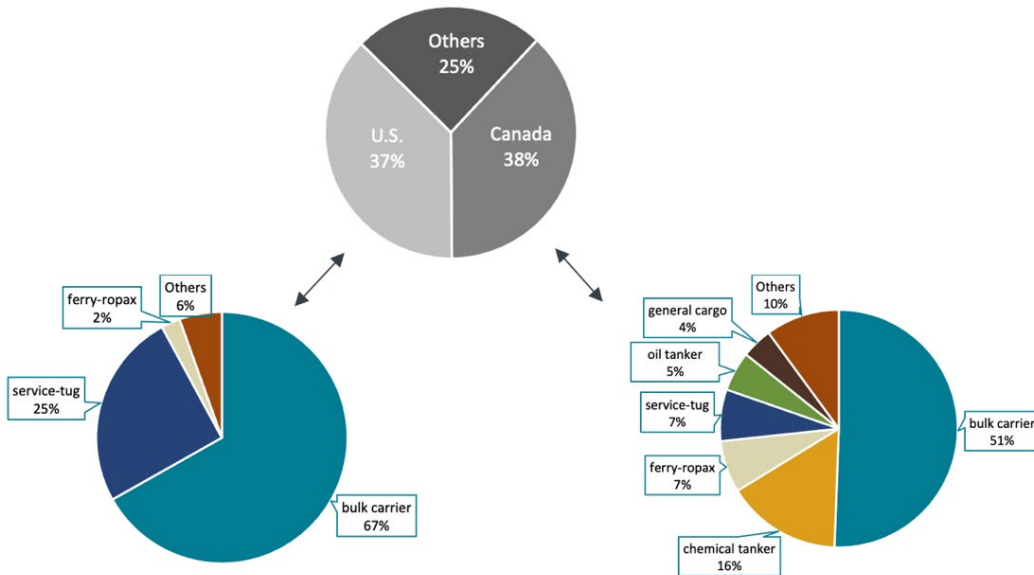
Figure 1: GL-SLS CO_2 emissions in 2021 per flag and ship type

Figure 2 summarizes of key trends from 2019 to 2022, which as noted above are influenced by a change in modeling methods. Relative to 2019, the 2021 inventory included about 170 (18%, in blue) more vessels and about 80,000 (15%, in yellow) more cruise hours in the GL-SLS region. But CO_2 emissions were flat because CO_2 per emission per ship and CO_2 per cruise hour fell 19% and 17%, respectively. It is difficult to attribute any change in emissions to external drivers, for example the impact of COVID-19, given the change in modeling methods.
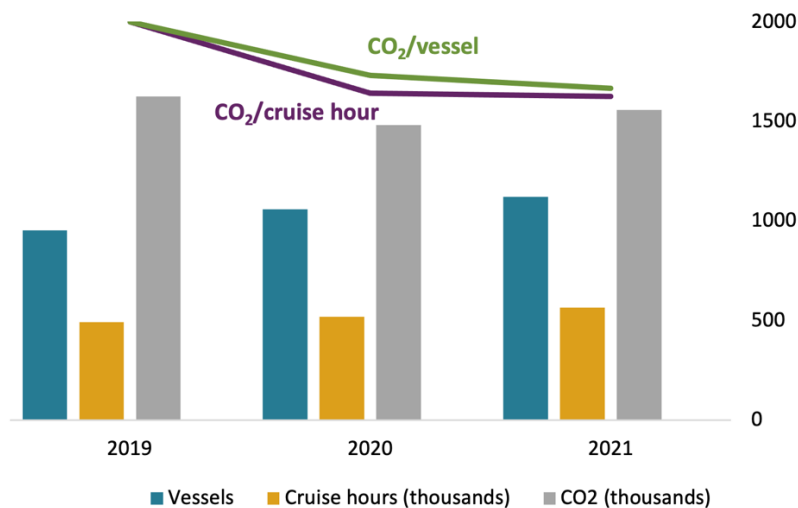
Figure 2: GL-SLS CO_2 emissions in 2021 per flag and ship type