



# **Evaluation of CO<sub>2</sub> emissions from cruise ships**

**November 2018**

**Introduction**

The main purpose of this short report is to present results of an evaluation of specific CO<sub>2</sub> emissions, i.e. emissions per passenger per travelled km for cruise ships. The CO<sub>2</sub> emissions are based on real oil consumption data per 24 hours reported by cruise ship operators to the company ShipPax which publish annual statistical reports for the cruise and ferry industry. ShipPax Information (<https://www.shippax.com/>) also collects their data in an electronic database, which accessible through a subscription service.

**ShipPax data**

A full up to date extract of oil consumption data from the ShipPax data base is shown in fig. 1 and 2 showing total oil consumption data per 24 hours for 156 ships, built in the period from 1960 to 2018.

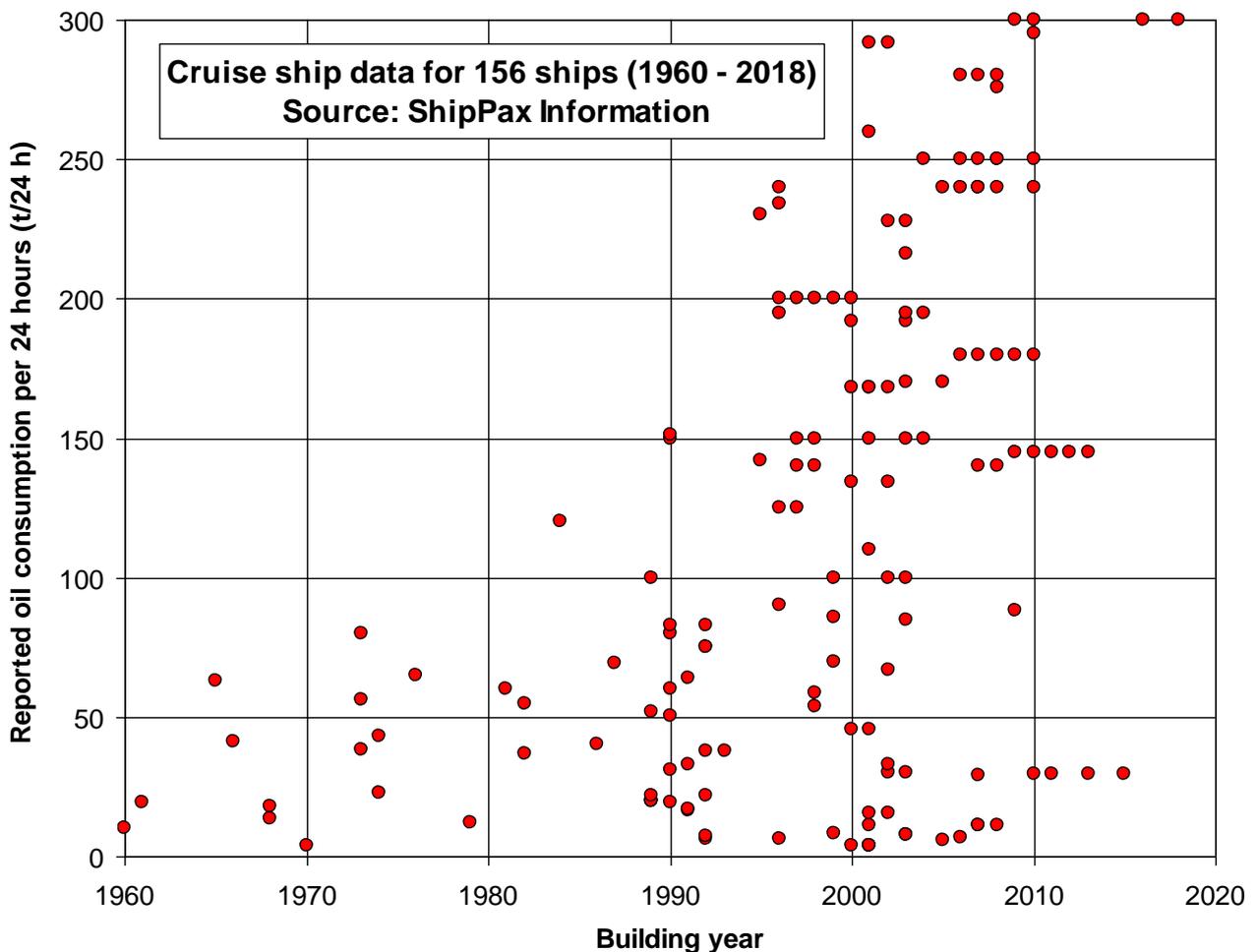


Fig. 1 Fuel oil consumption per 24 hours as function of building year for cruise ships

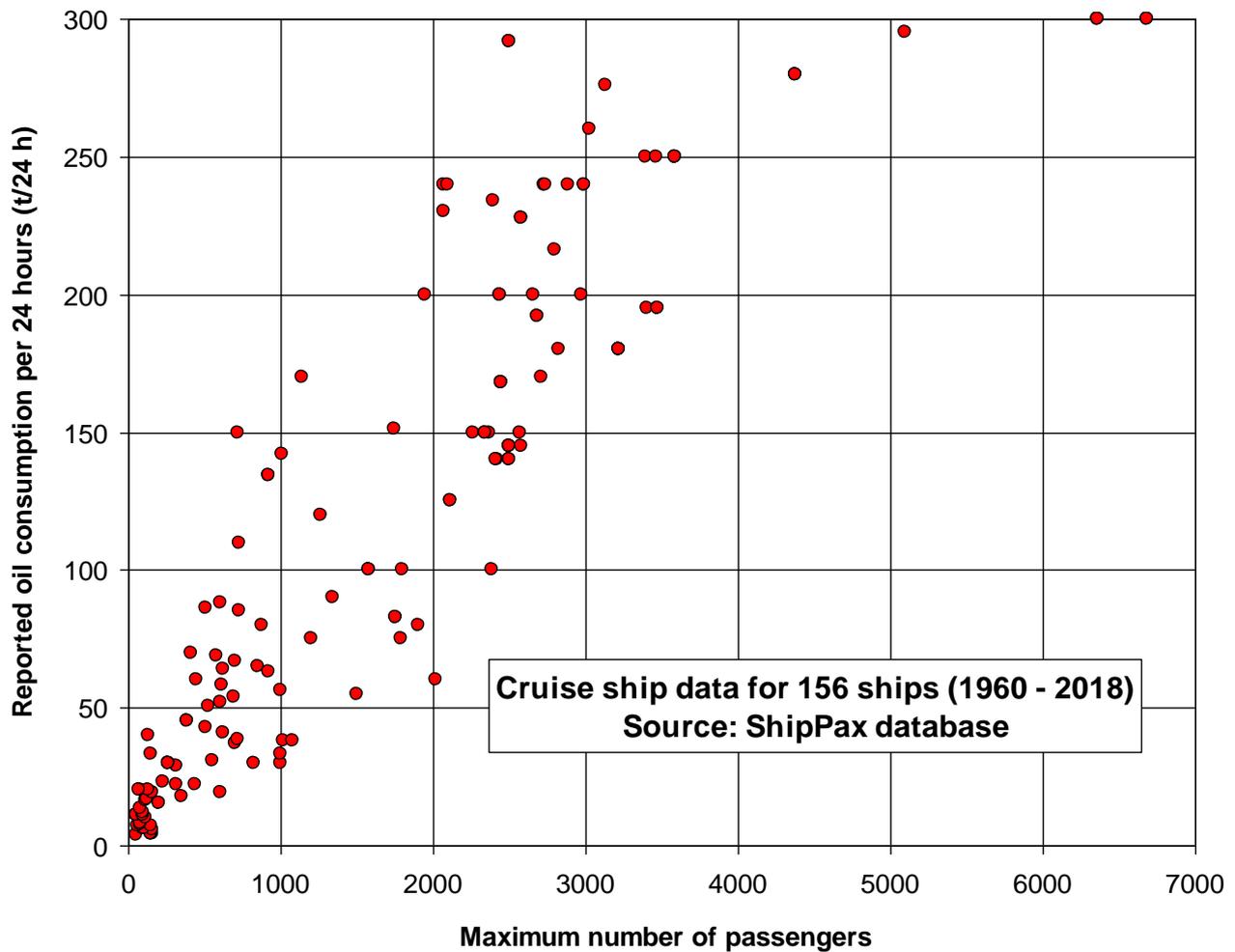


Fig. 2 Fuel oil consumption per 24 hours as function of maximum number of passengers for cruise ships

### Verification of oil consumption data

The ShipPax data base also contains data of the total main engine power and the associated total auxiliary power including the service speed. Using these data and assuming a specific fuel oil consumption of 180 g/kWh and 200 g/kWh for the main engines and the auxiliary engines respectively, the oil consumption per 24 hours has been calculated assuming, that the service speed is obtained at a service main engine rating of 75 % MCR (maximum continuous service rating) and using 1/3 of the installed auxiliary engine power.

Fig. 3 shows a comparison between the calculated oil consumption and the reported oil consumption, where it is seen, that the reported oil consumptions seem reasonable verifiable, with a slight tendency of larger actual consumption.

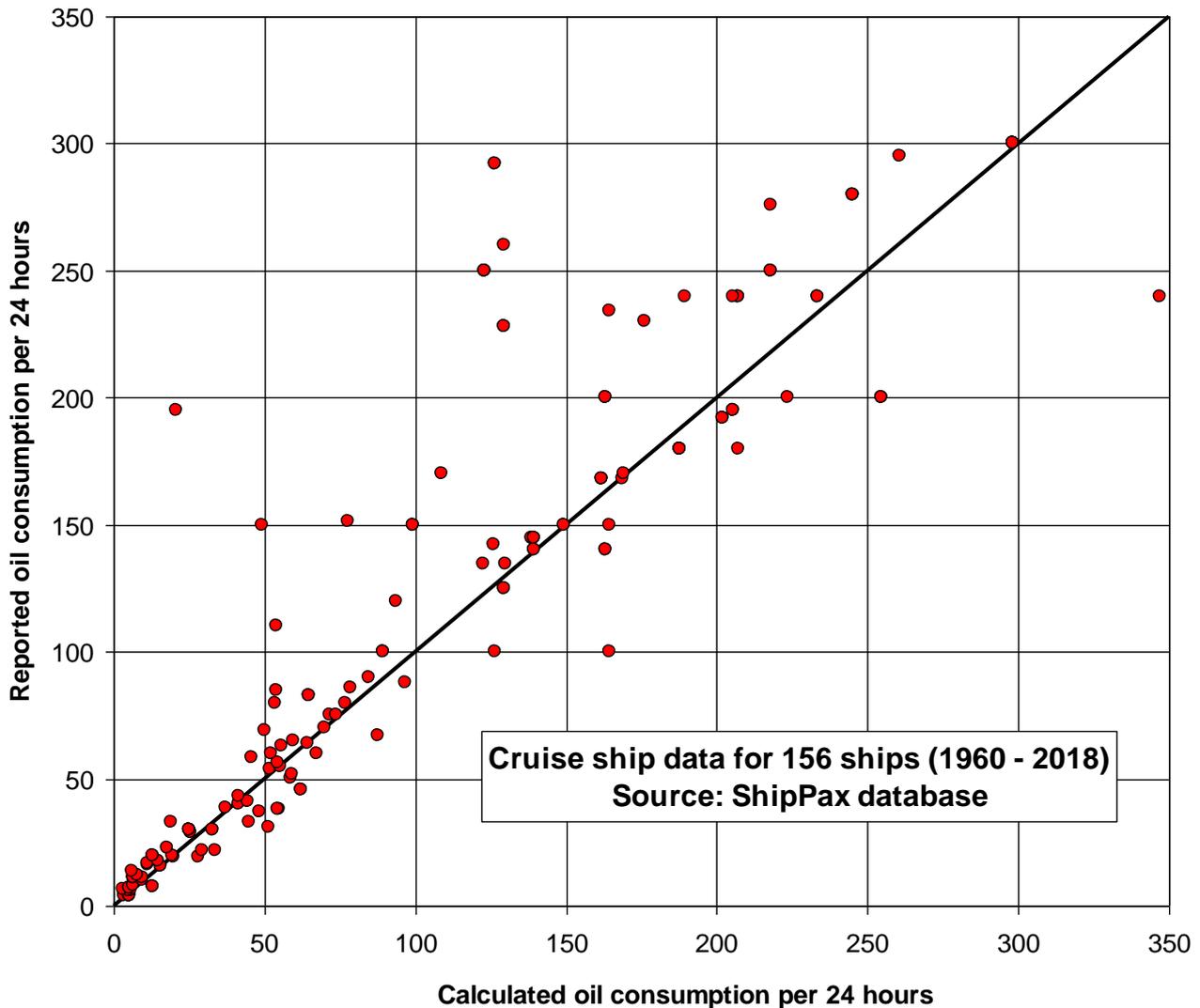


Fig. 3 Comparison between calculated and reported fuel oil consumption for cruise ships

**Calculation of CO<sub>2</sub> emission per passenger per km**

Assuming that the CO<sub>2</sub> emissions per ton oil is 3.15 ton, the CO<sub>2</sub> emissions have been calculated per passenger per km as both the number of passengers and the speed is reported in the ShipPax data base. The consumption reported by the cruise ship operators has been used in these calculations, which means that they are carried out without any kind of assumptions concerning engine loading and specific fuel oil consumption. The results of the calculations are shown in fig. 4.

The only assumption is 100 % utilization, which is too optimistic, as the cruise ships in general are not always fully occupied with passengers, although the utilization is relative large for this passenger ship segment. If the ships are sailing at a lower speed, the oil consumption will be reduced as example by 25 % at 10 % speed reduction. The 100 %

utilization assumption might therefore very roughly compensate for a possible lower service speed compared to the speed given in the ShipPax database.

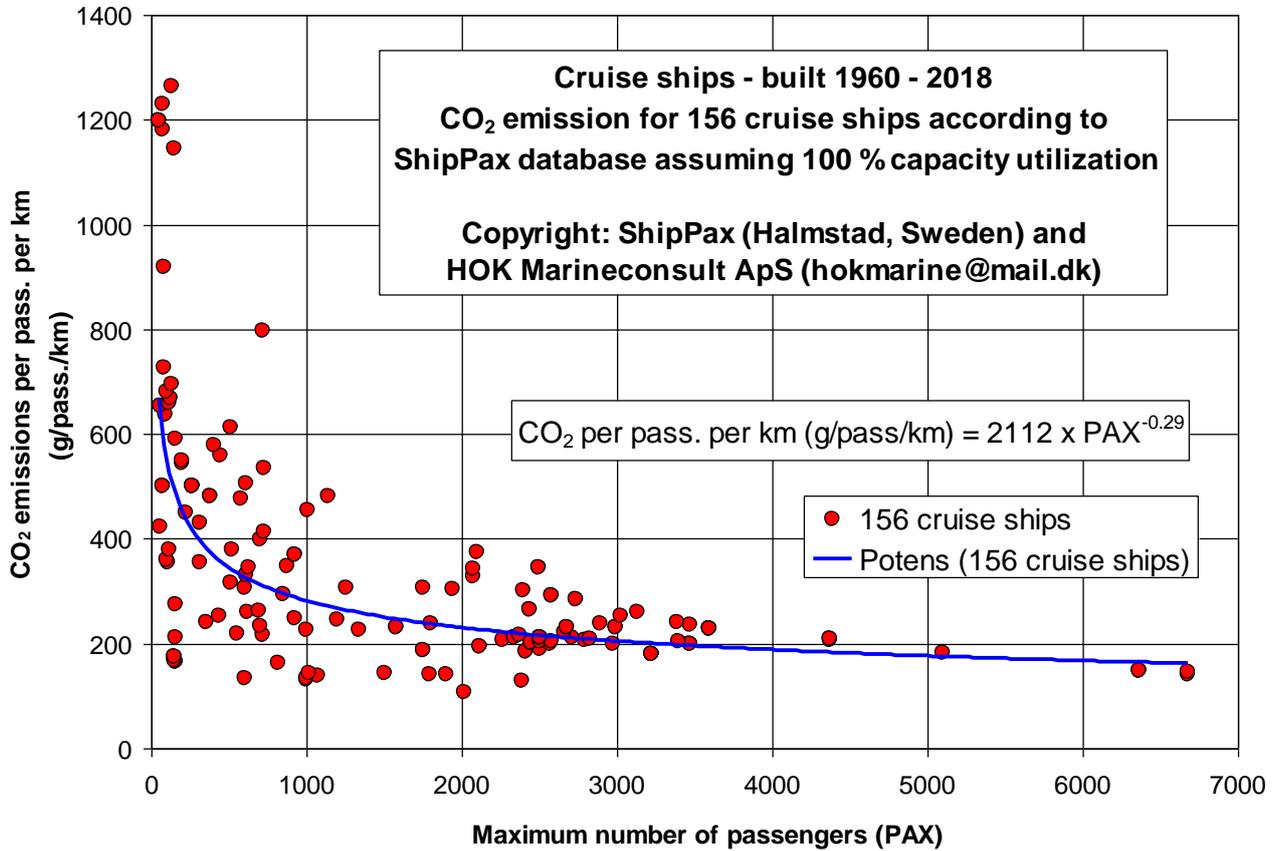


Fig. 4 Calculated CO<sub>2</sub> emissions per passenger per km

### Acknowledgement

The author wants to thank ShipPax information for the permission to use data from the company's extensive ship data base.