Thirsty passengers

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As a rule of thumb, commercial aircraft consume some 10 cm^3 of fuel per seat per second. That sounds like a lot. Imagine the whole cabin taking a sip each second, with the flight attendant beating time. Funny. But that's what the fuel consumption amounts to.

No wonder, one might think: at such tremendous speeds the drag must be enormous. Compare that with the slow boats of yesteryear, which took a week to cross the Atlantic. They must have been a lot less wasteful than those fast planes nowadays.

But wait: shouldn't we look at fuel consumption per *kilometer* rather than per second? Back to the rule of thumb: 10 cm^3 per second is 36 litres an hour, during which the plane flies some 900 km. That yields 4 litres per 100 km. Modern efficient aircraft do a bit better than the rule of thumb, and arrive at, say, 3 litres per 100 km. So: two passengers consuming a joint 6 litres per 100 km are just as wasteful as if they were sharing a reasonably efficient car.

What about the slow boat? Surprise. A large passenger boat or a cruise ship consumes about 25 litres per 100 km per passenger. Despite its moderate speed, the boat is much worse than the plane, in terms of fuel consumption per passenger km. How come? A bit of physics leads the way. Of course, the drag is determined not only by speed but also by the density of the fluid. Water and air differ by three orders of magnitude. It's even more than that: since commercial aircraft cruise at 10 km, and since the density goes roughly as exp(-h/8km), they cruise at roughly1/4 of the standard value.

But perhaps the biggest difference is the payload. On a cruise ship, the mass of the passengers plus their luggage typically amounts to a few tenths of a percent of the total mass. The reason, of course, is that a cruise ship is a floating village, with shops, restaurants, swimming pools and the like. Even a huge modern vessel such as the Queen Mary 2 with its 150 000 tons carries 2600 passengers only. Compare that with a big airliner. The total mass of its passengers is well above 10 % of the aircraft.

One can agree that: in the interest of energy and the environment, we travel much too much, kerosene is much too cheap, and we fly much too often. But if we *have* to, crossing the Atlantic by boat would be even worse. ■