Estimated Energetics of a Thames Sailing Barge by Nick Baker

How much energy, and CO_2 emission, does a sailing barge save in a year compared with a small motor ship and a lorry?

Energy intensity of small motor coaster – 0.3 MJ/tonne km.
Energy intensity lorry (ave small – large) – 1.5 MJ/tonne km

Thames barge – two round trips Harwich-London per week – 500 km

Assuming ½ loaded (allowing for trips empty) and in commission 30 weeks / year with capacity 150 tonnes - 1,125,000 tonne km.

Energy equivalent for motor ship	337,500 MJ	(337.5 GJ)
Energy equivalent for lorry	1687,500 MJ	(1687.5 GJ)

How much energy is this?

An average household uses about 45 GJ for heating, lighting, cooking and hot water.

So the saving is equivalent to building about 7 zero energy houses if it displacing marine transport, or equivalent to building 38 zero energy houses if displacing lorry transport. (Building a zero energy house is difficult and expensive)

How efficient is the sailing barge? How much wind energy does it need to achieve this?

This is difficult to estimate but we can get a feel for it by seeing how much wind energy would be available during sailing hours. Using a very crude model, taking the mean windspeed for the Thames estuary 4.5 m/s and a sail area of 250m^2, allowing for the sailing time as in the scenario above, the average available power is about 18 kW (25 hp) and the total energy about 97 GJ. So it appears that the sailing barge is doing rather well, moving the same amount of freight for about ¼ of the amount of energy.

Two explanations – firstly, sailing barges move slower and generate much less waste of power in wave-making, and secondly barge skippers know that they must make use of the tides – thus lunar energy (the moon's orbiting is slowing down) is supplementing wind power.

The saving in CO_2 emissions is as follows:

Motor ship	24.75 tonnes
Lorry	123.75 tonnes

One less favourable comparison is that the barge travels 7500 km whereas a typical lorry (crew of one and no dog) travels around ten times that distance.

Efficiency

Finally, it is quite interesting to see how efficient the human + barge system is at gathering ambient energy.
Two men working at an average of about 240 watts = 480 watts. Average power available from wind 18,000 watts.
Coefficient of performance = 18000/480 = 37.5 i.e. the barge is in effect multiplying the human energy 37.5 times.

1 MJ (Mega Joule) is equivalent to 0.27 kWh (kiloWatthour)
1 GJ = 1000 MJ

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