JULIE'S BICYCLE

SUSTAINING CREATIVITY

FACT SHEET:

UP IN THE AIR OR OUT TO SEA?

Air and sea freight

By Tristan Smith
University College London Energy Institute

International touring is, by definition, contingent on travel - often by air and sea. However, aviation and shipping rely on fossil fuels and, in the short to medium term there are no viable alternatives. Both these sectors are growth sectors and therefore it is inevitable that the greenhouse gas emissions they generate will also increase. This note gives an overview of the environmental issues associated with air and sea travel, where government policy is heading and some guidance to reduce environmental damage.

Why the environmental concern about aviation and shipping?

Our best guess at the moment is that anthropogenic greenhouse gas (GHG) emissions created by aviation and shipping are of a similar magnitude - each accounting for approximately 3% of global emissions. Analyses to break down that figure for the EU and UK return similar estimates of more localised proportions. Given such a diminutive share of the carbon problem, and considering the complexities of regulating international businesses, it is tempting to focus on the bigger carbon criminals; agriculture, industry, power generation and the like.

But aviation and shipping are the workhorses of globalisation. Together they move an overwhelming majority (80% of global trade travels by ship) of the raw materials, fuels, manufactured products and labour force around the world that has been fundamental to high consumption lifestyles typical of the West, as well as the inexorable industrialisation of China and the Far East.

As a result, both sectors have experienced feverish growth rates over the last few decades. Growth projections assuming business as usual suggest that, if we fail to control emissions from aviation and shipping, they could contribute as much as 30% of anthropogenic emissions by 2050. If that happens we will be left wondering why we ignored such a large and fundamental part of the problem.

Beyond the headline figures on emissions proportions, both shipping and aviation have separate and additional climate challenges. Aircraft emissions are complicated by the physical and chemical impacts of their emissions on the upper atmosphere. Some analyses apply a metric or multiplier to the quantity of GHGs emitted by a flight in order to produce a more accurate representation of its climate impact.

Shipping's dirty secret is that it burns some of the lowest grade fuel that we extract from the ground. When crude is distilled to produce petrol and diesel for road transport, the high sulphur content ‘heavy fuel oil' is a comparatively cheap by-product and consequently the fuel of choice for the cost conscious shipping industry. Acid rain, smog and health issues associated with burning high sulphur fuels such as heavy fuel oil and coal have led to legislation that has all but banned it from most of its previous applications.

The regulatory complexity and the ‘out of sight, out of mind' nature of the shipping industry has meant that burning high sulphur fuels in ships has gone unchecked. Through the International Maritime Organisation (IMO), there is now a framework in place to bring shipping's sulphur emissions down from current levels (about 4.5% of exhausted emissions) closer to that of a modern car. This will be achieved either by switching to low sulphur fuels, or fitting technology to ships that will ‘scrub' the

sulphur from the engine's exhaust. Similar regulatory attention is being paid to nitrous oxides and particulate emissions.

One way to solve the land-based anthropogenic GHG problem is to decarbonise energy supply. This might involve increased provision of renewable energy to the grid or the revival of the nuclear power industry. However, it is not easy to plug a plane or a ship into a wind turbine. For these reasons neither the aviation nor the shipping sector currently foresees an imminent switch away from liquid fossil fuels. The physics of flight constrain planes to energy dense fuels and compact high-power-to-weight ratio engines, which currently limit their options for large long distance aircraft to gas turbines burning aviation fuel (which is currently distilled from oil).

Ships are less restricted from a technological perspective, and have more space and carrying capacity to explore the application of emerging (or recurring) technologies. The motive force for global trade was originally derived from the wind. Tea, wool, spices and many staples of our ancestors' lives were distributed by sail power and some now see the combined challenges of high fuel prices and GHG emissions stimulating resurgence in wind-powered shipping. Many modern ships are too large to be powered wholly by sail, and nor would modern expectations of punctuality tolerate such a whimsical service. However, giant kites, flettner rotors (a rotating column which generates lift from the wind) and folding deployable wings have all been studied, and in some cases trialled on large ocean-going ships, to investigate their technical and economic viability. Similarly, solar panels can be used to augment the power generated through internal combustion and their integration into ship design could become commonplace in the future.

Renewable power sources are not reliable and so future ships and planes still need to carry either fuel or energy storage that can be tapped into when the sun stops shining or the wind is not blowing. Biofuels are the most obvious technological answer because they require minimum disruption to our existing liquid fossil fuel infrastructure (See biofuels hot topic). Indeed, blends of biofuels (where biofuel is mixed with fossil fuel to reduce the modifications required to existing engines but incorporate a proportion of the benefits of a low carbon fuel) are already in use. However, the true sustainability of this miracle cure to mankind's oil addiction is now being questioned. As demand for biofuels in all sectors increases, constraints on supply due to the large surface areas and resources (e.g. water) required for their production are likely to constrain their viability. This leaves synthetic fuel, such as hydrogen, ammonia and methanol. Low carbon generation of these fuels is technologically feasible, but the high costs associated with this will prevent their widespread uptake until sufficient regulation is in place.

Government aviation and shipping policies

Aviation and shipping are both included in the UK government's commitment to reduce GHG emissions by 80%. However, it is hard for the UK to act without international collaboration because both are 'mobile' industries that could easily re-route to hubs in neighbouring countries, with negative consequences for the UK's economic growth. This dilemma is epitomised by the current debate regarding the expansion of Heathrow. The turgid progress of global negotiations witnessed at Copenhagen in December 2009 suggests that international consensus on emissions

reductions and a framework to enforce it is a long way off. Progress on this international framework is crucial before effective global regulations on aviation and shipping can be used to drive and incentivise emission reduction in these sectors.

Fortunately, as we await those global commitments, the EU has been busy pioneering a GHG Emissions Trading Scheme (ETS) which places caps on the GHG emissions in certain sectors and provides a market so that the higher emitters can buy 'permission' to emit GHG from lower emitters: this effectively redistributes the burden of GHG emission reduction to the emitters for whom the cost implications are lowest whilst ensuring the cap provides a simple high level control that obviates the need for micromanagement of many industries and sectors. This ETS is now in its second phase and in 2012 will start a third phase that will include aviation within its scope. The terms for including aviation mean that any flight landing or taking off from the EU will be covered (i.e. even those to and from non-EU destinations) and so depending on the market price of carbon this could start to drive up flying costs and encourage adoption of lower carbon technologies and operating practices. Like fuel price forecasts, carbon prices will fluctuate and so it is hard to assess the scale and timing of the impact of this regulation. Current expectations are that even by 2020 price effects created by the EU ETS are unlikely to exceed 50% and could be a substantially lower portion of ticket cost.

Shipping is further behind aviation from a GHG emissions regulation perspective. The United Nations Framework Convention on Climate Change (UNFCCC) has delegated the responsibility of developing emissions regulation for shipping to the IMO, a UN agency. A variety of tools that could form the basis of emissions reduction implementation are under discussion, including a global ETS for the shipping industry, but all currently face significant technical and political challenges. As a result, only voluntary energy efficiency standards have been introduced so far, and it is expected that it will take some time before legally binding global regulations are introduced. The EU is concerned about the rate of progress at IMO, although it recognises that only global regulation can produce the fundamental changes in the sector that are required for it to achieve a substantial reduction in emissions. To bring the subject into close focus the EU is threatening that should the IMO make insufficient progress towards introducing regulation over the next two years it may incorporate shipping into the EU ETS, perhaps following the model applied to the aviation sector.

So, without substantial regulatory impacts on the horizon, unless we see a dramatic increase in fuel price due to scarcity of supply it is unlikely that in the next ten years we will see significant changes to the aviation and shipping sectors, or to the planes and ships on which freight and passengers travel. This means that emissions reductions are only likely in the shorter time scale if individuals and businesses make careful decisions about how much demand for these sectors they create. Only travelling when absolutely necessary and ensuring that preference is given to sourcing raw materials and products locally is the most effective and immediate response that individuals and companies can take.

Guidance for reducing aviation and shipping emissions when touring

Air freight is easily the worst emitter, and whenever possible preference should be given to transport by ship, even over rail and road transport, although clearly any decision must be based on the details of the specific route (See Figure 1). Unfortunately, the timescales associated with global freight movements by ship may not be consistent with a hectic touring schedule. Perhaps ports will become the preferred concert venues of the future - you could do worse than Sydney, New York and London.

Figure 1: Grams of CO2e per tonne-km associated with each type of freight

Source: NTM (Swedish network for transport and the environment) - cited in British Chamber of Shipping (2009)

When it comes to passenger transport, it is harder to generalise about the relative GHG impacts of different types of transport. Whilst long distance sea passages are still possible, either on a modern liner like the Queen Mary II or by hitching a lift on a container ship, factoring in weeks of travelling time, romantic though the voyage could be, is a luxury few busy people can afford. Because we demand short passage times, ferries have been getting faster. Even the Queen Mary II travels at approximately 35 mph, in order to keep the voyage length to a week. Combining such higher speeds with the space and levels of comfort that passengers demand mean that in practice a switch from flying to travelling by sea in our current passenger ships would rarely result in significant emissions savings.

If aviation is the selected mode of passenger transport then you can make some contribution by choosing the most efficient type of flight. The equation is simple: it's all about getting the most people into the largest possible plane flying your route. Unfortunately this means that the responsible thing to do is to shun being pampered in first class, as first class seats reduce the number of more spatially efficient economy class seats you can fit on a plane and therefore increase the GHG. Airlines

would stop fitting out large areas of their aircraft to higher-class travel if there was no longer the customer demand for this service.

So to sum up, the choice when it comes to travelling or moving equipment long distance is between a bad option (a combination of land and sea transport) and a worse option (flying). As is so often said about GHG emissions, there is no silver bullet which can be applied to revolutionise either of these sectors. However, there are steps being taken to bring in regulation which will provide a framework for implementing change in the future. In the meantime, the best advice if you want to create the minimum GHG impact is to take your time and to enjoy your journey. Take a slower ferry and enjoy the views from a train – it's better than the cloudscape you see from the window of an aeroplane.