**Trains - the environmentally acceptable alternative to Planes?**

Over the last year we've seen the main political parties trying to outdo each other over their environmental credentials. There has even been a proposal to ban UK domestic flights on the grounds that they are environmentally irresponsible and for all UK travel to be undertaken by high speed train. Now it seems the transport sector is following this lead. For example, the new Virgin Trains campaign that advertises that "Our Pendolino trains emit 76% less CO₂ than cars or domestic flights".

On the face of it, pretty compelling evidence that, in climate change terms, train travel is the way of the future. However, like everything, things are not that simple. For example, the wording of the advertisement states that the comparison is based on CO₂ "emitted" by the train. Comparing the CO₂ emissions of a train that runs primarily on electricity with an aircraft cunning avoids including the emissions of the gas-fired powerstation that produces the electricity on which the train runs.

What is also unknown is the basis on which the comparison is made - is it made on the maximum capacity of the two forms of transport or the average load factor (ie, the number of seats available or the number of seats occupied). This makes a big difference when you consider that airlines usually operate at 75% capacity while Intercity trains usually operate at about 35% capacity. Another important factor is the distance over which the comparison is made. Planes use a large amount of fuel to achieve take-off and reach cruising altitude. Once at cruising altitude their fuel consumption decreases significantly. Therefore, the shorter the distance over which the comparison is made, the more inefficient planes will be.

For train companies to compete with airlines they have to be able to transport people to a destination as quickly as can be achieved in a plane. This is easily achievable over small to medium distances but becomes increasingly difficult over distances of 500km.

Take, for example, the comparative trip times between London and Edinburgh and London and Paris. Edinburgh is 610km from London whereas Paris is only 340km.

The travel time between London and Edinburgh by plane is 1.5 hours whereas by train the time is 4.5 hours. Even when the total travel time is considered (ie, the time taken to travelling to and from the airport/station and the waiting time there) it still takes about 1.5 hours longer to travel from London to Edinburgh by train (about 4.5 hours versus 6 hours). However, the total travel time to Paris by train is only 3.5 hours (soon to be 3.25 hours) whereas by air the time is 4.5 hours. Therefore, time-wise, it makes sense to travel to Paris by train and to Edinburgh by plane.

Even the Commission for Integrated Transport, when looking at high-speed rail in the UK, concluded that the case for high speed rail is strongest where there is a large market for travel in the range 300-600km and it is currently not competitive with air transport for journeys longer than approximately 800km. Hence Paris is in the optimal range for high speed trains whereas Edinburgh is marginal.
The obvious way to make train travel to Edinburgh more competitive is, therefore, to make it faster. However, the increase in speed comes at a price and that price is a disproportionate decrease in the fuel efficiency of the trains due to the greatly increased air and rail friction caused by the higher speed.

Once a train reaches speeds of about 200mph (which would be required to make trains competitive with planes on the Edinburgh run), the power required for it to overcome the additional friction means that its fuel consumption gets very close to that of an aircraft. This means that unless there is a step change in train technology, there is a limit to the distance at which trains are a viable alternative to air travel in terms of reducing emissions if they are to provide a comparative service. And while Magnetic Levitation trains could provide that step change, at a cost of £35m per mile of track, there is no way they can yet compete in terms of cost.

So there is it, trains are indeed better for the environment than planes but only for distances up to about 500km. Above this distance they need to travel much faster to be competitive in terms of time and this comes at the expense of their environmental advantage.