

AN INVESTIGATION OF SUSTAINABLE TOURISM USING HIGH SPEED RAILWAYS

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ABSTRACT

The economic growth and increases in the personal income and life expectancy, coupled with more leisure and free time activities have generated more need for transport. The preferences given to energy-intensive modes of transportation have increased dependency on non-renewable energy resources and as a result, the tourism sector contributes to around five percent of the total greenhouse gas emissions. In order to manage the growth of carbon dioxide emissions produced by the tourism industry, there is a need to switch to less polluting forms of transportation. The purpose of this research is to investigate the opportunities offered by High Speed Railway (HSR) for the tourism industry, new types of tourists travelling by train, and possible ways to promote a modal shift towards more sustainable modes of transportation. The secondary data methodology has been used in this research, supported by empirical evidences. It analyses the influence of HSR in terms of reducing the carbon dioxide emissions from the tourism industry, and the offer of new types of travel. Cases from countries with sufficient experiences of operating HSR were selected. Most of the data was gathered from the internet, including in depth research of the HSR in the selected countries, International Union of Railways, available railway statistics and European and Institutional publications. The expected outcome of this research is that it will contribute to better understanding of the possibilities offered by HSR in terms of reducing the carbon dioxide emissions from the tourism industry. HSR can also change the international and domestic tourist travel experience by reducing travel time and costs.

Keywords: high-speed railway, sustainability, tourism.

1 INTRODUCTION

The International Panel on Climate Change (IPCC) has predicted that if nations around the world do not reduce production of greenhouse gas emissions, then temperature will rise between one and six degrees Celsius from the current level by 2100 [1]. The transport industry produces around 23% of global CO₂ emissions which will increase by 1.7% by 2030. Most of this pollution comes from road and air transport as railways are responsible for only 2% of the total transport emissions [2]. To limit global warming to under two degrees Celsius compared to pre-industrial levels there is a need to dramatically cut the greenhouse gas emissions. It is required to be zero emissions between 2030 and 2050. To achieve this target there is a need to find new solutions for producing goods and services. One of the solutions would be to shift traffic from air and road to more sustainable transport modes. The tourism industry is the fifth largest polluter in the world and responsible for approximately 5% of global greenhouse gas emissions and more than two thirds of that come from travel. There is an urgent need to shift mass travel to more energy-efficient mode of transportation. In the last ten to fifteen years, HSR have had great attention as a transport mode that can help solve the problem by moving people around in the most sustainable way. Air transport is becoming less reliable and roads are getting more polluted and congested. The time needed for air travel or car travel increases but trains are getting faster. After the 2015 United Nations Climate Change Conference in Paris the environmental policies are tightened whilst the HSR is expected to expand further and becomes the most environmentally friendly mode of mass transportation that offers high levels of mobility.



2 INCREASE IN NUMBER OF TOURISTS WORLDWIDE

The tourism industry has a huge economic and social impact on society. It creates new jobs, brings prosperity to host communities and builds bridges between countries and cultures. Tourism is one of the largest and fastest growing economic sectors of in the world economy. The number of international tourists has substantially increased in recent years from 527 million globally in 1995 to 1133 million in 2014. There is a need to add another five to six billion people who travel in their own country every year. Income from the tourism industry worldwide had increased from US\$415 billion in 1995 to US\$1245 billion in 2014. Between 2010 and 2030 the number of international tourists worldwide is expected to increase by 3.3% a year to reach 1.8 billion by 2030. In 2014 the largest growth in arriving international tourists belongs to USA with an increase of 8% compared with 5% for Asia, Pacific and Middle East, 3% for Europe and 2% for Africa [3]. To satisfy these increases in the number of travellers there is a need to expand existing transport systems. As stated by the European Commission, demand for passenger transport in Europe is expected to increase by approximately 25% between 2010 and 2020 [4].

Table 1 shows the ten most visited countries in the world by international tourists. The tourism industry is responsible for approximately 5% of the world Gross Domestic Product (GDP) and contributes approximately 6–7% to the total employment. The tourism industry is in the top five export earners in more than 150 countries. The growth of economy, increasing incomes of population, more leisure time, and the variety of activities can increase growth in travel. An aging population, living longer and having more active life and free time mean more travel. People have a great need of mobility and recreation, and this will increase traffic growth. The tourism sector is closely linked to climate change as it involves the use of transport to move people from one destination to the other making the transport sector one of the major sources of greenhouse gas emission. The tourism industry is responsible for approximately 5% (1,302 Mt carbon dioxide) of global greenhouse gas emissions and 75% of it came from tourism transport [6]. Emissions from tourism transport deviated by as much as 40% from air transport, and 32% from road transport [7]. Aviation is responsible only for 17% of the total number of trips taking by tourists, but coach and rail transport account for 34% of all trips. All trips taken by coach and rail in the tourist industry produce only 13% of all carbon dioxide emissions [8].

Tourism is the fifth largest polluter worldwide and future emissions from the tourism industry are expected to increase substantially despite the technological improvements in the transport energy efficiency. It is estimated that one tourist journey on average generates 0.25

Table 1: Top ten most visited countries in the world. Adapted from [5].

Country	Number of international tourist (million)
France	83.7
USA	74.8
Spain	65.0
China	55.6
Italy	48.6
Turkey	39.8
Germany	33.0
UK	32.6
Russian Federation	29.8
Mexico	29.1



tons of carbon dioxide emissions and aviation is responsible for most emissions from the tourist industry. In the next 30–50 years emissions from aviation are expected to grow by at least a factor of 2 to 3 [9]. Transportation is the major area of environmental impact for the tourism industry but switching to less polluted modes of transportation will improve the environmental sustainability of the tourist sector. The HSR can offer an opportunity to develop a tourism model that combines cultural experiences, fast and safe way of transportation to holiday destinations and an environmentally responsible mobility. It is predicted that in the next twenty years the number of trips will grow and passenger-kilometres will increase by 222% and as a result the carbon dioxide emissions produced by the tourism sector will increase by 156% [10]. Tour operators do not have the potential to influence the sustainability of air transportation but they have some choice over the mode of travel which means that they can offer to tourist's alternative ways of transportation such as HSR.

In the twenty first century, transport provides a huge demand for increasing mobility and reduces the friction of distance; as a result, the world is becoming a smaller place. In the last fifty years, travel distances sharply increased and it is still increasing particularly with the operation of airlines that offer cheap flights. The average growth rate of passenger-kilometres has been rising by 4.6% each year. Average travel for passengers in developed countries is 16,645km per year compared with 2,627km in developing countries [11]. With the increasing awareness of people about the environmental issues and air pollution and the expectation that by 2030 at least 37 cities worldwide will have a population of over 10 million [12], the amount of travel by HSR to the seaside and countryside at weekends will increase. This type of travel can be observed in countries such as Japan and China. HSR connecting the tourist attraction spots will create new types of tourists travelling by train to locations of natural beauty and historical places.

In 2015 the number of international tourist who visited Europe reached 609 million which is 51% of the total number of international tourists worldwide. The tourism industry in Europe generated approximately 404 billion of euros in export [13]. To satisfy the increasing demand for long distance travel, high-speed night trains will have a substantial potential. They can offer more sustainable ways to travel. HSR can change the international and domestic tourist travel experience by reducing the time needed for travel and costs and offering high service standards. With the increasing GDP, per capita it increases the length of travel and number of trips [14] whilst the increasing threat of terrorism more people than ever before prefer to travel domestically.

3 DIFFERENCES IN CARBON DIOXIDE EMISSIONS BETWEEN AIR AND HIGH-SPEED RAIL TRAVEL

The average temperature is rising across the world and natural phenomena such as flooding, drought and volcanic activity are also increasing. The sea level had increased by 1.8mm per year between 1961 and 1993 and by 3.1mm per year between 1993 to 2003. Twenty of the thirty megacities are in the areas susceptible to flooding from the rising sea level [15]. Flooding can affect over 500 million people. The United Nations Environment Program suggests that economic damage from global warming is doubling every decade and that climate-related disasters are occurring with an increasing frequency [16].

Concentration of CO₂ in the atmosphere is currently over 370 ppm which is highest level for over 420,000 years and is rising by over 2 ppm per annum. Before industrialisation in the western countries the concentration of CO₂ was at 280 ppm. By 2020 it is likely to be over 430ppm [17]. The rising concentration of CO₂ in the atmosphere to 450ppm will increase the average temperature at the surface of the planet by up to 2°C. To stabilise the CO₂ level at 450ppm, there is a need to reduce carbon dioxide emission by almost 60% from that of



1997 levels by 2050 [18]. Transport is a major user of energy and a major source of pollution. To stabilize the CO₂ level in the atmosphere there is an urgent need to use a more sustainable way of travel.

Table 2 shows that CO₂ emissions from the transport industry have significantly increased over the period 1990–2000.

The transport industry is the second major contributor to CO₂ emission after the energy industry. World-wide transport is responsible for around 20% of pollution, and it is the only one major sector where the absolute amount of pollution continues to increase. The Railway industry is responsible for around 2% of the total CO₂ emissions whilst the road transport produces 73% and aviation around 11% of CO₂ emissions. Domestic air travel increases the production of CO₂ emissions. In 2000, it was 1.38 million tons of CO₂ emission and it was predicted that by 2030 this will increase by 31% and reach 1.881 million tons per year [20]. Comparatively, the rail transport is continuously reducing the CO₂ emissions and between 1990 and 2005 the European railways cut their CO₂ emissions by 21% [21]. High-speed trains are powered by electricity which means that by improving the energy efficiency of trains and using renewable energy such as wind and solar, CO₂ emissions from HSR can be close to zero.

The energy consumption of HSR in Japan is one-sixth of the aircraft and CO₂ emission of HSR is just one-tenth of that of an aircraft [22]. Rail transport produces on average of 3–10 times less carbon dioxide than road or air transport. By transporting 7–20% of the total number of passengers and freight, rail transport is responsible for less than 2% of the total transport sector carbon dioxide emission in Europe [23]. In the UK, despite improving fuel efficiency of the air industry, CO₂ emission was expected to increase by 1.7% per annum, from 33.2 million tons in 2010 to 43.5 million tons in 2030 [24]. The cost of CO₂ emissions by aviation in the UK in 2000 was £1.4 billion, but unconstrained demand for air travel means that the cost of CO₂ emissions will rise to £3.6 billion by 2020 [25]. HSR produces only 17g of CO₂ to transport one passenger per one kilometre, and this is nine times less than what is required for air transport, and almost seven times less than that required by car and nearly two times less than that required by coach [26]. HSR is the most energy efficient mode of transportation and is continuously improving the performance in terms of energy use per passenger-kilometre. Using renewable energy such as in Sweden and Norway HSR can offer carbon-free transportation. Railways have targets to reduce the carbon emissions by 50% by 2030 and 75% by 2050 [27]. Railways had reduced CO₂ emissions by 22% over the past ten years, which is twice the reduction for cars while airplanes had increased CO₂ emission intensely [28]. Railways particularly HSR can be among the effective solutions of current transport problems as railways offer efficient transportation of passengers and freight with low carbon emissions, low environmental impacts, and positive economic growth.

Table 3 shows the difference in CO₂ emissions produced by airplanes and trains on the selected corridors. On the corridor between London and Madrid it is ten times less CO₂ emissions per trip per person by train compared to air transport. With the increasing population and mobility, the external cost of travel will increase.

Fig. 1 shows that the external cost of aviation is higher than that of rail transport. HSR

Table 2: Total CO₂ emissions from transport, 1990-2000, million tons [19].

EU15	Rail	Road	Air	Inland Nav.	Total	%
1990	8.9	625.0	82.2	19.6	735.7	23.9
1995	8.4	675.6	96.2	20.5	800.7	26.2
2000	7.0	762.3	126.0	15.1	910.5	28.7



Table 3: Current CO₂ emission for airplanes and trains. Adapted from [29].

Corridor	Flight distance km	Rail distance km	CO ₂ kg per trip per person flight	CO ₂ kg per trip per person rail
London-Madrid	≈1350	≈2200	245-280	24-29
Fukuoka-Sapporo	≈1650	≈2100	290-345	42-95
Bangalore-Mumbai	≈900	≈1400	180-205	n/a
Shanghai-Hong Kong	≈1300	≈1700	230-290	26-68
Washington-Ottava	≈800	≈1200	135-185	120-135

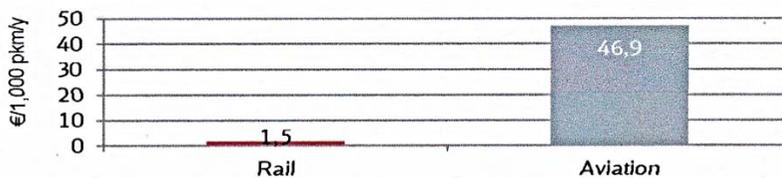


Figure 1: External cost for climate change in passenger transport in 2008 for EU-27 [31].

is becoming an important mode of transport as it has the lowest external costs and it can offer efficient and an effective way to transport passengers and goods while using less energy, taking less land and being a less environmentally polluting mode of transport [30].

4 NEW OPPORTUNITIES THAT BRINGS HSR TO THE TOURISM INDUSTRY

The first organised one-day trip using train was by Thomas Cook in 1841 and it was the beginning of transportation becoming part of the tourism industry. In modern time, air travel was included into tourism packages. There is a need to look for opportunities to offer to tourist's low-cost holiday packages that include travel to their destination point by rail. At this moment, low-cost packages offer only travel by air. Offering rail travel instead of air would help to shift travel to less polluted mode of transportation. The major advantage of air travel is speed but new technologies and technological innovations in the railway industry and the expanding HSR network would make rail transport a strong competitor to air transport. Air travel is getting less reliable, as airports get more congested. HSR can replace a significant volume of air travel in Europe with the introduction of high-speed non-stop night trains.

Congestion is already causing the loss of many billions of Euros a year due air transport and related industries in Europe, and this figure is expected to rise further. Since introducing the budget airlines, traffic expanded dramatically, with an average annual rise of approximately 5% for the last 30 years [32]. Airports have not been able to expand due to environmental constraints and lack of clear government policies, and Heathrow airport is one of the examples. In the UK, air passenger numbers are expected to increase from 219 million in 2011 to 315 million in 2030 and to 445 million by 2050 [33].

From the late 1990 the low-cost carrier expanded rapidly whilst the demand for travel increases every day. Low-cost airlines offer a cheap and fast way of travel. However,

travel by train is the most environmentally sustainable, enjoyable, and comfortable way to travel in addition to being safe and relaxing. Some tour providers advertise rail holidays such the case of Rail Discoveries but it cannot be compared with low-cost airlines. Furthermore, Rail Discoveries advertise this as railway holidays but most the tours include a flight to destination points. A 5-days holiday in The Netherlands in springtime and a stay in a 3-star hotel which is offered by Rail Discoveries will cost from £615 each [34]. However according to Thomas Cook web-site; 5 days in Amsterdam in a 4-star hotel at the same time of the year including flight may cost approximately £231 each. It is nearly three times cheaper than the holidays that are offered by Rail Discoveries. This difference in price discourage people to shift from airlines to railways. It would be very beneficial for customers, the environment, and the society if a major tour provider looks for a more wider range of holidays for which customers are offered train and hotel in a competitive price to that of flight and hotel. There is a promising example in Italy to encourage tourist to travel by train in such a way that hotels reimburse the train fee by 80 euro per person in Rimini, Riccione and Cattolica [35].

HSR brought a new beginning for railway transport following a dramatic decrease in the numbers of passengers after the Second World War. HSR provided the most important factors for passengers: speed, comfort, convenience, and safety. The increased awareness about air pollution and the adverse impact that transport has on the environment together with the realisation of the problem is caused by cars and airplanes, society turned to the HSR as the most environmentally friendly mode of transport. The future of HSR will lay in the integration of each nation's network into one European network and later into a Global Network. This will reduce the costs of building, operating and maintaining the high-speed network. HSR gives the ability to arrive only a few minutes before departure by car, tube, bus, metro or on foot compared to airports where passengers need to arrive at least one hour before the flight. Consideration the fact that airports are always located away from city centres, it would take longer to get an airport than to a railway station. Access-egress time to most of HSR stations is much less than that of airports. Modern multimodal railway stations provide fast and convenient access to the railway network. To respond to climate change, the tourism industry needs to look at high-speed non-stop night trains as an alternative to medium distance flights to achieve Climate Neutral Tourism. High-speed train technology is more energy efficient than flights and it can help mitigate the greenhouse emission from the tourism industry. It was forecast that the CO₂ emission from flights departing UK will increase from 33.3 MtCO₂ in 2011 to 47 MtCO₂ by 2050 [36]. There is a need not only to look at the growth in aviation and growth in CO₂ emissions but also to look for ways to shift travel to more sustainable way of transportation. One of the ways to achieve this would be by improving marketing holiday packages with transportation by railway instead of flying. The largest soft adventure tour operator in The Netherlands, SNP offers train transport as an alternative to flying for all package holiday destinations under 1000 km [37]. There is a need to go further and offer high-speed night travel to destinations under 2000–2500 km. Currently ten countries in Europe have developed HSR systems with a total length of HSR line network of 8269 km as shown in Table 4. According to data from the UIC, in 2016 the length of HSR lines worldwide in operation, under construction and planned are 86,781 km. New technologies and many improvements have been made to infrastructure and rolling stock to improve the performance of HSR and reduce the carbon footprint. In many cases, ballasts have been replaced by concrete slabs and long welded rails were introduced, which will reduce the maintenance cost and improve the running performances of high-speed trains. To reduce the speed losses and reduce vibration and noise level, the aerodynamic of locomotives



Table 4: Length of HSR lines (in operation+ under construction+ planned) in selected countries worldwide. Adapted from [38].

Country	Length of HSR in operation and planned (km)
France	4562
USA	1874
Spain	5460
China	33834
Italy	1269
Turkey	2291
Germany	2167
UK	656
Russian Federation	2978
Mexico	210

and vehicles have been improved. There have been improvements made to the bogies, axles, and braking systems of high-speed trains.

High-speed trains are an alternative to medium distance flights and represent a more sustainable way of transportation. There is an opportunity for travel operators to develop a new travel strategy by offering customers new options of travel such as high-speed night trains. It will open new business strategies that could lead to a strategic transformation of the current holiday model. With the increased speed of trains in range 250-350 km/h and by running non-stop distances of 2,200–2,500 km can be covered in just 10-12 hours. France, Germany, Italy, Spain, UK, and Turkey were included in the ten most popular countries to visit worldwide and they also have the most developed HSR network in Europe. Germany, Sweden, and UK have upgraded many thousands of kilometres of conventional network that can be used by high-speed trains. Between 2010 and 2020, Spain planned to build about 10,000 km of high-speed lines to make the railway more accessible for inhabitants. It will give access to 90% of the population to a high-speed station within 50 km of their home [39].

It is time to match two aspects together; expanded the HSR network in Europe and continuously increasing the number of tourist travelling in Europe. Approximately four out of five arrivals worldwide originate from the same region. The HSR network in Europe in recent years has grown rapidly and largely concentrated in the centre of Europe.

Nowadays, it links almost all major cities. High-speed night trains can provide a comfortable way to travel with different choices of seats, couchettes, and luxury beds. Carriages of high-speed train have been designed to provide convenient spaces suitable for work and relaxation. Passengers have greater personal space on a train than in an airplane as they have access to internet, power sockets and real-time passenger information systems. Trains have restaurant-cars serving food and refreshments. The holiday starts when the passenger boards the train, and restaurant-cars can provide regional gastronomy from the area of tourist destination. On trains, different type of entertainment can be offered including for example, jazz carriages, children carriages, etc. The high-speed night train is an alternative for medium distance flights, and, can open new destinations that previously have not been served by airlines. Rail transport is less impacted from projected increases in the cost of oil, as oil is finite natural resource. With the introduction of kerosene tax and VAT for aviation, costs of flight will increase. Introducing the high-speed night trains will reduce the dependency of tourism industry on non-renewable energy resources. It would be appropriate



to look possibility for high-speed night trains boarding in the evening in London and Central Europe and arrival in Spain, Italy, and west Europe in the morning. Europe has a wide HSR network and high density of population. This is the good basis for introducing the high-speed night trains for package holiday markets in Europe and it would only be the first step. China and India which have growing numbers of middle class people and increasing number of tourists are the second most visited regions in the world [40] and it looks a promising area for the high-speed night trains too.

5 CONCLUSIONS

With averseness about negative environmental impact from transport many people are looking for alternative ways of travel. There is a gradual shift in tourist preferred destinations. For example, the tourists from North and Central Europe tend to spend more holidays close to their home country or nearby. This is due to; firstly, the weather is getting warmer, secondly, the political instability in the countries where they would holiday in including the increasing number of terror attacks, and thirdly, the increasing awareness of the negative impact that is caused by air travel on the environment. There are more factors that influence the change in travel preferences such as the aging population, globalisation, fuel prices, and the increasing concerns about travel safety. These factors may support a shift of travel from air to rail. The changes in travel destinations open a huge opportunity for a railway to develop a tourism model that is more environmentally sustainable. The increasing speed of HSR and its expanding network may mean that there would be a huge potential for high-speed night trains. The high-speed night trains can offer comfortable, high quality, safe and less polluted train services on corridors 2000–2500km long. Improving the HSR links to Spain, France, The Netherlands, and Central and East Europe makes it easier to get to a destination point without flying or driving. Shifting travel to a more sustainable mode of transportation can help tackle the climate change, protects the environment, and maintains more efficient use of the natural resources. The high-speed night trains offer new business opportunities for the tourism industry and can create new market for low-carbon transportation. Such market is expected to grow substantially in the future. High-speed night trains can play a major role to close the gap in the sustainable mobility in the future particularly for the tourism industry. Reducing the level of CO₂ emissions produced by the tourism industry may support the continuous growth of the tourism sector and the sustainable development of nations.

Climate change has affected our lifestyle and social well-being but the society must adapt and mitigate such effect. To reduce the CO₂ emissions from the tourism industry, there is a need to make use of the opportunities that offer a modern HSR. The transportation cost that railways charge must be more competitive so that it would help attract tourists to use the HSR.

Currently tour operators do not offer any viable alternative to air travel. For example, “Thomas Cook” owns a fleet of airplanes making it possible to offer customers low-cost holidays and it may be profitable for them to own a fleet of high-speed trains too. This may reduce the price of holiday packages where transportation is provided by high-speed trains. The tour providers must cooperate more closely with the railway industry to offer low-cost integrated holiday package of travel by rail and includes hotel and rental cars.

Investing in railways provides not only environmental benefit but also economic growth, climate change mitigation and social inclusion. If the tourism industry invests in sustainable transport it will attract new investors, builds a reputation as a green industry and supports economic growth.



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