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AVIATION EFFECTS

FACT SHEET 1 GLOBAL IMPACTS OF AVIATION

Air traffic contributes to the greenhouse effect and the depletion of the ozone layer. Although this contribution may not yet be of great significance, if air traffic increases substantially this contribution will also rise sharply. While other sectors in society (such as car traffic, industry, etc.) will have to improve their environmental performance (and cause less polution), air traffic is allowed to cause more emissions every year. In addition, the pollution of aviation will chiefly occur at high altitudes, where it can have much more serious consequences because gases remain present for longer periods there.

The greenhouse effect

The burning of kerosine produces pollutants which contribute to the greenhouse effect, particularly CO_2, NO_x and water vapour[1].

In 1990, air traffic contributed 2% to 3% to global CO_2 emissions from fossil fuels, which corresponds to a 1.3% contribution to the greenhouse effect[2]. Given the rapid growth of air travel, this share is expected to double by the year 2015. In 1990 air traffic was responsible for more than 2% of global NO_x emissions. In combination with sunlight, NO_x produces ozone in the troposphere and lower stratosphere[3]. This ozone augments the greenhouse effect. Although the exact extent of this contribution is still unclear, it is known that NO_x remains in the atmosphere much longer at high altitudes than closer to the ground, which strengthens the effect by 30-50 fold. It is estimated that air travel is responsible for 0.3% to 3.8% of the greenhouse effect in this manner. Furthermore, by 2015 this share, too, will have nearly doubled. The burning of kerosine also produces water vapour. Because the temperature at an altitude of 10 kilometres is so cold, the vapour freezes instantly, forming ice crystals - the aircraft trails which are visible in clear weather. These ice crystals can form cirrus clouds, which serve to reflect the sun's rays back to the earth, increasing its warmth. This effect of the vapour is estimated to add several percent to the greenhouse effect[4].

Depletion of the ozone layer

Higher in the stratosphere (above 15 kilometres) NO_x contributes to ozone depletion, by which the ozone layer becomes thinner. It is estimated that the NO_x emitted by air traffic is responsible for 1% of the depletion of ozone in the stratosphere. Future generations of supersonic aircraft (such as the already-existing Concorde and most jet fighters), however, may cause 0.3% to 1.8% depletion of the ozone layer annually. In this way air traffic will become responsible for 6%-45% of the annual depletion of the ozone layer[5].

1. A.N. Blijenberg and R. Moor, 'Air pollution by air traffic', Delft, August 1993; M. Barrett, 'Aircraft pollution', WWF, August 1991; Ministerie van VROM, 1995

2. CO_2 is responsible for approximately 60% of the greenhouse effect.

3. The troposphere is the layer of air up to 10 kilometres above the earth's surface. Above that is the stratosphere. Aircraft mostly fly at an altitude of 10-12 kilometres.

4. W. Fransen en J. Peper, 'Atmospheric effects of aircraft emissions', KNMI and NLR, 1993.

5. Assuming an average 4% to 5% annual degradation of the ozone layer.

Greenhouse effect

The greenhouse effect refers to a warming of the earth. This can lead to a rise in sea level of more than a half metre in the next century. The consequences of this for coastal regions are enormous. Approximately 18% of Bangladesh may become flooded and 10% of the Egyptian population will be forced to relocate. Shanghai and other Chinese coastal regions will be threatened, by which 76 million people will be forced to move their homes. The Maldive Islands may even disappear from the map. The impact of a rising sea level will be further heightened by an increase in extreme weather conditions: more storms, but also long periods of draught or heavy rainfall.

Due to higher temperatures, climate zones will shift. An increase of 1^0C. will lead to a 150 kilometres shift of vegetation zones. Plants will not be able to make the adjustment: 10% of woodlands will be dissipated, while tundra regions will disappear altogether.

These higher temperatures can have great consequences for agriculture as well. Because of a higher concentration of CO_2 certain plants, such as rice, grains and soya beans, will grow faster, bringing greater crop yields in Russia, Canada and North Europe. But these positive effects will be negated because large areas of fertile land will become flooded, and because drought, storms and extreme rainfall will reduce crop yields in other parts of the world. There is no doubt that developing countries especially will have extreme difficulty to cope with the consequences of this. Recent studies have indicated a possible decline of food production in these regions by 10% as a result of the greenhouse effect. Estimates of the number of people threatened by hunger range from 50 to 350 million.

Besides these impacts, and in fact because of them, the greenhouse effect will also bring social consequences. Millions of people will be forced to move if their land or food supply is threatened. Conflicts between countries may arise over the control of lands and natural resources. Moreover, the availability of drinking water may also become a reason for discord, because the supply of good quality water in some parts of the world may become affected.

Depletion of the ozone layer

The ozone layer protects people, plants and animals from the damaging ultraviolet radiation of the sun. The depletion of this layer is responsible for the so-called 'hole in the ozone layer'. When skin is exposed for too long to the sun, the chance of skin cancer is increased, and the human immune system may be damaged. UV radiation can also contribute to eye disorders, especially in developing countries. In some parts of the world, agricultural yields may also be considerably reduced.

FACT SHEET 2 ENERGY USE AND EMISSIONS OF DIFFERENT MODES OF TRANSPORT

Energy-use and emissions caused by aviation strongly depend on distances and occupation rates. Looking at different studies form different countries, it is also important to pay attention to the way energy is being produced, since this can influence differences in efficiency and emissions as well.

Energy Use

Table 1: Energy-use of different modes of transport for different distances (plane: 500 km = 100)

	200 km	500 km	1000 km	2000 km
Air Traffic (1)				
Paveaux et al. '91		100	79–83	
Hofstetter '92 (2)	190	100	70	56
IFEU '92	154	100	76	
High Speed Train				
Paveaux et al. '91	20–43	20–43	20–43	20–43
(1) CEC '92	24–35	24–35	24–35	24–35
Train				
IFEU '92	24	22	21	
CEC '92 (1 en 3)	11–14	11–14	11–14	11–14
Hofstetter '92 (4)	20–31	20–31	20–31	20–31
Car (3–way catal. converter)				
IFEU '92	67	70	71	
CEC '92 (3 en 5)	44–55	44–55	44–55	44–55
Kageson '93 (3 en 6)	43–54	43–54	43–54	43–54

Source: CE, 'Air pollution by Aircraft', Delft 1993

1: Occupation rate 65%
2: Average of 8 types of aeroplanes
3: Assumed energy consumption: 3,2–4,0 MJ/pkm for 500 km flight
4: Assumed average; 0,8–1,0 MJ/pkm
5: Cylinder volume: 1,4–2,0 litre; occupation rate 1,7
6: Fuel use: 8,5 l./100 km; occupation rate of 1,7 = 1,74 MJ/pkm.

Although different studies give different performances, we can notify a clear trend. At short distances (200 km) trains use 80–90% less energy than planes. At these distances cars are 60–75% more efficient than planes. At longer distances transport per train is still 50–80% more efficient than transport per plane.

Emissions

Table 2: Emissions per passengers kilometres for different modes of transport for a distance of 500 km, at current occupation rates

Mode of transport	Occupation rate	CO2 (g/pkm)	CO (g/pkm	NOx (mg/pkm)	VOS (mg/-pkm)	SO2 (mg/p-km)
Bus	70%	22	75	479	56	23
Train	65%	48	2	87	12	60
Intercity	44%	51	2	94	13	64
Car	2 persons	86	250–1600	270–145	45–220	71
Boeiing 737-300	71%	146	240	440	10	10

Source: 'luchtverontreiniging en luchtvaart', Dutch Ministry for the Environment, 1995

From table 2 we can learn that planes, cars and busses are less environmentally friendly than High Speed Trains and normal trains. Concerning CO_2–emissions, busses are also more environmentally friendly than planes.