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# Sustainable Mobility

## The Routledge Handbook of Sustainable Tourism

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## Key terms (box)

**Sustainable development**: The term was coined in 1987 by the Brundtland Commission as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Its main characteristics are safeguarding long-term ecological sustainability, satisfying basic human needs, and promoting intragenerational and intergenerational equity.

**Sustainable mobility**: The term was first used in the 1992 EU *Green Paper on the Impact of Transport on the Environment.* Although no widely accepted definition exists, we suggest that to achieve sustainable mobility societies must reduce per capita transport energy consumption while simultaneously offering necessary transport services to satisfy basic needs. These services should be based on an affordable and accessible public transport system. Moreover, societies must increase the share of renewable energy used for transport.

**Approaches**: There are three main approaches for achieving sustainable mobility: the efficiency approach, the alteration approach, and the reduction approach. The literature often refers to these approaches as "improve", "shift", and "avoid" strategies.

**Policy instruments**: The goal of achieving sustainable mobility must be accompanied by policy instruments that facilitate its fulfilment; the three main instruments are market-based instruments, information-based instruments, and command-and-control instruments.

**Sustainable mobility policies**: A combination of approaches and policy instruments which potentially can contribute to achieving sustainable mobility.

## Case study: A Study of ‘Green’ Attitudes’ effect on travel (box)

The study is based on a travel survey of 960 individuals in eight residential areas within the Greater Oslo Region (Holden and Linnerud, 2011; Holden and Norland, 2005). Variation in energy consumption for everyday and long-distance leisure travel, respectively, was explained in a multiple regression analysis. The explanatory variables included land-use characteristics as well as socioeconomic, sociodemographic, and attitudinal variables.

*The Dependent Variables*: Respondents were asked to estimate the distance travelled daily by car, bus, tram, and train in the preceding week. Their estimates were used to measure everyday travel. Moreover, the questionnaire asked respondents to state the number of long-distance leisure trips by plane and car (more than 100 km one way) they took during the previous 12 months. All travel distances were converted into yearly energy consumption per individual.

*The Independent Variables*: Physical-structural characteristics of the house and the residential area (type of housing, size, age, access to a private garden, distance from the house to the city centre and nearest sub-centre, housing density, and local land mix); socioeconomic and sociodemographic factors of the household (sex, age, education, occupation, income, car ownership, and access to a private holiday house); and environmental attitudes (using a Likert Scale to measure attitude strength, whereby attitudes are measured according to whether a respondent expresses agreement or disagreement with environmental statements).

The analyses (figure 1) show that respondents who express concern for the environmental consequences of transport have significantly lower household energy consumption related to everyday travel than do other people. However, the concerned individuals travel more by plane for leisure than do others. And this contradictory pattern becomes more pronounced (statistically significant), the more specifically the attitudinal variables address environmental issues related to transport. In summary, the overall consumption of energy for transport by people holding positive environmental attitudes is essentially equal to that by people who do not hold such positive environmental attitudes.

(figure 1)

To explain the contradictory pattern revealed in figure 1, in-depth interviews of Norwegian households' green attitudes and transport were studied (Holden, 2007). The study suggests that there are different mechanisms that influence whether individuals are able to behave in an environmentally friendly way in everyday and leisure travel, respectively. While green individuals strive to act in an environmentally responsible manner in their everyday lives, they seem to have a conflicting need to cast aside their environmental concerns when travelling for leisure. Many respondents indicated that in some situations they have a desire to indulge themselves, to free themselves from the constraints involved in environmentally friendly behaviour. Moreover, they seem to feel that they do their fair share for the environment in their non-leisure time, and that they therefore should not have to continue behaving environmentally responsibly during their leisure time. These findings have profound influence on sustainable mobility policy based on promoting green attitudes. The finding in the survey and in the in-depth interviews that environmental behaviour depends on the context is supported by findings in a similar UK study by Barr et al. (2010).

## Introduction

Since launching their 1992 *Green Paper on the Impact of Transport on the Environment*, the European Union has had sustainable mobility[1] as an overriding goal in its transport policy (CEC, 1992). Since then, the European Union has continued pursuing this goal in two *White Paper*s (CEC, 2001; CEC, 2011).

Still, as the European Union emphasizes in their 2011 *White Paper*, the transport system is not sustainable: 'Looking 40 years ahead, it is clear that transport cannot develop along the same path. If we stick to the business as usual approach, the oil dependence of transport might still be little below 90%, with renewable energy sources only marginally exceeding the 10% target set for 2020. $CO_2$ emissions from transport would remain one third higher than their 1990 level by 2050. Congestion costs will increase by about 50% by 2050. The accessibility gap between central and peripheral areas will widen. The social costs of accidents and noise would continue to increase' (CEC, 2011, p. 4). Thus, finding ways to make transport sustainable is high on the political agenda.

This chapter focuses on efforts to achieve sustainable mobility in passenger mobility (including air transport). Nevertheless, the efforts may eventually be relevant for the equally important challenge of achieving sustainable mobility of goods. The chapter has four parts. The first part explains why we presently are facing an unsustainable mobility system. The second shows how the concept of sustainable mobility has changed since its launch in 1992. The third part outlines a typology of sustainable mobility. The final part draws attention to a particular challenge regarding sustainable mobility: the already high level of leisure-time mobility and the fast growth of such mobility.

## An Unsustainable Mobility System

For the last 100 years, both population and mobility have grown remarkably. However, whereas population growth shows signs of becoming sustainable, the growth in mobility does not (IEA, 2009). While the world's population last century grew by a factor of about four, motorized passenger kilometres and tonne kilometres by all modes each grew on average by a factor of about 100. In particular, mobility has grown extensively during the last four decades. Box 1 shows passenger mobility development in Norway during the 20th century. A similar pattern exists in the European Union and all other OECD countries (ibid.). More than 90 per cent of growth in passenger travel during the last four decades in the European Union (and in other OECD countries) was due to the emergence of two powerful mobility phenomena last century: the private car and later the airplane (Black, 2003).

The trend of increased travels by road and air is likely to continue for decades (IEA, 2012). In a study of future global mobility, Schafer et al. (2009) project per-capita mobility in Western Europe to increase from 14,100 passenger kilometres (pkm) yearly in 2005 to 39,100 pkm yearly in 2050. By comparison, they project the average North American's mobility to reach 48,000 kilometres yearly by 2050. They reach their conclusions based upon a comprehensive study of travel patterns worldwide, which shows that on average, a person spends 1.1 hours daily travelling and devotes a predictable fraction of income to travel. These personal travel budgets have been relatively stable across time and countries, and thus Schafer et al. claim that they can be used to predict future travel patterns. Their most important finding is that as we become richer and as technology improves, we will travel faster and further. We would like to add that such will be the case unless scarcity of resources or political decisions prevent us from doing so.

Transport growth has been, according to the OECD, mostly positive: 'It has facilitated and even stimulated just about everything regarded as progress. It has helped expand intellectual horizons and deter starvation. It has allowed efficient production and the ready distribution for widespread consumption. Comfort in travels is now commonplace, as is access to the products of distant places' (OECD, 2000, p. 13). However, during the last decades, the costs – in terms of negative social and environmental impacts – associated with increased motorized mobility by road and air have been acknowledged. The intensity and scale of these negative impacts have escalated, and the negative impacts are now all too apparent as travel by car and airplane has increased. In fact, probably no other activity impacts the environment, both locally and globally, as negatively as transport does. In addition to negative environmental impacts, transport has several negative social impacts:

- Transport is a major consumer of energy and material resources. Almost 30 per cent of worldwide final energy consumption is used for transport. Globally, energy consumption for transport is forecast to grow by 1.5 per cent yearly up to 2030. Transport presently uses, and will for decades, mostly non-renewable energy resources (IEA, 2010, 2012).
- Producing vehicles and transport infrastructure requires large amounts of materials. Such material use accounts for 20–40 per cent of the consumption of major materials: aggregates, cement, steel, and aluminium. In addition, producing vehicle and transport infrastructure requires large amounts of energy: approximately 20 per cent of the energy consumption during a vehicle's life cycle (OECD, 2000; IEA, 2009).
- Transport is a major contributor to local, regional, and global pollution of air, soil, and water. Chief among transport's global impacts is its contribution to climate change; transport activity contributes about 20 per cent of anthropogenic $CO_2$ worldwide and almost 30 per cent of these emissions in OECD countries. Air pollution is the main local and regional impact, with major effects on human and ecosystem health. Transport is today a main source of these air pollutants. Air pollution is expected to decline in OECD

countries, although not enough to improve air quality to WHO standards. Worldwide however, air pollution is expected to increase (IEA, 2012, 2009).

- Transport infrastructure, mainly roads, consumes about 25–40 per cent of land in OECD urban areas and almost 10 per cent in rural areas. Roads and railways cut natural and agricultural areas in ever-smaller pieces, threatening the existence of wild plants and animals (OECD, 2000).
- Yearly, up to 1.2 million people are killed on roads and up to 50 million more are injured. About 30 per cent of the EU population is exposed to urban traffic noise levels that represent a significant cause of annoyance and ill health. Some 10 per cent of the EU population is estimated to be seriously annoyed by aircraft noise; however, little change in exposure to high noise levels can be expected during the next decade (Peden et al., 2004; OECD, 2000).
- Transport infrastructure might disrupt communities. The increasing orientation of urban transport systems toward private vehicles can negatively affect the quality of community life. Urban motorways are sometimes built through established communities, creating physical barriers within them.
- Mobility has not increased for everyone. Low access to transport may reduce people's access to basic public and private services, leading to social exclusion, particularly for poor people, disabled people, elderly, women, and the growing number of low-income immigrant groups in developed countries (Root et al., 2002; Tillberg, 2002; Rudinger, 2002; Uteng, 2006).

The situation described above characterizes an unsustainable mobility system (Black, 2010; Schiller et al., 2010; Castillo and Pitfield, 2010; Litman and Burwell, 2006; Banister, 2005; Sperling and Gordon, 2009). Without major changes in policies and practices, future transport activity could well continue last century's unsustainable trends. According to the 2011 EU

*White Paper on European Transport Policy* (CEC, 2011), the principles of sustainable mobility should guide necessary changes in policies and practices: ‘a new imperative – sustainable development – offers an opportunity, not to say lever, for adopting the common transport policy’ (ibid., 14).

## Sustainable Mobility: A Changing Concept

There is, however, as yet no political or scientific agreement on a definition of sustainable mobility. Rather, the concept’s focus has to an increasing extent reflected socially desirable attributes of local- and project-level problems. A diversity of definitions and interpretations of the concept has been presented; the risk, therefore, is that the concept will become mere rhetoric and of little value in guiding policy makers and scientists.[2]

A review shows that the focus of mainstream literature about sustainable mobility indeed has changed during the last two decades (Holden, 2007). Sustainable passenger transport problems are being addressed in new ways by researchers representing an increasing number of scientific disciplines applying different methodological approaches (Black and Nijkamp, 2002). The concept’s definition has changed to include a broader set of passenger transport types like production travel, reproduction travel (e.g., Shiftan et al., 2003; Castillo and Pitfield, 2010; Amekudzi et al., 2009; Banister, 2011), and leisure-time travel (e.g., Black and Nijkamp, 2002; Mokhtarian, 2005a, b; Næss, 2006; Banister, 2008; Holden and Linnerud, 2011).[3] This broadening has added to our understanding of the challenges posed by sustainable passenger transport, but has also added to the complexity of how the concept is defined, measured, assessed, and evaluated.

More importantly, the concept’s definition has changed to include a broader set of transport’s impacts on society. Gudmundson and Højer (1996) focus on impacts on the environment and social equity. Black (2010) adds impacts on health and security. Lautso and Toivanen (1999) include all these impacts and add quality of life considerations. And lately, several studies have broadened the list of impacts to include economic growth (e.g., Shiftan et al., 2003; Castillo and Pitfield, 2010; Amekudzi et al., 2009).

Thus, sustainable mobility is about to include every aspect of transport which is desirable in society and therefore risks becoming meaningless. To avoid diluting the concept, it may be helpful to clarify the main dimensions of sustainable development by returning to its origin, the Brundtland Report (WCED, 1987), and then to adapt these dimensions to sustainable mobility. Based on such clarification and adaptation, we suggest that to achieve sustainable mobility societies must reduce per capita transport energy consumption while simultaneously offering necessary transport services to satisfy basic needs. These services should be based on an affordable and accessible public transport system. Moreover, societies must increase the share of renewable energy used for transport.

## Achieving Sustainable Mobility: A Typology

### *The main approaches*

There are three main approaches for achieving sustainable mobility: the efficiency approach, the alteration approach, and the reduction approach. (In everyday terms, the three approaches can be characterized respectively as 'travel more efficiently', 'travel differently', and 'travel less'.) These three approaches, under different names, represent established knowledge within the sustainable mobility (and sustainable development) literature, for example, the IPAT equation (Commoner, 1972; Ehrlich and Holdren, 1971); the ASIF equation (Schipper and Lilliu, 1999); the ISA model (Dalkmann and Brannigan, 2007); the SMART model (Holden, 2007); social, technical, and infrastructural emission drivers (Sager et al., 2011); and the STPM index (Black, 2003).

The efficiency approach for achieving sustainable mobility suggests that environmental problems caused by transport can be reduced and that the lack of accessibility for low-mobility groups can be relieved by developing technology that is more efficient. The concept ‘technology’ is here used in a broad sense; it includes the use of both ‘hard technology’ (like developing more efficient vehicle technology and fuels) and ‘soft technology’ (like developing more efficient transport logistics). Moreover, technology that is more efficient could be implemented in all parts of the transport system: motorized transport, transport infrastructure, and the energy system.

The alteration approach recognizes the urgent need to fundamentally change present transport patterns. Accordingly, the prevailingly transport pattern, dominated by the car and the plane, must be changed into one based on collective forms of transport, namely an affordable, well-functioning public transport system.[4] Such a public transport system would lead to increased use of buses, trains, and trams – which are all more energy efficient than cars and planes – and therefore reduced use of cars and planes. Moreover, an affordable, well-functioning public transport system would increase accessibility for low-mobility groups. In addition, the alteration approach comprises the idea of substituting walking and cycling for motorized travel.

The reduction approach for achieving sustainable mobility does not question the importance of improved efficiency and increased alteration. Indeed, the latter two approaches would, according to the reduction approach, offer some reductions in, for example, energy consumption. However, these reductions are insufficient to meet sustainable mobility’s energy goal. Moreover, continuous transport growth negates any reductions in energy consumption achieved by implementing new technology and altering transport patterns. Thus, present transport volume must urgently be decreased – except for those whose basic transport needs are not met – or at least transport growth trends must be changed.

*The policy instruments*

Three are three main policy instruments which facilitate sustainable mobility: market-based instruments, information-based instruments, and command-and-control instruments (Holden, 2007; Banister et. al, 2000). Market-based instruments include taxes and subsidies, which affect our behaviour through their impact on market prices. Ideally, authorities should make all emitters pay a Pigouvian tax – that is, a tax on emissions equal to the emission's marginal cost to society. An alternative is to use fuel as a proxy for emissions and to levy a differentiated fuel tax. Examples of more indirect ways of addressing the emission problem are to subsidise low-carbon fuels (such as biofuels), to support R & D of low-carbon technologies, and to subsidise public transport. These indirect marked-based instruments may, however, have unintended side effects. Subsidising public transport, for example, may result in some people's reducing their use of bicycles (Sandmo, 1976).

Information-based instruments involve the assumption that informed consumers will make decisions that are more socially desirable; that is, providing consumers with information that is more detailed concerning the social costs of emissions and concerning the availability of options that are more environmentally friendly will cause them to voluntarily change their behaviour (Stern, 1999, 2000). Even if we disregard for the moment the complex relationships between information, attitudes, and behaviour, there are simple examples of possible unintended side effects from using such information-based instruments. If, for example, the information is focused on reducing emissions from one activity (such as shifting to more energy-efficient light bulbs), while other mitigating activities are ignored (such as reducing the number of flight trips), then individuals may allocate their mitigation efforts in a way that does not reduce overall emissions.

Control-and-command (CAC) instruments impose standards on products and processes and use physical planning to steer behaviour directly in the desired direction. For instance, authorities could set a minimum vehicular emissions limit or a minimum energy-efficiency level on new cars, they could invest in public transport systems, or they could use land-use planning to reduce travel distances. Again, unintended side effects occur because these policies do not impose equal emissions costs on all emitters. If, for example, a more energy-efficient car will reduce the amount of energy consumed per kilometre, it may also give the driver an incentive to drive further because the fuel cost per kilometre is reduced.

### *A typology of sustainable mobility policies*

A typology for sustainable mobility policies can be constructed using those three approaches and those three policy instruments. Figure 2 shows a number of sustainable mobility policies – a combination of policy approaches and instruments – which can contribute to achieving sustainable mobility.

(figure 2)

The policies shown in the figure are chosen due to their prevalence in the literature on sustainable mobility. Moreover, these policies are high on the political agenda in most developed countries.

## The Troublesome Leisure-time Travel

Since the 1960s, the growth in leisure-time travel (in particular by car and plane) has increased alarmingly. Although this growth is mostly positive for travellers, it represents a serious challenge for achieving the goal of sustainable mobility.

However, research on leisure-time transport and sustainable development has largely been neglected and is today an underdeveloped field. For example, whereas knowledge of appropriate measures for achieving sustainable *everyday* transport is well established, this is not the case for measures for achieving sustainable *leisure-time* transport (Banister, 2005;

Black and Nijkamp, 2002; Holden, 2007). Thus, knowledge is still lacking concerning the complex relation between sustainable mobility, everyday travel, and leisure-time travel.

There are five reasons for increasing in transport research the focus on leisure-time travel: First, in EU and most other developed countries, travel surveys show that leisure-time related trips account for one third of all daily passenger trips (EEA, 2008). Due to generally longer average trip lengths, leisure-time travels total just over half of all daily travel length. Moreover, because leisure-time travels to a larger extent than everyday travels rely on cars and planes, leisure-time–related energy consumption and $CO_2$ emissions account for more than 60 per cent of total passenger transport's energy consumption and $CO_2$ emissions.

Second, as the population ages over the next 20 years, elderly people will spend more time on leisure activities (Banister et al., 2000). Much of this increased leisure time may involve long-distance air travel as people have the means, time, and desire to see the world.

Third, as indicated by travel surveys (Holden and Linnerud, 2011; Barr et al., 2010, 2011), although most of the year people may follow sustainable mobility practices, travelling locally by low-energy modes, they may once (or even twice) yearly travel long distance for leisure, thus negating the positive effects of their sustainable mobility practices. If people cast aside their environmental concerns when travelling for leisure, policy measures like information and awareness campaigns must be rethought.

Fourth, and related to the previous point, a deeper understanding of factors that influence leisure-time travel is generally lacking. Indeed, leisure has become more than time remaining after work. Instead, leisure has become a crucial component of our lives (Anable, 2002). Thus, the pull and push factors in leisure-time travel decisions tend to be different from those in, say, everyday commuting. Therefore, achieving sustainable mobility requires understanding how leisure-time travel differs from other travel.

Fifth, as the understanding deepens, policymaking must change. For example, traditional sustainable mobility policy measures – improved public transport, compact urban form, and green awareness campaigns – are probably less relevant to leisure-time travel. Policy must reflect an understanding of the psychological issues related to leisure-time travel; for example, leisure-time travel is linked to people's expression of identity. Moreover, leisure-time travel is politically sensitive because leisure time involves notions of freedom, choice, and self-improvement. Sustainable mobility policy measures must reflect an understanding of all these factors.

## Notes

[1] In the *Green Paper*, the European Union used the term 'sustainable mobility'. Applying the imperative of sustainable development to the transport sector, however, has led to several concepts denoted by terms such as 'sustainable transport', 'sustainable mobility', 'sustainable transportation', 'sustainable transport systems', and 'sustainability issues in transport' (Holden, 2007). In the literature on transport and sustainable development, these terms are essentially synonymous. Variants of 'sustainable transport' seem to be the preferred terms in North America, whereas 'sustainable mobility' variants are preferred in Europe (Black, 2003). We use 'sustainable mobility' here.

[2] Examples of issues dealt with by these and other studies include: protecting wildlife and natural habitats, reducing noise levels, promoting economic growth, facilitating education and public participation, reducing congestion levels, minimizing accidents and fatalities, ensuring stakeholder satisfaction, enhancing aesthetic dimensions of neighborhoods, supporting cultural activities, increasing tourism's contribution to GDP, promoting livable streets and neighborhoods, and minimizing transport-related crime.

[3] Vilhelmson (1990) distinguishes between three categories of travel: production travel (travel to work and school), reproduction travel (travel to shop and nursery school) and leisure-time travel (travel to recreational activities, on holidays and to visit friends and relatives).

[4] True, travel by plane is also a collective form of transport. However, its high energy consumption per passenger kilometre makes travel by plane comparable to travel by car in that regard.

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