

Eco-efficient Transport

Background and methodology

This briefing note is based on the STOA project on eco-efficient transport, which ran from January 2011 to April 2013. A wide range of technologies and concepts supporting eco-efficient transport are available; others are only recently emerging. Transport is a complex system, which is triggered by various kinds of demand, by different preferences and by different interests, with interdependencies between internal and external factors. Given this complexity, it is crucial to assess approaches to eco-efficiency in a broader context: a systemic perspective is required. Therefore, a set of scenarios on eco-efficient transport futures has been developed and combined with a stakeholder consultation to better understand different assessments of the feasibility and desirability of pathways towards eco-efficient transport.

For this project, it is assumed that **eco-efficient transport** encompasses all approaches that help to reduce the ecological footprint of transport-related activities. The point of reference is the amount of resources needed to fulfill a certain purpose (e.g. work, social contacts, production or purchase of a good). The general quality of life and the economic wealth should explicitly not be reduced. The focus of the project lies on road, rail, and waterborne transport (excluding aviation). Carried out with the transport model ASTRA, scenario building was used to quantitatively simulate potential effects of different concepts, technologies, and policy strategies. All three scenarios were embedded into a basic set of general assumptions that explicitly assumed high rates of innovation, technological change, and diffusion in society. At the same time, scenarios were kept as simple and transparent as possible. Each of the scenarios focus on one of the following three basic strategies to achieve eco-efficiency:

- Scenario I: Making transport modes cleaner. In this scenario, the same modes as today are employed for users and goods. Policy orientation is focused on R&D, regulation, and incentives to reach a fast and far-reaching market penetration of cleaner technologies (such as alternative fuels and propulsion technologies). Users do not necessarily change their mobility patterns.
- Scenario II: Changing the modal split. This scenario induces a shift to other modes for users and goods, while origins and destinations remain the same. The main technological changes are in infrastructure, encouraged by a policy orientation towards infrastructure investment, and ICT.
- Scenario III: Reducing growth rates in transport demand. This scenario aims at avoiding and reducing the need for physical transport. The origins and destinations of passengers and goods change. One important trigger is a very high oil price (\$300/b). The main technological driver is ICT. The policy fosters virtual mobility and eco-efficient land-use planning. Logistics are significantly improved.

In a next step, the scenarios and their elements were the subject of a stakeholder consultation, which was carried out in two steps:

1. A survey was conducted to collect opinions related to feasibility (drivers, barriers, presuppositions) and desirability (expected impacts, pros and cons).
2. A workshop was carried out, which used the results of the survey to focus and trigger the debate. The stakeholders invited included organizations from the transport area based in Brussels, where the workshop was held.

Results of scenario calculations

All three scenarios are able to reach the 2011 White Paper targets on CO₂ emissions (60% reductions with

respect to 1990), but this is achieved in very different ways:

- Scenario I: Through cleaner fuels and propulsion technologies.
- Scenario II: Through the change of travel patterns; additionally, efficient fuels and propulsion technologies are also pushed in this scenario – but not as strongly as in scenario I.
- Scenario III: Through a reduction in transport volumes. The virtualization of physical travel and drastic changes in land-use patterns play an important role.

Compared to scenario I, scenario II appears to offer a broader variability and flexibility in the choice of assumptions and measures. In both scenarios, the reduction of CO₂ emissions depends heavily on developments in the energy sector. The provision of “clean” energy is crucial for the overall eco-efficiency of “cleaner” fuels and propulsion technologies. In scenario III, more than 70% of the cars are still running on fossil fuels. But the “success” of scenario III comes along with various benefits: fewer raw materials are used, further emissions than CO₂ are reduced, and less waste is produced.

Results of stakeholder consultation

The stakeholder consultation revealed that there is a need to look beyond the technological scope in order to move towards a more eco-efficient transport system. Scenario II was identified as the most “robust” and “flexible” set of options. There was overall agreement on focusing on core elements of scenario II, combined with some mobility management elements of scenario III. ICT was considered as a key technology for this. It was argued that technical developments as outlined in scenario I would be realized anyway in the mid to long term, as most of the stakeholder organizations already initiated activities and programs to meet technical challenges. There was less agreement on *the* most promising technological pathway. For example, some stakeholders doubted that battery electric cars will provide ranges of 400-500 km in 2050. Others expected this to become true even before 2030.

It was clearly emphasized that the development and the commercialization of technologies needed to be accompanied by corresponding infrastructures. In general, non-technical issues were seen as hampering factors: particularly high costs of cleaner technologies and the importance of addressing infrastructure challenges, as well as uncoordinated institutional actions and responsibilities. Moreover, service, attractiveness, information, planning, and cooperation should be improved. Further, stakeholders stated that a much better understanding of dynamics in consumers’ preferences, attitudes and behavioural patterns is needed. R&D strategies for alternative fuels and propulsion technologies should be embedded into a broader context. Further, it was emphasized that to assess the eco-efficiency of alternative fuels, the generation of hydrogen, electricity, or biofuels need to be considered, as well as the potential role of new technologies in the energy system (e.g. batteries in cars as storage for fluctuating renewable energy).

As regards scenario III, it was stated that this scenario contradicted the idea of moving goods and people freely within a single European market. The desirability and acceptability of this scenario was questioned, since the impacts on economic wealth and quality of life might be negative. Mainly reducing transport volumes appeared to be too simplistic to the stakeholders. However, several stakeholders argued that elements of scenario III are needed to cope with future challenges. In this context, the term mobility management was mentioned to express the need for strategies focusing on the development of transport growth. However, there were different understandings of how mobility management should be executed. For example, the main controversies emerged in relation to measures restricting car transport in urban areas. The majority welcomed these approaches, while there were clear critical voices as well, pointing out negative consequences for the economy. However, stakeholders emphasized the need for incentives and public investments to achieve modal shift.

Furthermore, stakeholders pointed to a gap between European policy and “reality”. There was a claim that the EU needs to focus on the feasibility and success of the implementation of EU strategies.

Key areas

One of the findings of the project is that the assessment of the potential eco-efficiency of different approaches needs a broader and systemic perspective. Corresponding policies should not be taken in isolation; policy packages are usually needed to cope with systemic impacts of measures. Accordingly, instead of single

measures, a number of key areas were identified by the project team, based on the scenarios and the stakeholder consultation.

These key areas are regarded as being crucial for a transition to a more eco-efficient transport system.

- Energy system
- Cleaner cars
- Cleaner trucks
- Smart logistics
- Automation
- Integrated ticketing
- Access instead of ownership
- Shift to rail
- Shift to short sea and inland shipping
- Awareness of/making use of habit and attitude changes
- Urban design
- Mobility pricing

Policy conclusion

Based on the findings of the project, a series of policy conclusions can be drawn that are considered promising:

Enabling progress in fuels and propulsion technologies: Stakeholders considered technological progress in the field of alternative fuels and propulsion technologies as a must, but no general agreement on the most suitable fuel-propulsion combination was made. This is in line with findings of other studies, indicating that it is not yet clear to what extent electric vehicles, hydrogen, or biofuels will be a fuel of the future. Further R&D activities are needed that are open for different approaches. There is an urgent need for more field trials integrating the socio-technical context in which technologies will be implemented: infrastructures, business models, potential operators, and users should be integrated in much more vigorous and systemic ways.

Enabling progress in information and communication technologies (ICT): Stakeholders stated that more emphasis should be placed on ICT, where visible progress and dynamics are observable. There are still huge potentials for ICT to further improve eco-efficiency. ICT can be an enabler for a variety of promising approaches, such as new businesses (see below), for more flexible mobility patterns, and for integrated ticketing, but also for electric mobility or for the substitution of physical transport. However, there is the danger of isolated approaches that are not sufficiently connected and coordinated with each other. Harmonized concepts and standards are needed to push the progress of ICT in the transport sector.

Applying a broader systemic perspective: Transport is not at all an isolated system. In particular, the linkages to the energy system are relevant in this context. There is a need for life cycle assessments (LCAs) to assess the full ecological footprint of individual technologies or approaches. Systemic perspectives assessing the relevance and impacts of approaches in a broader context are needed. For example, an assessment of new energy carriers needs to take into account their potential role in the energy system. A potential lack of efficiency might be balanced by its ability to serve as a flexible storage for renewable energy. Such linkage between different technological sectors needs to be addressed. This could mean developing cross-cutting roadmaps that cover development in the energy, transport, and ICT sectors.

Enabling new mobility concepts: A broad range of bottom-up approaches, such as free floating or private vehicle sharing (for cars and bikes), or dynamic ridership, are increasingly widespread and show continuous growth rates. They have the potential to offer options for flexible intermodal transport chains and are being discussed as an enabler for alternative propulsion technologies. These initiatives are often driven by private initiatives and private investments. But to reach considerable modal shares, more policy support is needed. This does not have to be as cost-intensive as infrastructure investments would be, but rather refers to regulatory changes. For example, the option to foster business models such as car sharing could include: an allowance to enter congestion charging zones and to drive on bus lanes, reserving parking spaces in downtown areas and close to train stations, the participation of public bodies in such schemes, or encouraging local companies to take part in them. These are all examples of cost-effective policy support measures.

Considering non-technical factors: The scenarios and the stakeholder consultation illustrate that many developments are impeded because of uncoordinated political actions and a lack of political vision. It was underpinned that in many cases, it is non-technical factors that hamper the success of eco-efficient transport. A striking example is the shift to rail, which was assessed by the stakeholders as highly desirable but hard to realize. Harmonized standards and regulations are needed in various fields.

Considering land-use planning: One highly crucial issue for optimizing transport in the long term is a better integration of land-use planning and transport planning. It was highlighted in the key area of “urban design” that this is particularly true for urban agglomerations.

Understanding end-users: The project reveals that there is a need to better understand the users of the transport system. There was a broad consensus at the stakeholder consultation that the measures of the technical scenarios do not suffice. Behavioural changes are needed to achieve eco-efficient transport. Mobility patterns and related preferences and attitudes are not static but dynamic. It is crucial to more effectively take these dynamics into account in scenarios on the future of European transport, but they also need to be more effectively taken into account as part of transport policy strategies. A basis for this could be provided by more research on the dynamics of users’ and customers’ transport-related perceptions and attitudes.

Applying integrated strategies: Isolated strategies are not enough. Scenario II was selected as the most promising one. Transport is a highly dynamic field that needs integrated strategies and cross-cutting packages of technologies to be able to react flexibly and comprehensively to existing and future challenges.

Understanding new and emerging technologies: Foresight processes accompanied by technology assessment are needed in order to look into the development of new and emerging technologies and concepts, particularly when they have the potential to become relevant on a systemic level (an example is autonomous driving). There is definitely a need for further science and technology option assessment within the field of transport and beyond.

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