
1 Introduction

Stephan Helmreich and Hartmut Keller

Abstract This book has been written on the basis of the research done between 2008 and 2010, as part of the European Commission funded FREIGHTVISION project. The project's goal was to develop a long-term vision and action plan for a sustainable European long-distance freight transport system in 2050. The sustainability aspects addressed are greenhouse gas emissions, dependency on fossil fuels, accidents, and congestion. This chapter introduces the problem of reaching a sustainable freight transport system, and describes the objective, methodology, and conceptual framework of the book.

1.1 The Problem—Reaching a Sustainable Freight Transport System

The European Union faces the challenge to ensure and increase economic growth and to cope with an increasing freight transport demand and limited transport infrastructure in the next years and decades, while at the same time the transport system should become *sustainable*.¹ As the transport system “should be” sustainable, policy makers apparently realized that they did not succeed to develop a sustainable transport system in the past. But what does “sustainability” mean, and in which aspects did transport policy not succeed?

“Sustainability” is one of these words used by various interest groups with different focus. According to the Brundtland Report (United Nations, 1987), a sustainable development should

- “ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs”, and
- ensure that the “poor get their fair share of the resources required to sustain that (*their economic*) growth”.

S. Helmreich (✉)

AustriaTech, Federal Agency for Technological Measures Ltd., Vienna, Austria
e-mail: helmreich@austriatech.org

1 “The goal of the ETP (European Transport Policy) is to establish a sustainable transport system that meets society's economic, social and environmental needs . . .”, (European Commission, 2009).

- It is “a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional changes are made consistent with future as well as present needs.”

Sustainable development has to consider the three dimensions economy, environment, and society, and thus includes many different aspects, like food security, species and ecosystems, energy availability and peace, housing and health care.

With regard to European freight transport, not all sustainability aspects have the same relevance, e.g. European freight transport has limited impact on housing or peace. The European Commission funded project FREIGHTVISION, which is the basis of this book, therefore focused on a subset of sustainability aspects, which currently are considered as the most critical ones with regard to a sustainable European transport system, as their development apparently is not sustainable up to now. In addition, they were specifically mentioned in the mid-term review of the European Commission's 2001 Transport White paper. These aspects are greenhouse gas (GHG) emissions, fossil fuel share, road fatalities, and traffic congestion.

Concentrating on these four criteria does not mean that economic growth, social development, or other sustainability criteria are of minor importance to either the European Commission or the project. But the goal of the project was to elaborate recommendations for Directorate-General for Energy and Transport on how a sustainable development for these four criteria could be reached without negative impacts on other sustainability criteria.

1.1.1 An Unsustainable Development with Regard to GHG Emissions

The environmental aspect of European² transport was unsatisfying in the past. In Europe transport's GHG emissions³ grew between 1995 and 2007 by about 17% (European Commission, 2010), whereas Europe's total emissions were reduced (−3%). Thereby transport's share increased from 16 to 19.5%. In this timeframe GHG emissions decreased in all sectors except the transport sector (European Environment Agency, 2009).

The major problem is the dynamic development, which is caused partly by a strong freight transport performance (in tonnes-kilometers) increase of 38%, which was higher than passenger transport growth (25% pkm⁴) and even slightly higher than economic growth (36%⁵). The technical improvements in freight transport were lower than transport demand increase.

If freight transport continues to have very strong growth rates in the future and will not be decoupled from GDP growth, there is definitely a sustainability problem,

2 EU-27.

3 CO₂ equivalents.

4 Passenger km.

5 GDP.

considering IPCC's⁶ (IPCC, 2007) and Stern's (Stern, 2006) reports on environmental and economic risks involved with GHG emissions.

1.1.2 An Unsustainable Development with Regard to Fossil Fuel Share

In 2007 Europe's import dependency on oil was 82.6% (European Commission, 2010). Transport's dependency on oil is about 98% (European Commission, 2006). As oil seems to be a finite natural source, one of the main questions is, when this source will be exhausted. The term "Peak Oil" refers to the maximum rate of production of oil in any area under consideration. There are different opinions when this point in time will be reached (or has been reached); but as FREIGHTVISION looks on a timeframe until 2050, there seems to be a high consensus that Peak Oil will be before then.

However, considering that a sustainable development should "ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (United Nations, 1987), the current transport is apparently not sustainable with regard to energy usage.

1.1.3 An Unsustainable Development with Regard to Road Fatalities

In 2007 Europe's road transport system caused 42,496 fatalities.⁷ In addition 1,232,211 people were injured in road accidents (European Commission, 2010). Although very strong improvements in road safety have been reached in past decades,⁸ further improvements are needed for a sustainable transport. The White Paper's (European Commission, 2001) goal to reduce the number of road fatalities by 50% between 2000 and 2010 will fail mainly due to the EU enlargement: EU-15 could reduce the number of road fatalities by 38.6% between 2000 and 2008, but EU-27 could reduce only by 31.1%.

1.1.4 An Unsustainable Development with Regard to Traffic Congestion

There are different numbers on the costs of road traffic/transport congestion varying between 0.5% and 1.5% of the GDP, which is generally considered as being too high.⁹ Congestion is therefore a major economic sustainability aspect causing time losses, increased vehicle emissions, and as it has impacts on European competitiveness.

The objective of FREIGHTVISION was to provide policy recommendations for a sustainable development, focusing on these four sustainability criteria. The project should especially answer the following two questions:

6 Intergovernmental Panel on Climate Change.

7 All persons deceased within 30 days of the accident;

8 In 1990 there were 75.977 people killed (EU-27).

9 The congestion costs in Western Europe are estimated to be about 1% of the GDP. (UNITE 2003).

- What should be the politically agreed reduction targets for 2050 for these four sustainability criteria?
- What should be done by transport policy-makers to reach these targets?

The first question was answered by proposing a “Vision”, and the second question was answered by proposing an “Action Plan”. The “Vision” and the “Action Plan” were the two main project results.

1.2 Project’s Objectives—Vision and Action Plan

1.2.1 Vision

The term “vision” can have many different meanings. Within this project, this term is used in two ways: a qualitative vision and a quantitative vision of a future European freight transport system.

The *qualitative vision* is displayed in Fig. 1.1. It was developed in one of the four FREIGHTVISION Forum Meetings together with the Forum participants. It visualizes the ideas and visions of the stakeholders about the future of the freight transport system and relevant economic aspects, like production and logistics processes. Like every brainstorming session, where many people are involved, the result is interesting but also very heterogeneous.

The qualitative vision was used as background information for the project.

The *quantitative vision* is a definition of reduction targets for each of the project’s four sustainability criteria. These numbers (in percentage points) indicate which improvements—with regard to the four sustainability criteria of the project—should be targeted and thus agreed. Although called vision, these reduction goals should be both realistic and ambitious. It is important that this vision should be no utopia. It was a basic concept not to lose the ground under the feet and just define unrealistic goals.

The quantitative vision therefore describes a desirable, but realistic development path for the four criteria in focus for 2020, 2035, and 2050. The quantitative vision is meant, when in the further text the term “Vision” is used.

1.2.2 Action Plan

The action plan is a policy recommendation, on how the vision can be reached. It consists of bundles of actions both for transport and technology policy. Each action¹⁰ contains research and technology development (RTD), transport policy aspects, and milestones for 2020, 2035 and 2050. The action plan is both robust and adaptive, as each action can be applied more or less strict and thus adapted in the future when additional information will be available.

¹⁰ For list of Actions see later chapters.

1.3 Methodologies

There are two different major approaches for studies of the future: *modeling* and *participative processes*. Modeling is usually used for policy assessment with shorter time-horizons, while participative processes, like Delphi or FORESIGHT, are used for long-time horizons. In this project these two approaches, which in general are two different philosophies, were both sides depreciate the other methodology for their limitations, have been combined.

1.3.1 Modeling

On the one hand, the project team based its work on three models: TRANS-TOOLS¹¹ model was used for transport modeling, PRIMES¹² model for energy modeling, and the Finnish Environment Institute developed the SYKE-model within the project, which was used for modeling GHG emissions and fossil fuel share. These models were used for the trend analysis of the key drivers, and for the development of the forecasts and scenario.

1.3.2 Foresight

FORESIGHT is the preferred methodology for long-term policy making. As the subject is about developments until 2050, which definitely is a very long-time horizon for policy making, this methodology was also applied. The basic idea of *FORESIGHT* processes is not so much about predicting the future, but to get a common understanding amongst stakeholders about future developments and how this future could be shaped. This is done by establishing discussion rounds with stakeholders on predefined topics.

Within this participative process, different stakeholder groups create proposals to achieve sustainable freight transport, but due to their professional background, most of them address only part of the problem or focus on only one aspect of a solution. Following these advices would lead to sub-optimization and less-efficient proposals. As this project intended to take a holistic approach, where all aspects of the problem were addressed, i.e., infrastructure, ITS, propulsion systems, vehicles, fuels, interoperability etc. and all types of criteria in the solution: research, technologies, policies, and pricing, and these aspects should be biased, it was important to get a balanced number of participants from the different interest groups. Regarding the invitations,

¹¹ TRANS-TOOLS is a transport modeling tool developed for the EC.

¹² PRIMES is an energy model for Europe developed from the ICCS.

it was therefore paid special attention that all relevant areas were covered and that there also was no over- or underrepresentation of a certain stakeholder group or transport mode.

The participants¹³ were personally invited and only invited experts were allowed to attend. In the project's FORESIGHT process more than 100 representatives participated from the EC, Member States' ministries, Advisory Councils, Technology Platforms & ERANET, freight forwarders and logistics companies, infrastructure operators, industry, trade, cargo owners, vehicle technology and energy suppliers, non-governmental organizations (NGOs), and trade unions.

There was a Forum Meeting every four months where the project's results were discussed together with the stakeholders. These Forum Meetings were mainly participative sessions, where stakeholders discussed specific questions, around tables with maximum 10 participants on each table, and under guidance of trained moderators. These four meetings took place in 2009 and 2010 and the results of the discussions provided input both for the project and for this book.

In Fig. 1.2 it can be seen how the integration between the two methodologies, modeling and FORESIGHT, took place. Modeling was done in the following project steps: (1) key drivers—policy, technology and mega trends; (2) forecasts and preliminary vision; (3) actions, scenario, and wild cards; and (4) vision and action plan. The FORESIGHT Forum Meetings took place after each project step.

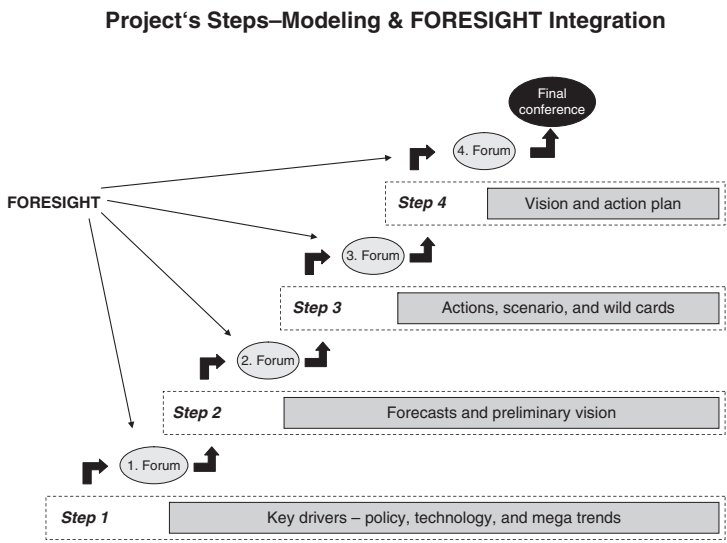


Fig. 1.2 Project's steps—integration of the modeling and FORESIGHT process

¹³ The list of participants can be found in the Appendix.

Figure 1.2 also shows the project’s four steps:

- The key drivers (policy, technology, and mega-trends) of the European freight transport system were analyzed.
- Based on the key drivers’ trends, Business-as-usual (BAU) forecasts for each sustainability criterion were developed, and a preliminary vision (i.e. reduction targets for the four sustainability criteria) was defined.
- Policy actions both from transport and RTD were evaluated, with regard to the sustainability criteria; a scenario was developed, on how the vision can be reached; and wild cards, low-likelihood, high impact, and hard-to-predict events, were identified.
- Finally, an action plan was developed by integrating policy actions into the scenario, and the vision was defined.

All these project’s steps were based on the conceptual framework, which is described in the following section.

1.4 Conceptual Framework

The conceptual framework (see Fig. 1.3) defines the methodological approach for the FREIGHTVISION project and provides a structure of the main system components and the interrelationships between these components.

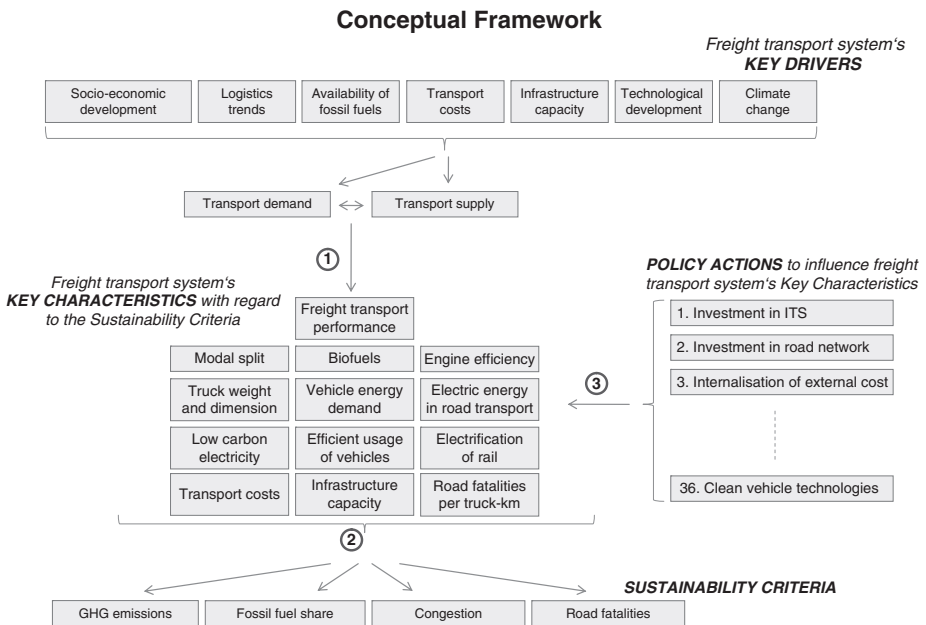


Fig. 1.3 Conceptual framework

FREIGHTVISION's conceptual framework consists of the following four components: key drivers, key characteristics, policy actions, and sustainability criteria.

- *Key drivers—freight transport system's key drivers.* These are the key influencing factors that trigger and change the transport system. They contain both external factors like socio-economic development and internal factors like transport cost.
- *Key characteristics—freight transport system's key characteristics with regard to the sustainability criteria.* Key characteristics describe the status of the transport system.¹⁴ If the key characteristics are known, then the transport system is sufficiently described for a certain task. Different tasks might demand different key characteristics.

FREIGHTVISION'S objective was to estimate the status and development of the four sustainability criteria; and therefore one of the challenges of the project was to identify the key characteristics, with regard to the four sustainability criteria.

The following key characteristics describe the status of the transport system sufficiently for the project's task:

- Freight transport performance: total tkm¹⁵ of road, rail, and IWW;
 - Modal split: tkm split between road, rail, and IWW;
 - Biofuels: upstream emissions in producing biofuels and the share of biofuels;
 - Engine efficiency: the efficiency of the engines used in road, rail, and IWW;
 - Truck weight and dimension: transport performance split between different truck types;
 - Vehicle energy demand: MJ needed to move 1 tkm;
 - Electric energy in road transport: primary energy input for trucks;
 - Low-carbon electricity: upstream emissions in producing electricity;
 - Efficient usage of vehicles: road, rail, and IWW transport efficiency that is not covered in vehicle or engine efficiency. It covers aspects like loading factors, empty runs, driver behavior, etc.;
 - Electrification of rail: percentage of rail tkm transported with electric engines;
 - Transport costs: price per vdkm;
 - Infrastructure capacity: vehicle throughput on road network;
 - Road fatalities per truck-km;
- *Policy actions—policy actions to influence freight transport system's key characteristics.* These are transport and RTD policy actions. These are the options transport policy-makers have. Within the project, 36 policy actions were identified.
 - *Sustainability criteria.* These are the four sustainability criteria—GHG emissions, fossil fuel share, traffic congestion, and road fatalities.

¹⁴ The methodological difference between Key Drivers and Key Characteristics is the following: Key Drivers are the triggers for changes of the transport system, whereas Key Characteristics describe the status of the transport system.

¹⁵ Tonne km.

The arrows in Fig. 1.3 show the linkages between the system components. Three linkages are relevant.

- *The impact of the key drivers on the key characteristics* (via transport demand and transport supply). This linkage is marked with the number “1” in the figure.
- *The impact of the key characteristics on the sustainability criteria*. This linkage is marked with the number “2” in the figure.
- *The impact of policy actions on the key characteristics*. This linkage is marked with the number “3” in the figure.

The vision, forecast, scenario, and action plan are based on the components and linkages of the conceptual framework.

- **VISION:** The vision is a definition of targets for each of the four sustainability criteria to be reached by 2020, 2035, and 2050.
- **FORECAST:** In the forecast, the development of the sustainability criteria was modeled. This was done by assuming: how the key drivers will develop and derive from this development, and how the key characteristics of the transport system will evolve (link 1). Based on these key characteristics, the development of the sustainability criteria was calculated (link 2).
- **SCENARIO:** The goal of the scenario development was to find a way, where both the vision is reached and a realistic development of the key drivers is taken into account. This was done using a “*BACKCASTING*” approach: the starting point was the vision, i.e., the targets defined for the sustainability criteria. Based on these numbers, a certain development of the key characteristics was calculated (link 2), which is also realistic with regard to the development of the key drivers (link 1). The scenario is therefore a certain composition of the key characteristics, where the vision is reached and the development of the key drivers is not neglected.
- **ACTION PLAN:** The goal of the action plan was to find a bundle of policy actions, where the scenario, i.e., a certain composition of key characteristics, is reached. This analysis was done for each key characteristic separately, i.e., the action plan consists of a bundle of actions and tasks for each key characteristic (link 3) and answers the following question: Which bundle of policy actions is most effective to reach the status of each key characteristic defined in the scenario?

These system components of FREIGHTVISION and their results are presented in the following chapters of this book.

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