TRANSvisions

Contract A2/78-2007: Report on Transport Scenarios with a 20 and 40 Year Horizon

Executive Summary

March 2009

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Project funded by the
European Commission – DG TREN

Contract A2/78-2007: Report on Transport Scenarios with a 20 and 40 Year Horizon

Report information

Report no: TRvCR503_002

Title: Report on Transport Scenarios with a 20 and 40 year Horizon, Executive summary

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Version: 2.2

Date of Publication: February 27th, 2009 (with editing corrections March 24th, 2009)

Project Information

Project Acronym: TRANSvisions

Project Name: Report on Transport Scenarios with a 20 and 40 Year Horizon

Contract Number: TREN A2/78-2007

Duration: 1.01.2008 – 28.02.2009

Commissioned by: European Commission DG TREN

Lead Partner: Tetraplan A/S, Copenhagen, Denmark

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Table of Contents

1 Executive summary

1.1 Outline of study

The **purpose** of the study is to provide technical support to a debate on **transport scenarios with a 20- and 40- year horizon,** *inter alia*, by collecting and analysing information on transport long-term scenario forecasting, by developing long-term transport scenarios including modelling work and case studies, and by suggesting long-term objectives for the European transport policies.

A comprehensive discussion of the drivers related to transport has been carried out in the study, resulting in a subdivision of the drivers in question into: **external drivers**, that is drivers external to the transport sector, where five main categories of drivers were identified (population, economic development, energy, technology development and social change); **internal drivers**, that is drivers internal to the transport sector e.g. infrastructure, vehicles and fuel development and transport impact on environment and society; and finally **policy drivers**, that is broad policy responses which affect the evolution of the transport system, and in particular the governance of the transport sector.

It is assumed that policies now under discussion, and today's emerging technologies, will still be important in 2030. But we don't know how transport will develop towards 2050. Many policies and technologies to be applied in 2050 do not exist today. Hopefully vehicles will be cleaner and more intelligent, and maybe on-line pricing and traffic management will reduce the difference between public and private transport, thus making door-to-door trips equally attractive. So the categories we use today as "transport modes" may not be relevant in forty years time. In order to somehow explore these and many other uncertainties, TRANSvisions carried out an intensive research of "seeds", defined as current developments all over the world that, even if embryonic, may show starting points of changes that may have an huge impact in the future.

A number of different **exploratory scenarios** for 2050 have been formulated based on the identified drivers. The scenarios are formulated as different paths towards a post-carbon society. These scenarios have been named: "Move Alone" (Individualistic transport, technology, supply management and market spontaneous self-organisation); "Move Together" (pricing and modal shift, land planning, emphasis on cohesion); "Move Less" (behavioural policies and regulation, lifestyle changes, priority to local production); and "Stop Moving" (society initially puts a strong emphasis upon technology, but when breakthroughs do not take place it falls back on regulation and banning activities).

Scenarios have also been developed for 2030. These are fitted to the use of EC's transport model TRANS-TOOLS in the sense that the scenarios are established based on the main inputs for the TRANS-TOOLS model. Such inputs include: socio-economic input (population, GDP development, work places); transport policy input (change in vehicle operating costs, fares and transport costs for different transport modes); and network input (links and nodes and data related to these). Three scenarios have been set up: "Baseline", "High Growth" and "Low Growth".

An important aspect of the study has been to analyse different transport policy options to obtain reductions of the transport sector's CO_2 emissions by arbitrarily set targets of 10 % in 2020 and 50 % in 2050, compared to 2005. The main tool to accomplish this analysis has been the use of "Meta-Models", developed by the project for this particular purpose.

Meta-Models comprise sets of interdependencies between exogenous input and resulting output, mainly in the form of elasticities between two or more variables. The Meta-Model specification makes it possible to address the particular problems under investigation and it is possible to establish a model which enables analysis of the effect of different policy options on specific transport and environmental indicators. The Meta-Models applied in this study have been calibrated against TRANS-TOOLS results for 2005 and 2030.

It is emphasised that while TRANS-TOOLS is a forecast model based on a detailed description of the present (2005) situation, the Meta-Models are less accurate and their main application is in foresight studies e.g. providing transport indicators for the exploratory scenarios mentioned above.

Different policy options have been analysed with the TRANS-TOOLS model for 2030 and with the Meta-Models in 2020, 2030 and 2050.

Based on the results of the quantitative analysis and a thorough investigation of policy documents issued by the EC, a number of conclusions of the study were made, which are now presented.

1.2 Transport structure and trends

The policy analysis included the specification of policy packages aimed at reducing Greenhouse Gas emissions in Europe, with particular emphasis on CO_2. In order to do this a detailed analysis of the development of the structure of transport in the EU was carried out based on statistics and TRANS-TOOLS results. The following overall conclusions can be drawn:

Total passenger motorised transport with origin and/or with destination in EU27 (measured in passenger-km) will keep growing along existing patterns. A basic constraint which is expected to continue to prevail in the future for all scenarios is that the average time spent on transport per day per person is about one hour and that approximately 15% of personal available income is allocated, on average, to personal transport. Depending on GDP per capita and the evolution of transport costs, passengers will travel more or less (in passenger-km). This reflects the fact that personal mobility is not only driven by economic considerations. While daily commuting trips may remain stable, business, personal visits or leisure trips abroad will show more variation.

Road traffic is still expected to remain the dominant transport mode in passenger transport although it will lose some market share to the benefit of railways.

The relationship between passenger transport (passenger-km) and GDP depends very much on the type of trips made. When considering trips made by EU27 citizens inside the EU27 territory the expected growth in transport is less than the growth in GDP. The same result is valid if non-EU citizens' transport inside the EU is added to the transport carried out in the EU territory. However, when EU27 citizens' travel outside the borders of EU is added, the expected transport growth (passenger-km) is faster than the EU GDP growth. And the population of the transition countries (e.g. China, India, Russia) is expected to bring about further long-distance travel to and from the EU.

Total freight motorised transport with origin and/or with destination in EU27 (measured in tonnes-km) will keep growing following previous patterns, following the overall growth of the economy for all scenarios, but the elasticity to GDP growth will depend on the scenarios.

The freight transport elasticity towards GDP depends very much on the types of movement considered. National transport has a low elasticity, while export and import in tonnes-km inside EU show growth rates more in line with GDP growth. The development of freight transport is even faster if neighbouring countries are included, in particular because the import of crude oil and oil derivates from Norway and Russia are linked to economic development. When overseas trade is included, the growth rates of tonnes-km are increasing considerably more than the EU GDP.

In relation to freight, road transport may also be losing shares, but just marginally.

It is expected that Short Sea Shipping will continue to grow in Europe in line with overseas traffic. Therefore transhipments hubs and secondary ports in Europe may become more important in their regional hinterlands.

The footprint of Europe in the rest of the world measured in terms of CO2 direct emissions due to freight and passenger transport activities is already high, just a bit smaller than emissions generated inside the EU. Therefore, it is absolutely necessary to think more of European transport as an activity that European citizens and companies do at world level, and not only within Europe.

1.3 Policy packages

Five different groups of policy instrument were defined. The groups were:

- **Infrastructure**; development of new infrastructure in order to improve cohesion, accessibility and reduce congestion. However, it should be acknowledged that a majority of large infrastructure is in place today. If a new type of vehicle is invented, new infrastructure can be established relatively fast, as was demonstrated with the European High Speed Train system. EU has the possibility to influence infrastructure development.

- **Technology**; development of new or improved technology in the transport field. This includes development and improvement of vehicles using other types of fuel than fossils, but it also includes development of automotive technology, less fuel consuming technology, and integration and application of IT. EU has got limited possibilities for influencing this policy area (such as support to Research and Development, and framework conditions for introduction and use of new technology).

- **Economic**; this is an area where a number of transport policy initiatives are being carried out, including infrastructure charging and internalising external costs.

- **Regulatory**; development of legislation and regulations monitoring traffic, vehicle performance, working hours, and land use and planning regulations

- **Participatory**; instruments concerned with citizen involvement, for example in the planning of new infrastructure

Analyses were carried out, using the TRANS-TOOLS model, of two policy measures: Pricing of passenger cars on interurban roads and development of infrastructure networks. For the 2030 time horizon, the pricing measure led to a predicted reduction in CO_2 emissions, whilst the infrastructure measure led to a predicted increase of CO_2 emissions. In general though, the impacts of these policy measures (for 2030) on transport levels and CO_2 emissions was very limited in comparison to the impacts resulting from socio-economic changes, such as population development and economic development. The infrastructure improvements were mainly related to interurban road and rail development, and it is likely another result would have been reached if the improvements had been directed towards urban areas.

Analyses were also carried out with the Meta-Models testing four policy packages involving combinations of instruments from each of the first four of the policy instrument groups above. The aim of these tests was to examine the potential of the packages for reducing CO_2 emissions, and in particular for meeting two arbitrarily set targets involving the reduction of transport-related CO_2 emissions reductions by 10% in 2020 and by 50% in 2050. (The first of these targets was inspired by the existing targets for non-ETS sectors as a whole, since no specific targets exist for transport.)

The analysis shows that by combining different policies it is possible to meet these targets.

The policy packages involve:

- Technology: Vehicle technologies, reducing CO_2 emission limits for new vehicles and the introduction of non-fossil fuelled vehicles
- Regulatory: A reduction of vehicle speeds in roads and motorways and increase in rail urban transport
- Economic: Use of pricing mechanisms to increase occupancy rates and load factors
- Infrastructure: Selective road investments in congested road links.

All of these measures were tested against a baseline that includes measures already ”in the pipeline” such as: ETS for aviation; CO_2 emission limits for cars; and the internalisation of external costs for lorries.

According to the analysis the most effective measures concern vehicle technologies and pricing to increase occupancy rates. The measure concerning reduction in vehicle speeds and improvement of public transport is moderately effective. The construction of new roads is the least effective, but still it may bring CO_2 reductions due to the reduction in congestion.

The conclusion of these tests is that with the application of a combination of these policy instruments it is possible to meet these targets in all the analysed exploratory scenarios. The analysis shows that, in the long term, technology and/or changed behaviour will have an important effect on reducing CO_2 emissions, whereas more traditional transport policy measures are necessary in order to fulfil the 2020 target.

1.4 Social impacts of transport

It has previously been agreed at a high level that transport policy making in the EU should take into consideration the following sustainability impacts: economic, environmental and social. The first two such sustainability impacts are relatively straightforward to quantify and are thus generally included in practical policy evaluation. However, the third type of sustainability impact is often “forgotten”. It is therefore suggested that more emphasis in transport policy-making should be put on the **social sustainability impacts** of transport. In doing so, the concept of **social capital** is useful, providing an indication of “social strengths that need to be sustained”. Social capital can be understood as having two main components: **social cohesiveness** and **political capital,** which are described as follows:

Social cohesiveness considers the cohesiveness of communities on both local and EU-wide levels. It is understood that such cohesiveness includes both a “collective dimension” concerning how well the community “binds together”, as well as providing the basis for the “self-realisation” of individuals within the community (thus removing obstacles to individual and community self-empowerment). Social cohesiveness can be understood in the sense of “capacity to withstand threats”. With respect to the transport sector, such threats arise from:

(i) Differences in mobility opportunities between different social groups and between different regions of the EU, leading to problems of social exclusion. “Mobility” here can be understood in both the sociological sense of the “possibility for change in lifestyle and/or employment” as well as in the transport sense of “the physical means of movement by which such change might be facilitated”.

(ii) Differences in accessing ”local facilities” (jobs, education, healthcare), where those individuals with difficulties in this respect being required either to travel more than they would desire or be forced (against their wishes) to migrate to another location. This type of mobility will be classified as ”coerced mobility”.

(iii) A range of transport-related "security" problems resulting from tensions in society, including phenomena such as fear of walking alone or the threat from terrorist attacks on transport targets (planes, airports, trains, buses etc).

Apart from such threats, social cohesiveness also comprises an element concerning the "likelihood of citizens to treat each other with respect". In terms of the transport system, such respect leads to "polite behaviour", examples of which are: drivers voluntarily giving way to other drivers at road junctions (in accordance with local norms and rules); and drivers stopping their vehicles to allow pedestrians to cross the road.

In general, it is useful to distinguish between social cohesiveness impacts of transport that are **internal** or **external** to the transport system, with these terms being explained as follows:

- Internal social impacts of transport are those that affect individuals as "participants" in the transport system, as passengers or as transport workers. Policies which improve the experience of such participants, such as the enhancing of passenger rights or the raising of minimum working conditions for transport workers, have an impact on the overall social cohesiveness of society.
- External social impacts of transport are those that are experienced "outside" the transport system. For example, the impact of the transport system in terms of the possibility of accessing facilities (as mentioned above) would be an external social impact.

The concept of **political capital** is closely tied with the concept of social cohesiveness. Political capital emphasises the capacity of the community, and individuals within the community, to take control (in a political sense) over their everyday lives and futures. In particular, with respect to the transport system, two "levels" of political capital can be considered:

(i) At the local level, political capital involves the amount of public participation in (and hence democratic control over) transport policy-making. With regard to such participation, political capital also involves the freedom of individuals to be able to express diverse points of view.
(ii) At an EU level, political capital concerns the political strength of the EU as a transnational community and the resulting benefits for EU citizens when interacting with the rest of the world.

1.5 Policy aims and objectives

Various EU policy documents have been examined with respect to their stated aims and objectives. As a result of this review, the following **aims** are suggested by TRANSvisions:

(1) To ensure that our transport systems meet society's economic, social and environmental needs whilst minimising their undesirable impacts on the economy, society and the environment.
(2) To ensure that our transport systems are sufficiently resilient to be able to meet the future challenges presented by an uncertain world.

Furthermore, the following **objectives** are suggested, corresponding to the three axes of sustainable development (economic, environmental and social):

Economic sustainability

- Two objectives concerning the ability of the transport system to:
  - Contribute to **economic growth**
  - Contribute to **generation of employment**
- A further objective concerned with **reduction and avoidance of congestion**.

Environmental sustainability

- Three objectives concerned with the reduction and avoidance of
  - **climate change** effects by reducing greenhouse gases
  - harmful **local pollutants**
  - **noise** nuisance from transport
- Protection of **environmentally-sensitive areas** from transport encroachment

Social sustainability

- Reduction and avoidance of **fatal and serious accidents**
- Provision of **accessibility** to opportunities/services
- Enhancement of **social cohesion**, including the reduction of social and territorial exclusion
- Enhancement of political capital through the encouragement of a **participatory approach to transport planning**
- Enhancing the **rights of travellers** to good quality transport provision
- Attaining and maintaining **high quality standards of employment** within the transport sector

1.6 Policy synthesis

As described above, two types of modelling test have been carried out: “traditional” modelling of specific instruments using TRANS-TOOLS; and a “lighter” type of modelling of generic instruments using the Meta-Models. The TRANS-TOOLS modelling tests have been restricted to instruments that are implemented at a high (EU) level of governance (instruments concerning EU interurban road pricing and the Trans European Networks). The tests using Meta-Models have involved instruments that can be implemented at various different levels of governance, including urban. Both types of test have concentrated upon predicting the CO_2 impact of policy instruments.

A number of further “non-modelling” analyses of transport policy instruments have been made from a variety of methodological perspectives, putting particular emphasis on the social sustainability dimension of policy-making, as defined above. These analyses have ranged from theorising about participatory instruments to illustrative “real-life” examples of a variety of specific instruments, as given in the TRANSvisions case studies. Furthermore, a set of *a priori* instruments has been presented, which generally represent a “continuity” approach to EU policy instrument formulation.

The main conclusions from the synthesis of both modelling and non-modelling activities are:

- When formulating policy instruments for meeting specific aims, it is useful to think in terms of the creation of policy packages, where such a package is a combination of a number of instruments that are synergetic, or at least complementary, in their overall impact. In particular, packages can help ensure that the negative aspects of particular instruments can be offset by the positive aspects of other instruments in the package. When considering such complementary and compensatory effects, it is useful to think in terms of “instrument-types” (listed above as infrastructure, technology, economic, regulatory and participatory instruments).

- With respect to the reduction of CO_2 emissions, the model results show that options are limited if only those instruments are considered which can be implemented as a high level of governance (such as those in the TRANS-TOOLS tests). Large reductions in CO_2 emissions need to involve instruments that can be implemented at a variety of levels of governance, including urban (such as in the Meta-Models tests). In the specific context of European Transport Policy, this result has important consequences for subsidiarity issues. Furthermore, it is likely that an important contribution to the reduction of CO_2 emissions will come from “emerging technology” instruments (with a large number of such instruments being described in further detail in the TRANSvisions Case Studies). Given that new technology is invented and developed through the combination of a variety of factors, it can be seen that the implementation of technology instruments is not as straightforward (in a policy formulation sense) as the implementation of certain other types of instruments (such as road pricing or building new infrastructure). However, the EU can take a variety of actions to help the implementation of such instruments, where such actions can be classified under two general headings. Firstly the EU can provide financial support to help research and development of new technology. Secondly, once such technology is available, the EU can help its introduction through a variety of regulatory instruments and demonstration actions.

- Broadening the perspective from one focussing upon CO_2 emissions, it is clear that transport is an extremely complex phenomenon, as shown by the many strands of results and analysis presented in the TRANSvisions study. Given this complexity it inevitably follows that any policy thinking concerning the long term future (over the next 40 years) must be "doubly complex", given the uncertainties concerning the future. However, as is shown in this report, some aspects of the "long term transport problem" are reasonably well understood (for example some of the issues concerning different types of challenges). Furthermore, it is clear that transport policy needs to meet the overall goals of economic competitiveness and environmental sustainability. It is argued, though, that the "overall problem of transport policy" can be defined as being the fact that many other aspects of the transport system, particularly concerning social aims and issues, are not sufficiently well-understood, thus potentially giving an impression of fragmentation in much transport policy thinking.

- As stated above, it is suggested that transport policy-making puts more emphasis upon social sustainability, particularly concerning the "external social impacts" of transport policy (as opposed to "internal impacts" concerned with passenger rights and the working conditions of transport employees, which are well covered in terms of current EU policy-making). Arguably social sustainability concepts (social capital, social cohesiveness and political capital) can provide the "set of missing links" to overcome to fragmentation remarked upon above. One immediate use of such concepts is to provide a more nuanced understanding of the "restriction on freedom" criticism levelled at attempts to manage demand. Heightening focus upon social sustainability includes a recognition that some travel is unwanted/undesirable from the point of view of the people making the journey (e.g. they would prefer services to be closer to home).

- With respect to policy instrument formulation, packages of policy instruments need to be devised to meet objectives associated with the three dimensions of sustainability. Traditional transport policy instruments have generally not been devised with the purpose of meeting social sustainability aims and future instrument packages need to rectify this omission. Of particular interest here are those instruments that help reduce unwanted travel (by heightening accessibility through planning measures) and those instruments that help public participation in transport policy formulation.

- When devising policy packages, careful consideration needs to be paid to the level of government appropriate for implementing any particular instrument within the package. This in turn raises the issue of subsidiarity. In particular, due to the principles of subsidiarity, the EU has a limited role in urban policy-making. However, careful consideration should be made as to how the EU could expand upon its current role as a "facilitator of good practice", for example by making clear that it is a champion of public participation in the local transport-planning (without trying to specify *a priori* which conclusions such local planning should reach).