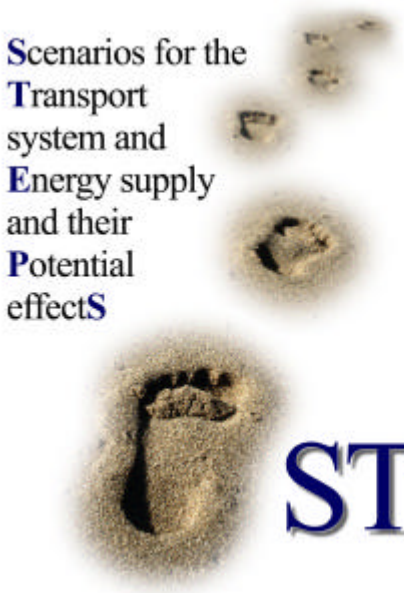
Transport strategies under the scarcity of energy supply



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July 2006

Produced by

The STEPs Consortium
2006

Published by

Buck Consultants International
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Reports can be obtained from BCI or via the STEPs website http://www.STEPs-eu.com

ISBN-10: 90-9020880-1
ISBN-13: 978-90-9020880-0

Printed in England

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Foreword and Acknowledgments

The fuel price developments during the last years have again showed the relevance and urgency of the subject of the STEPs project. The price of a barrel of oil has risen considerably until the beginning of this century and amounted to about $50 in 2004. The STEPs project started in that year. Currently (July 2006), the project is completed and the price for a barrel amounts to more than $65, which is an increase of 30%.

A clearer illustration cannot be found for the significance of this project, even though it has scenario building as a topic. The complexity of this subject, of which the scenarios cover a time horizon of 25 years, shows an interesting contrast with this astonishing, but simple statistic fact, which covers 2.5 years: exactly one tenth.

But not only energy is threatening the European economy and sustainable development, transport trends are also a real challenge for European Policy. The Common Transport Policy has two basic goals: efficient, accessible and competitive transport systems, and a high level of safety and environmental protection. However, the achievement of these goals requires European Policy to tackle several problems, such as the lack of interoperability of European networks, traffic congestion, a growing imbalance between transport modes, the increasing number of traffic accidents, growing environmental impacts, and problems of cohesion and accessibility in a larger European scene. Besides, the relevance of those problems is different at each policy level; some of them are significant at local or regional level, whereas they do not constitute a relevant issue for the whole of Europe.

How to cope with these problems and threats? There is a wide variety of transport policy options, such as technology improvements, regulation, pricing, or land use and transport integration measures. However, it is difficult to forecast their long-term impacts. It is also difficult to measure their indirect effects on issues such as social equity, accessibility levels, energy consumption, or environmental effects.

This is why there is a need to develop assessment tools that can provide a strategic vision of the expected effects of different combinations of the above policy measures to achieve a more sustainable future for European citizens.

Back in early 2004, the consortium partners for the project STEPs gathered for a kick-off meeting in Brussels to start working on Scenarios for the Transport System and energy Supply and their Potential effects. During the 2.5 years that followed, fourteen consultants and research institutions from nine countries have worked together to achieve a multitude of tasks. Extended research into the State of the Art and relevant trends and analysis formed the beginning of the project and gave the necessary inputs to define a base set of scenarios. These scenarios were simulated using a range of integrated land use – traffic models, on the European as well as on the regional level. The outcomes of the model calculations have been extensively tested, assessed and compared using various tools like meta analysis and multi criteria analysis.

Communication was a second important pillar of the project. All along the process several events were organised in which interim findings were presented and discussed with outside experts. Especially the last meeting in Gothenburg, Sweden, demonstrated that while all model and analysis outcomes represent clear figures, it is the consequences and implications that one can attach to the outcomes that makes one think about the future. Is it possible to decouple economic growth from the growth in transport and energy use? How fast will the oil price growth give rise to the development of other technologies, including renewable resources? What kind of policies will be acceptable to introduce some kind of management of transport demand? It turns out that, at end of the project, the partners have not yet seized the discussions: even at this late stage there are still e-mails coming in on the conclusions and recommendations. This will probably continue for some time.

During this process we realised that the efforts made and the relevance of results would merit a higher quality and more permanent dissemination product. Therefore, we decided to do some extra work, and to dedicate some resources, to publish a final book instead of a simple final report. We received the clear support of all partners to develop this task in parallel to the final part of the project. Thus, we can affirm that the final steps of STEPs have been even more interesting and scientifically challenging, in order to produce a good summary of results and helpful conclusions for all future readers of this book.

It is this active attitude which we have really learnt to appreciate. With the project partners we had a unique co-operation experience which has been a pleasure on the personal side just as well. It is therefore much more than appropriate to thank the partners for the great time together in this project. We cannot name everybody as more than 35 people at the partner organisations and subcontractors have contributed. But we will name some key persons that contributed in a special way.

The STEPs project originates from the LUTR (Land Use and Urban Transport) cluster, which was formed of several earlier projects in the field. Tony May of ITS can in this regard be seen as one as the initiators of the STEPs project. Sander Kooijman, who assumed to take the responsibility of conducting the project should certainly be named. Without the initiative and the additional effort of some colleagues this report would not have reached the quality level that it has. Especially, we would like to thank Elena López of TRANSyT-UPM for this. We would also like to mention Rachel Brooks of TTR, who was in charge of the design of this report.

Furthermore, we really wish to thank the experts that attended the Soundboard Forum meetings and Clustering Meetings. Although the attendance showed some variation, all of you really contributed in a valuable way to the discussions.

Then, there are some people who are not always thanked for their activities in an appropriate way. With all partner organisations, support personnel (secretariat, finance, etc.) played an indispensable role. We especially want to thank Bennie Beernink of BCI for being the STEPs financial manager.

Last but not least, a word of thanks goes out to the colleagues with the European Commission. After all, it is the Directorate-General Research that wrote the task for which the project was designed. It is great that international co-operation in research is supported this way. The first project officer responsible for the STEPs project was Maurizio Maggiore; later Reiner Dunker succeeded him. These are the officials to stay in touch with, when planning projects like this the future.

As a result of the interesting co-operation exercise carried out in STEPs over the last two and a half years, now, in 2006, we have a tangible evidence of our work, and in 2030 we will see if we did the job right.

Thanks to all of you, we certainly hope to see you again.

The Hague, The Netherlands, 22 June 2006
Andrés Monzón and Adriaan Nuijten,
Editors

Executive Summary

Background

The future framework of the transport system is intimately linked with the general energy supply of the future. The relatively cheap availability of petroleum oil has allowed great expansion of the transport system over the past hundred years. This relationship between energy supply and vehicle technology and the characteristics of the transport system is typified by the internal combustion engines that power much of the transport system. The wide availability of fuel, its relative cheapness, and the relative simplicity of the engine itself and the storage requirements has meant that transport system has facilitated an era of increased dispersion of activities with high levels of mobility for those who can afford it. The nature of the fuel technology and economy has been a major influence of the transport system and mobility patterns of today.

However, circumstances are changing. There is an increasing concern about the environmental consequences of the fuel technology used. Just as important are the concerns over the future availability of the fuel required. The recurrent crises and even wars in some areas where oil and gas is produced and the instability of political systems in other fuel producing areas only adds to this. Driven by these issues, a wide range of new or improved fuel technologies are being proposed and developed.

Each alternative fuel technology brings with it issues over the wider consequences of its adoption. These issues include the autonomy and security of the fuel supply, the infrastructure requirements of the fuel technology, the implications for the possible pattern of use of the vehicles, and so possible changes in the patterns of mobility with its impact on land use. There will also be political, social and environmental issues to be considered with the assessment which technologies should be encouraged and invested in. Just as the future is not certain, nor are the eventual 'winners' from amongst the new technologies. There are technological risks with all new technologies, combined with the uncertainties in the energy, social and economic future. The implications of the various futures are best considered by investigation of a series of scenarios reflecting a range of 'best' estimates of future conditions in the energy, transport, economic and social fields.

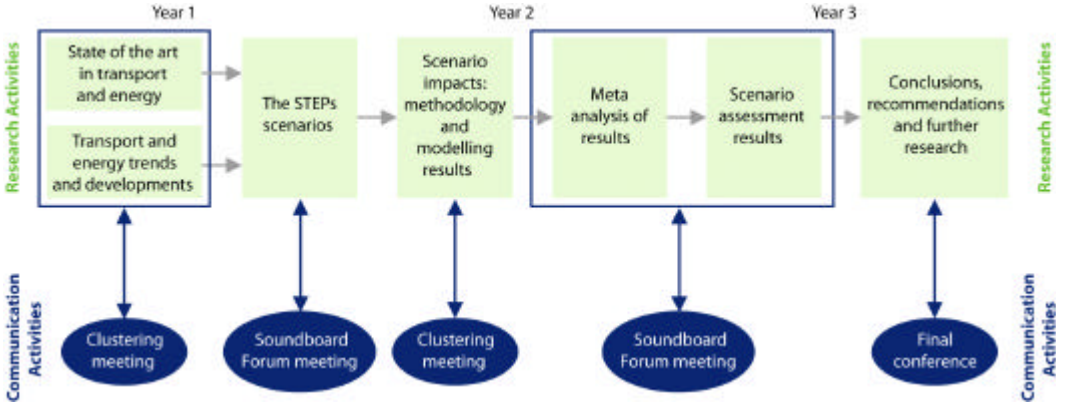
The STEPs approach

STEPs stands for Scenarios for the Transport System and Energy Supply and their Potential Effects. The project ran from January 2004 and finished in July 2006. Its main findings are presented in this report.

The STEPs project was designed and implemented by a group of institutes, companies and universities to achieve the tasks of Research Domain 1.10 within the Sixth Framework Research and Technological Development of the European Commission. The STEPs project had the following overall objective:

to develop, compare and assess possible scenarios for the transport system and energy supply of the future taking into account the state of the art of relevant research within and outside of the 6th RTD Framework and such criteria as the autonomy and security of energy supply, effects on the environment and economic, technical and industrial viability including the impact of potential cost internalisation and the interactions between transport and land use.

To achieve this overall objective, the STEPs project was divided into several tasks with their own specific objectives. In the figure below, the main successive and parallel project tasks are displayed.



The top part of the figure (green blocks) consists of the research tasks of the project. The lower part (blue ovals) represents communication activities, with which the project has tried to involve actors 'from the outside world' within the project in order to discuss results and progress with them and to incorporate their remarks, suggestions additions etc. This has provided added value and helped to enrich the project.

Project results

The project started with mapping the State of the Art, and description of relevant trends in transport and energy supply systems. With these outcomes, a basic set of scenarios was compiled. Two main variables marked the scenario framework. The first was fuel price increase, which is directly related to energy scarcity. In the coming decades the fuel price increase may be as generally accepted in current times, or energy may be subject to more severe scarcity (so pointing to a faster increase in the fuel price). The second variable is represented by the policies that various authorities deploy in response. Will the policy response be like 'business as usual' (not specifically meant to target transport system and its energy supply)? Will there be more targeted policies, for example technology investment to adapt with the use of innovative technologies, or use of more stringent demand management?

The scenarios were simulated with existing integrated land use – transport models, both on the European scale and on the regional scale. The regional models covered five diverse regions in Europe: Edinburgh, Dortmund, Helsinki and Brussels with their respective surrounding regions, and the region of South Tyrol in Northern Italy. Partly, the scenarios worked together to produce the input needed to calculate all parameters needed. In some cases, results from the European models could be used as input in the calculations within the more detailed regional models. The prognosis year was typically 2030 (in some cases 2020). The outcomes were described in an extensive overview of their impacts. The modelling exercise provided indications about the development of several variables (transport demand, economy, energy consumption, emissions, etc.) over the period 2005 – 2020 / 2030 under the different scenarios.

To acquire a good picture of their comparability, the scenario modelling results were subjected to a meta analysis. This gave the possibility to cross-validate the model results, which was needed because of some major differences between the models (their cities, regions) and model techniques. For example the urban regions are of various size, show either growth or decline, are administered in various ways and with various policies.

With the meta analysis showing that the model results were in reasonable agreement about major environmental effects and societal behavioural responses, the assessment and comparison of scenarios was conducted using a multi-criteria analysis. All scenarios were firstly tested as to current policy objectives on the European scale. To establish a valid and credible evaluation framework, a questionnaire was sent to a group of politicians and experts in the transport and energy fields to enquire what aspects they thought were most important: energy (including e.g. reducing consumption and dependence upon import), environmental aspects (emission reduction, global warming), social aspects (e.g. safety) and economic aspects (like competitiveness, employment, GDP and the decoupling of transport growth and economic growth). The resulting weight set was used to calculate value functions to assess the scenarios as to the fuel price effect and the policy effect.

Outcomes and implications

From this last assessment it was concluded that energy and environmental criteria improve in all scenarios and models. Demand management does, in the long term, appear to be more effective than technology investments but this is quite sensitive to the actual policy package which is selected, its efficiency and the way fuel prices will develop. The predicted effect on social criteria is not as straightforward. Both fuel price increases and policy measures tend to result in higher transport costs, mobility constraints and reduced accessibility. Economic development for large parts of Europe could be at stake because of this, and investment in new, sustainable technologies might be a preferable option for a better future for transport systems and their energy supplies.
The results of STEPs constitute a valuable synthesis of the main findings on trends and policy scenarios and their predicted effects. STEPs results serve as a basis for the development of a view on future policy and give insight into research requirements in the area of transport and energy scenarios.
This project has created a valuable contribution in the hugely complicated trade-off between energy and the energy sustainability of our transport networks on the one side, and economic development on the other. To what extent can economic growth be threatened in order to achieve, for example, environmental or social goals? What dilemmas are really crucial for decision makers? Can global megatrends be reversed, and to what extent? Regarding the scenarios' impacts, what aspects can be more important than the air that we breathe, the food that we eat, or the safety of our loved ones? These are profound items to be addressed in the coming decades. We as a project partnership do not think that we can provide actual answers to these issues, but STEPs might well help by taking a small and enlightening peek in the future.

Reader's guide

In this publication, the main activities and results of the STEPs project are described. The report is divided into five main parts which, in turn, each have chapters.

Part I treats the **framework** of the project, including both the trend analysis (Chapter 1) as well as analysis of the relationship between transport and energy use (Chapter 2).

Part II has the **STEPs assessment approach** as a subject. It describes the scenarios that were compiled in detail, as well as the process of compilation (Chapter 3). Also, the modelling system is described (Chapter 4), followed by an account of the multi criteria approach used with the further scenario assessments (Chapter 5).

Part III focuses on the **model outputs.** It features an extensive account of the results of the three European models used in the project (Chapter 6), as well as the regional model results (Chapter 7), followed by a summary of the results (Chapter 8).

Part IV is the account of the **scenario assessment.** The scenarios were investigated and compared in several ways. Firstly, a meta analysis of the model results is included in Chapter 9. Then the assessment results are analysed in Chapter 10. This part ends with a broad cross-model comparative analysis (Chapter 11).

Part V finally draws **conclusions** and presents a synthesis of the main findings, policy recommendations and future research requirements.

At the end of the publication there are references. There is also a full list with the STEPs deliverables: all the reports that were compiled in the course of the project.