PROJECT FINAL REPORT

Grant Agreement number:	233984
Project acronym:	REACT
Project title:	Supporting REseArch on Climate-friendly Transport
Funding Scheme:	Support Action
Date of latest version of Annex I against which the assessment will be made:	17/4/2009
Period covered:	from 01.08.2010 to 31.07.2011
Name, title and organisation of the scientific representative of the project's coordinator[1]:	Ms Eleni Anoyrkati, Project Manager, Coventry University Enterprises Ltd
Tel:	+44(0)7974984863
Fax:	+44(0)24 7623 6024
E-mail:	e.anoyrkati@coventry.ac.uk
Project website[2] address:	www.react-transport.eu

[1] Usually the contact person of the coordinator as specified in Art. 8.1. of the Grant Agreement .

[2] The home page of the website should contain the generic European flag and the FP7 logo which are available in electronic format at the Europa website (logo of the European flag: http://europa.eu/abc/symbols/emblem/index_en.htm logo of the 7th FP: http://ec.europa.eu/research/fp7/index_en.cfm?pg=logos). The area of activity of the project should also be mentioned.

Contents

Figures

1 Executive Summary

REACT played an important role in addressing climate-friendly (i.e. low-carbon) transport objectives by linking strategies for Research & Technology Development (RTD) in transport to the climate friendliness of European climate policies. REACT acted as the driving force for coordinating, supporting and strengthening European RTD on climate-friendly transport and mobility so as to avoid wasting funding resources and to achieve integration of funding opportunities at the European level.

Towards this goal, REACT has produced:

- A database of almost 500 transport stakeholders, who participated in consultation sessions, accessed information on climate-friendly transport related updates and innovations, received relevant news and networked in the participatory sessions and events.
- A Strategic Research Agenda (SRA) on Climate-Friendly Transport
- A database of EU-funded research projects, categorised into the SRA themes
- A database and analysis of funding initiatives, which were benchmarked according to best practice criteria
- A set of indicators for carbon impact from transport
- Two expert and one open consultation sessions, within a Delphi study to inform the SRA development
- Two expert workshops and a conference which received more than 75 papers
- A set of dissemination activities of research project results including the organisation of a project competition

To develop the above, especially the SRA and the set of carbon indicators, a number of external experts were involved in the project by submitting their feedback into the various consultation sessions. The sessions were carried out either through the means of technology (i.e., online questionnaires and discussion tools) or via expert workshops. The open consultation session, which was administered via an online questionnaire, attracted more than 160 participants, while the expert consultation attracted around 50 renowned experts. The REACT Strategic Research Agenda (SRA), which was developed through the consultation sessions, described the present state of the art of research on climate-friendly transport in Europe and the top priority research areas to be funded by the EC in order to achieve the vision of low-carbon transport.

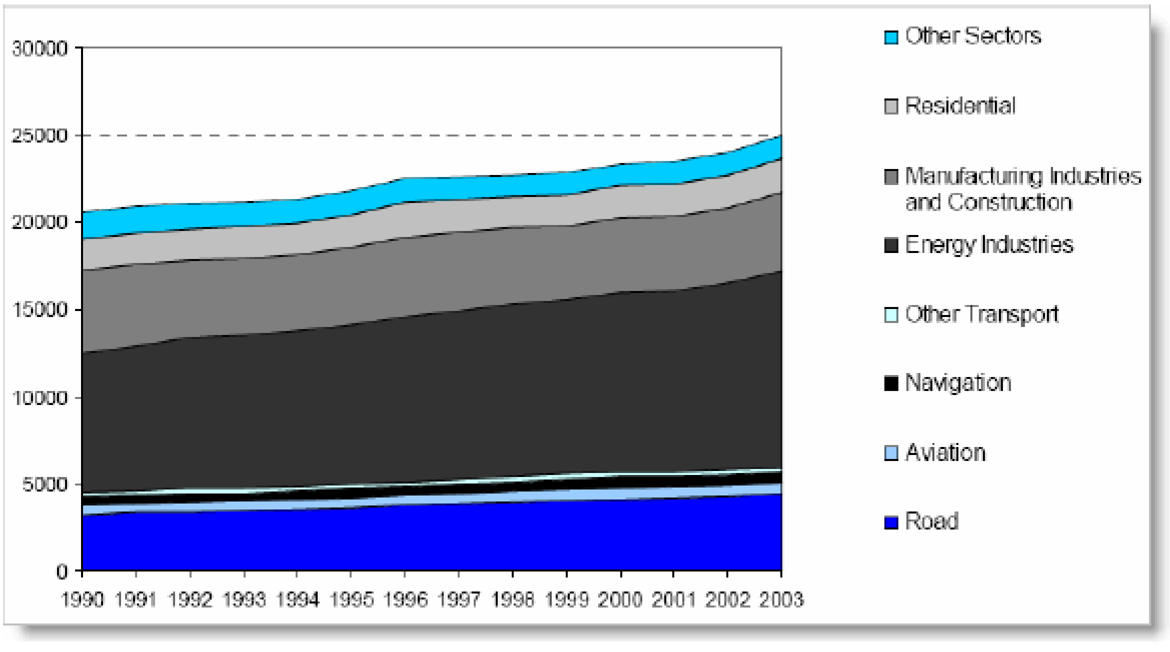
Through the extensive stakeholder consultation and detailed analysis of research projects and funding schemes it became apparent that technology alone will be insufficient to achieve the necessary reductions in carbon emissions to effectively tackle climate change. It is therefore increasingly recognised that achieving sustainable mobility requires an integrated approach comprising planning measures, behaviour change, industrial and economic measures, along with technological advances.

The Conference organised by REACT, entitled: ‘*Shaping Climate Friendly Transport in Europe: Key Findings & Future Directions’,* was the main dissemination activity of the project. It contributed significantly into the knowledge transfer and sharing in the field by allowing to more than 75 authors to present and publicise their research results in the field of climate-friendly transport.

2 Project context and objectives

It is due to the importance of transport for economies, that EU transport policy has historically focused on liberalisation and harmonisation to form a single trans-European transport network. More recently it has incorporated sustainability considerations into transport policies. Mobility is one of the six priority areas of the EU's Sustainable Development Strategy.

The policy objectives have a challenge to overcome the existing situation in the transport sector. Its emissions grew 1,412 million tonnes (31%) worldwide between 1990 and 2003, and increased 820 million tonnes (26%) in OECD countries. The OECD-EMCT region accounts for 71% of worldwide CO2 emissions from transport. Transport's share of CO2 is gradually increasing in all regions of the world; its share of world emissions increased from 22% in 1990 to 24% in 2003. Transport's share is highest in the more developed countries of the OECD (30% in 2005) (ECMT 2007).



Source: "Cutting Transport CO2 emission: European conference of Ministers of Transport, 2007

The challenges of environment protection are complex and diffuse, and so cannot be solved at the level of individual country or pollutant. The solutions are to be found within systematic multi-disciplinary research and within the application of the concept of sustainable development.

In light of the societal need for, and policy-relevance of, sustainable mobility, an active and practical plan for creating awareness and making use of research results from climate-friendly transport is of the utmost importance. Furthermore, the creation and exploitation of knowledge networks in research and dissemination of scientific breakthroughs will ensure innovation is exploited socially and economically. Another aspect for consideration is the funding resources that have to be managed efficiently and effectively. All these aspects have been integrated into REACT's methodological approach and activities, which have as their primary goal supporting research in reducing greenhouse gas (GHG) emissions.

Key to tackling global sustainability challenges is collective, societal action. The REACT Support Action aimed to support multi-stakeholder international collaboration in climate-friendly transport research, enhance EC Member States' research efforts and cooperate with Associated States and the broader international community. The scope of REACT was to diffuse innovation not only amongst the EC research community but also amongst Associated States and international community researchers. REACT also diffused innovation to stakeholders within transport and environmental industries and to public, policy and civil society organisations.

REACT had the vision not only to raise awareness but also to actively contribute to the incorporation of consensus and a common strategy among EC, Member States and Associated States RTD funding agencies, so that climate friendly-transport challenges could be addressed in a unified and effective way by fully exploiting available resources and avoiding resource wastage and fragmentation of research in such a crucial issue as climate-friendly transport.

REACT had the following concrete objectives:

- To share experiences among research program managers in the Member States, Associated States and EC, so as to create synergies and enhance collaboration. This will lead to the identification of national and regional funding initiatives on climate-friendly transport and mobility and of research opportunities for stakeholders and researchers.
- To articulate a long-term vision and a Strategic Future Research Agenda on climate-friendly transport that will contribute to the development of a European strategy in this area.
- To improve synergies between Member States, Associated States and the EU RTD Agenda on climate-friendly transport and mobility by enhancing coordination of funded research initiatives among EC and national agencies.
- To organise a set of focussed dissemination activities that will significantly enhance the impact of research outcomes from EC-funded projects. Coordination with the activities of ERA-Transport will be required.
- To develop a common set of indicators for the carbon impact of transport measures

The REACT project structured its operating principles around a set of activities that sought the advice of a network of expert stakeholders, investigated the transport funding initiatives and projects, examined and benchmarked funding initiatives, and supported dissemination of research results. These activities led to the development of the Strategic Research Agenda on Climate-Friendly Transport, the creation of databases of transport projects and funding initiatives, and the development of a Common Set of Indicators for Carbon Impact.

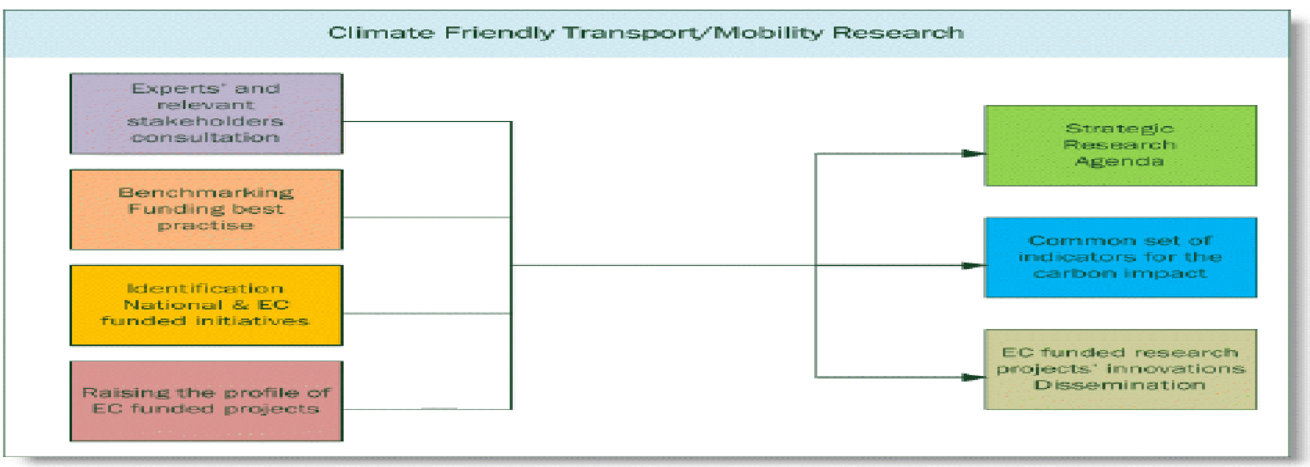


FIGURE 1: REACT CONCEPT

3 S&T results

The strategic key result of the REACT project was the development of the Strategic Research Agenda on Climate-Friendly Transport. The development of the SRA has been supported by a number of activities that contributed to other important deliverables including the creation of various databases that constitute a reference point for public funding authorities and stakeholders and the development of a set of carbon indicators. An important part of the project was also the various dissemination activities that have assisted a number of other FP-funded projects in making available their research results to the wider community.

The most important results are presented in more detail below:

3.1 Strategic Research Agenda on Climate Friendly Transport

General features of an SRA

A Strategic Research Agenda (SRA) represents an identifiable, coherent forward looking and adaptable framework for research at the beginning of the 21st Century. It suggests a clear signal and path to the stakeholders involved and indicates the direction to be taken and speed of progress needed to achieve a climate-friendly vision. This vision identified progress needed over the next 20 years, to identify targets that need to be met and the related innovation challenges (European Expert Group, 2011). In other words, an SRA can be considered as a strategic tool for the definition of research priorities, developing future roadmaps and suggesting targets that can actually be achieved. An SRA is generally constructed through a consultation process that involves stakeholders coming from the academic world, industry and/or policy.

The REACT SRA's primary focus is to provide the EU with strategic roadmaps for research to achieve the future vision of a green European transport system. This future vision is inspired by the EU strategic vision towards 2020 on climate-friendly transport (EC, 2001, European Parliament, 2009). The REACT SRA shares the EU targets for carbon reduction (i.e. carbon emissions reduction by 20% by 2020) and it considers all the research areas in transportation that pursue these targets.

REACT SRA development process

A comparison of the development process of the SRAs of the ETPs led to the development of REACT consultation process. From the beginning, the development process of the REACT SRA involved stakeholders, in the form of both European experts in transportation and the wider public. The development process ensured, firstly, that the internal coherence of the hierarchical classification proposed (i.e. correctly establishing relationships among research areas and lower and upper classification levels), and the completeness of the classification (i.e. checking whether research themes were lacking or were unnecessarily duplicated); secondly, the process was used to evaluate, for each specific research area included in the SRA, the priority in relation with the objectives of the vision, previously described.

Specifically, the development process involved three different consultation stages:

1. *Expert Consultation*. The first step of the development process asked experts to validate the REACT SRA structure and then to assess the priority to be assigned to the SRA specific research areas. Firstly the experts were asked for their views on the SRA structure: division into pillars, completeness of research areas and removal of inconsistencies. Secondly, a focused consultation activity focussed on building a picture of the present state of research on climate-friendly transport. In this phase a number of key experts expressed their opinion either through their participation in structured workshops or via email/phone/web. The stakeholders mainly came from industry, academia, NGOs and policy and evaluated the impact of each specific research area, according to their expertise.
2. *Open Consultation*. The second step of the development process consisted of consulting the wider public. To ensure an adequate representation of 'end users', we addressed a number of non-experts or

‘lay experts’ who expressed their view on future research priorities mainly based on personal experiences. The spectrum of experience of participants varies from transport PhD students to experienced research directors and end-users. The Open Consultation phase was mainly used to assess the results of the Expert Consultation, namely understanding whether there was agreement between high-level experts and the wider public.

3. *Interviews to key-experts.* This last step was carried out to enhance the consistency of the preliminary outcomes, resulting in priorities and scores assigned to the specific research areas. The interviews provided useful insight on the expert evaluations and a wider view on the SRA.

Structure of REACT SRA

The structure of the REACT SRA (see Figure 1), as it is conceived, includes all research areas to be considered and the criteria to use for defining, for each research area, priorities within European funding schemes. Two main pillars have been set for structuring the research areas:

1. Engineering and Information & Communication Technology (ICT)
2. Planning, Social Sciences and Economy

FIGURE 2: REACT SRA

Each pillar has been detailed through the logical and hierarchical flow of a tree-structure. The root node is the SRA; each branch is then divided into sub-branches (pillars, sectors, research approaches and main research areas) and the leaves of the tree, the most detailed level, correspond to the specific research areas.

The adoption of two main pillars originates from the assumption that reducing GHGs is not only a matter of technology but also that policy, economic measures and social behavioural patterns are themes that need further research. The strong links between technological achievements on one side and policy, social behaviours and market processes on the other is seen as affecting all transport modes similarly: technological improvements could offer a significant reduction potential, but strong interventions in policy schemes (e.g., emission trading schemes) would be needed as markets do not initiate the necessary changes (Rajan, 2006). Moreover, the tendency to focus on long-term technological solutions cannot be left aside from short-term behavioural change that becomes crucial if the benefits of new technology are to be fully realised (Chapman, 2007).

All the information included in the Engineering and ICT pillar derived mainly from ETPs’ documentation. Each of the four transport modes included in the first pillar has been further studied in depth by means of desk analysis (Schäfer et al., 2009; Uhureka et al., 2010; Rothengatter, 2010; Cascetta, 2001). The second pillar, instead, was set up assembling different sources (Banister, 2005; IHT, 1997) and REACT consortium expertise. It is in this second pillar that the research areas of policy (e.g. planning and analysis tools), economy and multimodal or non-motorised means of transport (cycling, walking) are included.

The second level of classification regards sectors. For the Engineering and ICT pillar, sectors correspond to the transport modes: road, rail, water and air. For the Planning, Social Science and Economy pillar, sectors refer to different measures of governance, acting in urban spaces, on people's behaviour or on the market: Planning and systems, Social and behavioural measures, Industry and economy. Two further levels of classification are provided: Main research areas and Specific research areas (as an example see Fig. 2 for an extract of the structure for the Rail sector). The "specific research area" is the most detailed classification available within the structure of the REACT SRA.

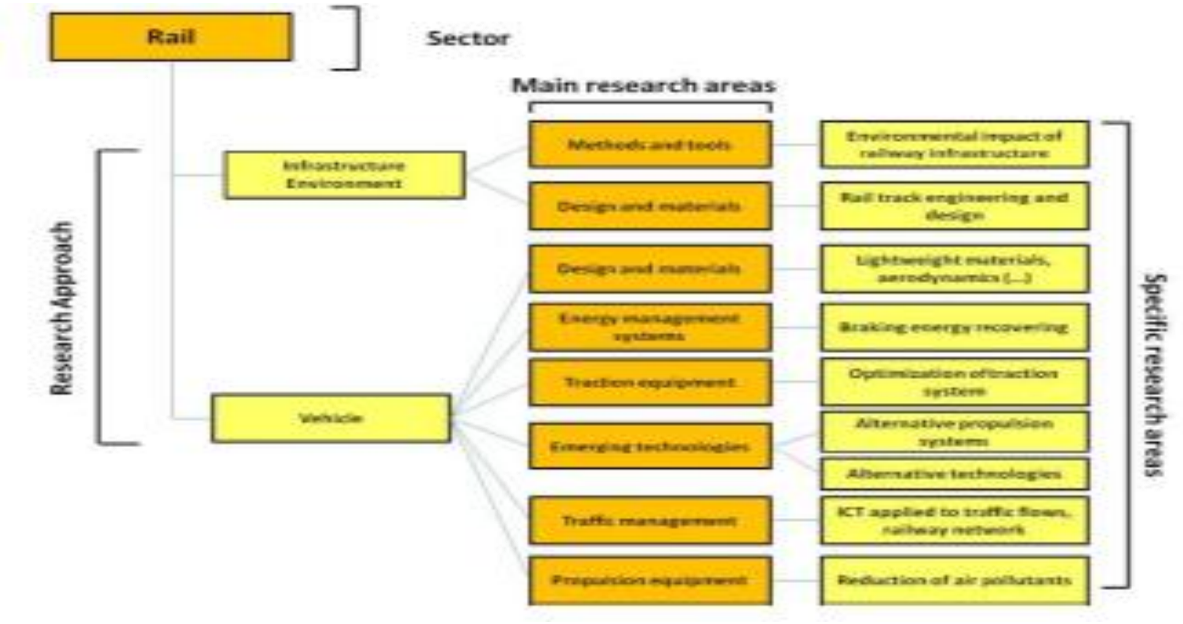


FIGURE 3: REACT SRA, RAIL SECTOR

The REACT SRA also inherited from the ETP SRAs the use of criteria and indicators to describe the research areas: they represent the means by which, through a consultation process, experts and stakeholders can express their evaluation of research areas and assign priority to them. Since the focus of the REACT SRA is primarily on carbon reduction effects, the criteria chosen to assess and classify the specific research areas are the following:

1. *Overall priority* allows a general assessment of the priority of specific research areas in terms of importance for climate-friendly transport research.
2. *Contribution to reduce GHG emissions* asks for an evaluation of how much a specific research area can be effective in reducing GHG emissions.
3. Cost-efficiency in reduction of GHG emissions that considers that considers the amount of GHG savings per financial unit: the higher is the ratio between GHG savings and costs, the higher is the criterion value.
4. Other effect evaluates the other important effects that the research in a specific field would bring together with its development, like, for example, social equity or job creation.
5. *Feasibility* evaluates the possibility of a specific research area to overcome social and/or political obstacles (e.g. it is acceptable or politically inconvenient) to its development.
6. *Research demand* indicates the timeframe of research stages, discriminating between basic, applied research and implementation stages. It considers the year 2030 as its end point.

Criteria are a fundamental part of the REACT SRA, since they represent the means by which experts involved in the consultation process (described in the next paragraph) can express their opinion and ultimately establish a priority rank for the research areas. Every criterion has been assessed by using an evaluation scale, from 1 to 5, where 1 stands for very low impact and 5 stands for very high impact. The research demand criterion is defined on a year-based scale: it was possible to indicate how much each research stage (basic, applied, implementation) is expected to last within the time horizon of 2030.

REACT SRA: ICT and Engineering

A description of the technological pillar of the SRA can be found below. The pillar is classified according to the transport modes:

Aeronautics

ACARE, the Advisory Council for Aeronautics Research in Europe, in respect of greening of air transport, defines as a challenge meeting continually rising demand whilst demonstrating a sensitivity to society's needs by reducing the environmental impact of operating, maintaining, manufacturing and disposing of aircraft and associated systems (ACARE, 2004). The related goals include the reduction of fuel consumption and CO2 emissions by 50%, the reduction of external noise by 50%, the reduction of NO_x by 80% and a reduction of the environmental impact of the manufacture, maintenance and disposal of aircraft and related products. According to ACARE SRA, all the actors involved in the Aeronautic sector have to cooperate responsibly for achieving these goals.

Both the ACARE SRA and our experts' comments agree on the following priorities for greening the transport sector.

- Airline companies have to renew their fleets with more efficient low-emission aircraft, combine routes and favour shorter stage lengths for intercontinental journeys. Also the reduction of cruise speeds can contribute, together with the reduction of circling and taxiing times in ground operations.

- As regards infrastructure, new airports have to be conceived around green standards, including the use of solar power, improved energy efficiency and minimisation of resource use (A17). Ground vehicles have to be hydrogen or electricity powered. Transportation to and from the airport and internal movement of passengers or goods (A16) have to become either all-electric or electro-magnetic; distances between terminals and runways have to be reduced: airports, in the long-term, will provide access without the use of service vehicles. Airports built close to intermodal hubs will allow a more efficient freight movement and dispatching.

- Aircraft and rotorcraft engines offer a large potential for achieving CO2, noise and other emissions reduction goals (A10)(A11)(A12). CO2 emissions are directly related to fuel consumption that can be reduced through aerodynamic improvements, weight reduction (A5) and fuel-efficient engines and systems. Novel aircraft concepts, such as adaptive structure in the airframe and Blended Wing Body (A14)(A4), can perhaps bring the technological breakthrough needed to reach the 50% CO2 reduction goal. For engines, technological solutions include both efficiency improvements on traditional jet motors and new propulsion concepts, such as the use of alternative fuels (e.g., liquid H_2, biofuels, synthetic fuels, LNG) or power sources (e.g., fuel cells)(A15). Alternative fuel power generators are expected to provide aircraft with the energy needed by the onboard systems (air conditioning, moving parts). From the point of view of non-technological improvements, Air Traffic Management systems will introduce new concepts for more efficient flight routes and flight phases (A1)(A2)(A3).

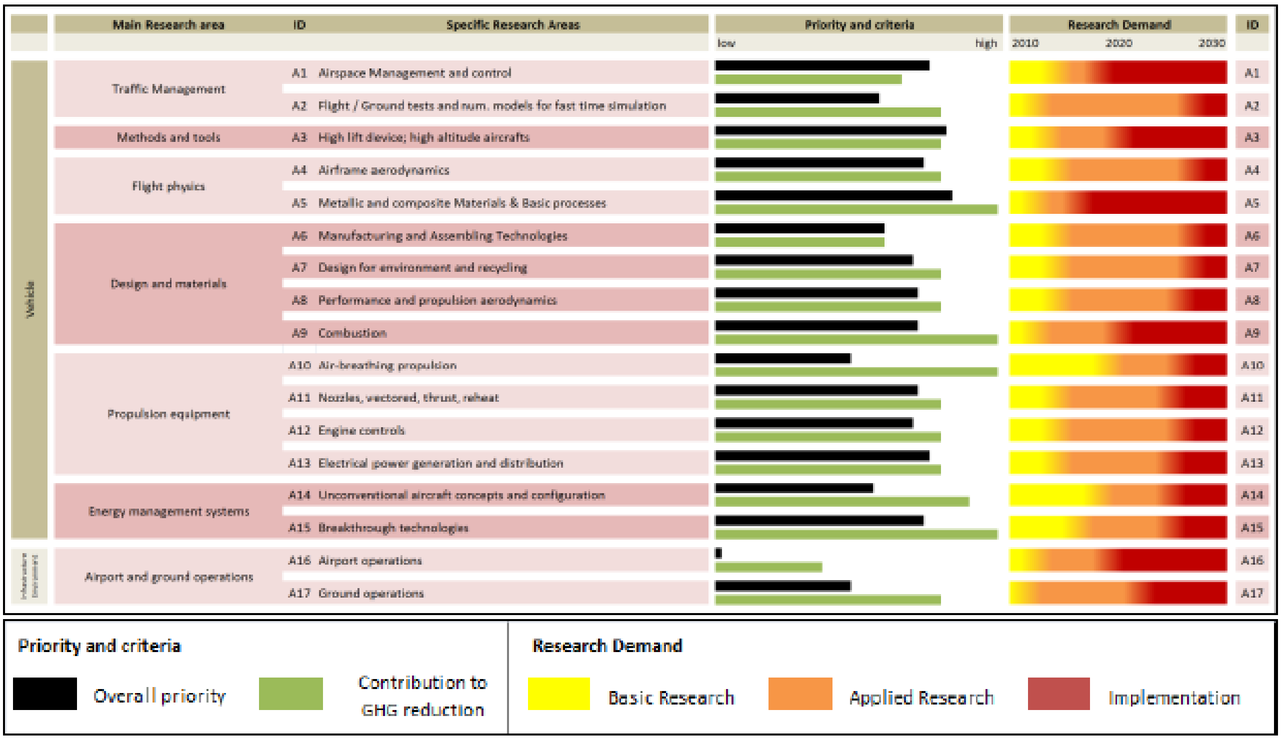


FIGURE 4: AERONAUTICS IN THE SRA

Rail

ERRAC, the *European Rail Research Advisory Council*, set up its strategic vision of research in the railway sector towards 2020 through the *Strategic Rail Research Agenda* (ERRAC, 2007). It highlights the roadmaps for research to be followed to fulfil the challenge of improved competitiveness, attractiveness, and performance of the entire rail transport mode. In particular, concerning environment and GHG emission related rail research, emphasis is given to energy efficiency, aerodynamic design and profiles, and environmentally friendly and innovative technologies such as fuel cell and levitation technology, use of solar panels for on-board services (air conditioning, lighting, pantograph raising and electric locking) and alternative propulsion systems (eco-diesels and hydrogen). Other technological improvements, especially for metro and light rail, relate to heating, ventilation and air conditioning equipment, with the goal of reducing both the costs and environmental impacts of such equipment.

Research should also concentrate on reducing weight (a modular structure can be used to reduce the weight of coaches and it can be sourced from renewable materials) and noise emissions of rolling stock and infrastructure, rail traction and energy supply, energy regeneration braking systems; particular care will be dedicated to a new design of vehicle components, using recycled materials also in refurbishment.

A special role will be played by ICT in the development of high-quality services and in implementing overall intelligent mobility concepts involving customer information for freight and passenger services, improved accessibility and availability. This would hopefully lead to a consistent modal shift, both from road and air to rail. In fact, the specific research area of *ICT applied to traffic flows and railway networks* (A18) gained the highest score in terms of overall priority: the role of traffic planning will benefit from the deployment of ICT technology and it is crucial to increase network capacity.

According to experts' evaluations, the highest potential for reducing GHG emissions is attributed to the reduction of weight and aerodynamics (A20), to the braking energy recovering systems (A21) and to alternative technologies (A22). The alternative propulsion research area (A23) has been considered as less important, maybe because the existing electric propulsion supplied with a clean energy mix would provide clean trains without the need to invest in new engines. The reduction of air pollutants has been considered low priority and low impact in reduction of GHG, probably because if a shift to electric trains happens there won't be a need to optimise old diesel engines. As regards timing, the specific research areas that most need basic research are design of lightweight materials (A20), alternative technologies (A22) and alternative propulsion systems (A23). ICT (A18), that has the highest overall priority, is entering the applied research phase and it will be full operating by 2020.

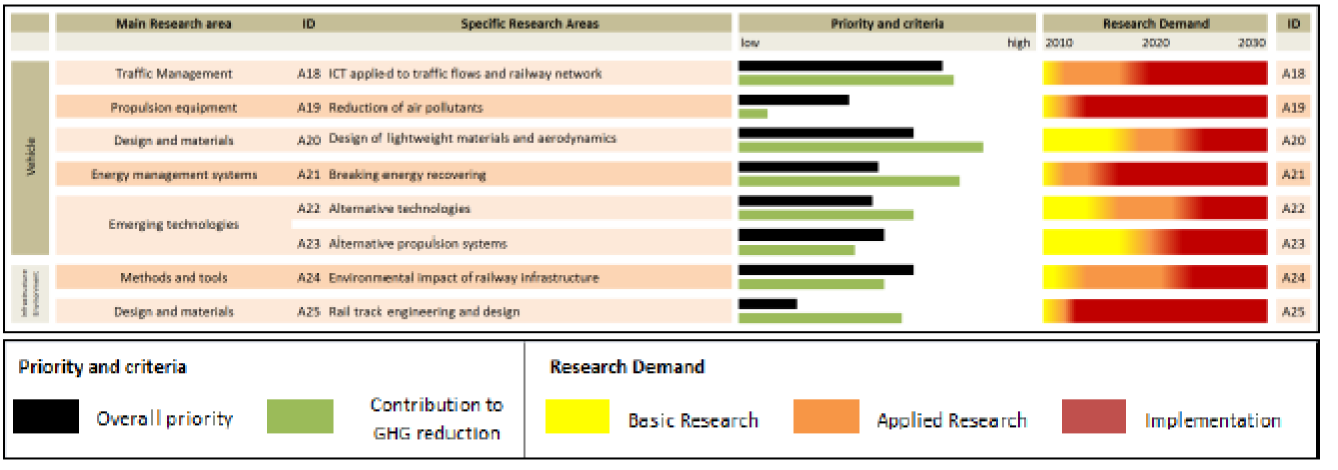


FIGURE 5: RAIL IN THE SRA

Road

The innovations addressed by ERTRAC, The European Road Transport Research Advisory Council, focus on a vision of a 50% increase in efficiency by 2030 for road transport. Innovation and research points to a broad set of challenges, among which is global climate change and environment. Decarbonisation is a social issue, therefore it has to be approached from the user's point of view: such a challenge, according to the ERTRAC roadmap, is achievable by increasing the energy efficiency of road transport activities and by decarbonising the energy they consume (ERTRAC, 2010).

As regards the pool of energy sources, research will concentrate on a variety of propulsion systems: Internal Combustion Engines (ICEs) will remain the dominant propulsion technology at least until 2030 but the use of electricity, biofuels, LPG and CNG will increase from 10% to 20%. Concerning electrical vehicles, one of the major challenges regards the storage of electricity onboard in sufficient quantities to compete with fossil fuels. Particular care, moreover, has to be put on the constructive materials and minerals, since copper, for instance, is not an unlimited resource: recycling will play an important role.

ICT will provide a consistent flow of information between driver, vehicle and infrastructure. New vehicle concepts (low weight, modularity) will intercept different mobility demands. The progressive penetration and diffusion of these innovations will be eventually fostered by regulation and environmental policies. The deployment of ICT services and of an improved network management will ensure an optimised use of the present infrastructure, meaning new roads need not be built. For both goods and passengers, multi modal hubs will reduce bottlenecks and ensure a global optimised integration of transport modes. Improvements in urban mobility are needed: innovative business mobility solutions, intelligent route planning tools, efficient transfers and deliveries of goods and people, between modes and networks. ICT and a better knowledge of transport demand will play a major role in these developments.

The Expert Consultation mostly confirmed the priorities enhanced by the ERTRAC SRA. In particular, what emerges as overall very important, is research on non-conventional hybrid systems (A32), full electrical vehicles (A33) and fuel cell technology (A38). The lowest priorities, instead, have been attributed to biomass-derived fuels (A28) and new combustion concepts (A27). The areas with the highest feasibility are those mostly related with ICE technologies and fossil fuels: it is not hard to invest money into something that is already widespread. Most of the specific research areas will be ready for implementation by 2020. Basic research is mostly needed by A31, A32 and A38, hybrids and fuel cells.

FIGURE 6: ROAD IN THE SRA

Water

Work on low-emission technologies in the shipping world could eventually lead to the “zero emission” vessel, as and when technologies become available. The International Maritime Organization (IMO) is addressing the challenge to reduce emissions now, by working on possible new regulations, using instruments such as the Energy Efficiency Design Index (EEDI). This will need to operate within a framework of future carbon trading schemes that address the real cost of carbon to the environment (Waterborne TP, 2011). Regulating ship emissions requires a comprehensive knowledge of current fuel consumption and emissions, an understanding of their impact on atmospheric composition and climate, and projections of potential future evolutions and mitigation options (Eyring et al., 2010).

In the consultation, the highest overall priorities were given to the research areas of Port operations (A51), followed by Alternative propulsion systems (A48), and Innovative and hydrodynamic vessel concepts (A49). The first ranked is “Port operations”; this specific research area has the most immediate predicted implementation phase, starting around 2013. The second ranked, Alternative propulsion systems (A48) is included in the main research area “Propulsion equipment”. Applied research in this specific research area will continue to 2020 with the start of the predicted implementation phase. Also, this specific research area has high impact on further development on water transport with great expectation in experts’ opinions. The third ranked is in the main research area of “Design and materials”. This area has the shortest time period in applied research of around two years, with the start of implementation projected before 2016. The third ranked specific research is “Shipping operations and training” according to the overall priority, GHG reduction, cost efficiency, other effects and feasibility. However, applied research will require a long time period, from ten years and 2020.

Basic research requires a very short time (1-2 years) for all the specific research areas, except “Innovative and hydrodynamic vessel concepts” (3 years). The implementation phase of “Vehicle emission reduction systems”, “Innovative hydrodynamic vessel concepts”, “Manufacturing and maintenance” and “Accident prevention technologies” is starting soon.

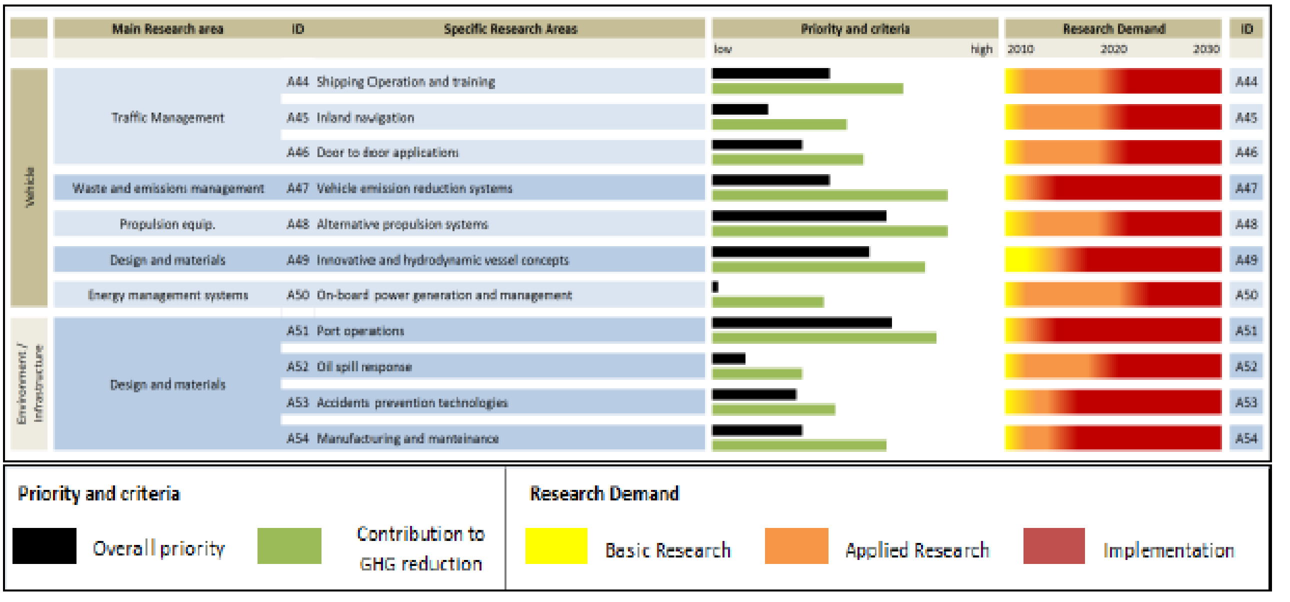


FIGURE 7: WATER IN THE SRA

Planning, social sciences and economy

Technology alone will be insufficient to achieve the necessary reductions in carbon emissions to effectively tackle climate change (e.g., House of Lords, 2011; EC, 2011). This is for two reasons: firstly, the benefit of technical measures to reduce vehicle emissions and noise has often been outstripped by the increase in vehicle numbers, engine size, travel frequency and trip length (EC, 2001). Secondly, the timescale on which technological versus non-technical measures can be implemented may differ significantly (see below). It is therefore increasingly recognised that achieving sustainable mobility requires an integrated approach comprising planning measures, behaviour change, industrial and economic measures, along with technological advances (e.g., Whitmarsh et al., 2009b).

Still, the major part of today's research funding in the EU and the member states is allocated to technology-related research (see REACT Deliverable 3.3). Several stakeholders consider this fact a problem: one NGO stakeholder we interviewed argued that there is a mismatch between a technological research focus and many effective ways of saving CO2 in the transport sector, e.g. in the fields of policy and economic measures. This interviewee sees different reasons for this: the organisation of research funding, the thematic responsibilities of the DGs tending to neglect cross-cutting issues, political taboos and a general bias towards technology in research funding.

The following sub-sections deal with non-technical approaches to achieving low-carbon transport, grouped into Planning and systems (5.1), Social and behavioural (5.2), and Industry and economy (5.3).

Planning and Systems

The SRA section "planning and systems" comprises research areas dealing with systematic aspects of transport infrastructure, and with policies and planning for a reduction of transport or for a modal shift. While the technological research areas described in chapter 5 mostly focus on the particular carbon reduction for vehicles, these specific research areas are aiming at a carbon reduction on the level of the whole transport system – by raising the share of lower-carbon modes of transport, by reducing the distances travelled, for example. The planning and systems research areas mostly address administrations and other political decision makers, in contrast to technology research, which mostly addresses industry.

In the consultation, the highest overall priorities were given to the research areas of Non-Motorised Mobility Planning (A59), followed by Integration of Spatial, Urban and Transport Planning (A55), Optimisation of Logistics (A64), and Public Transport Planning (A60).

Stakeholder interviews underlined the importance of this main SRA sector. One interviewee argued that planning is a base on to which other successful measures can be applied. The importance of this area is also based on the long lifetime of spatial planning and transport infrastructures. A general problem that research could focus on is the political constraints which often obstruct a coherent implementation of measures. Another stakeholder pointed out the importance of integrated planning for a better connection of the different modes, allowing for a modal shift towards public transport or walking and cycling. The importance of research on restrictive policies and planning for road transport and supportive planning for public transport (like the installation of bus lanes) and non-motorised transport (like bike-rental systems) was also mentioned.

Regarding logistics systems, EIRAC (European Intermodal Research Advisory Council) has selected research priorities. The priority relevant for this planning and systems section is the interoperability between modes, where research should focus on how to agree on the design features of a standard loading unit for Europe.

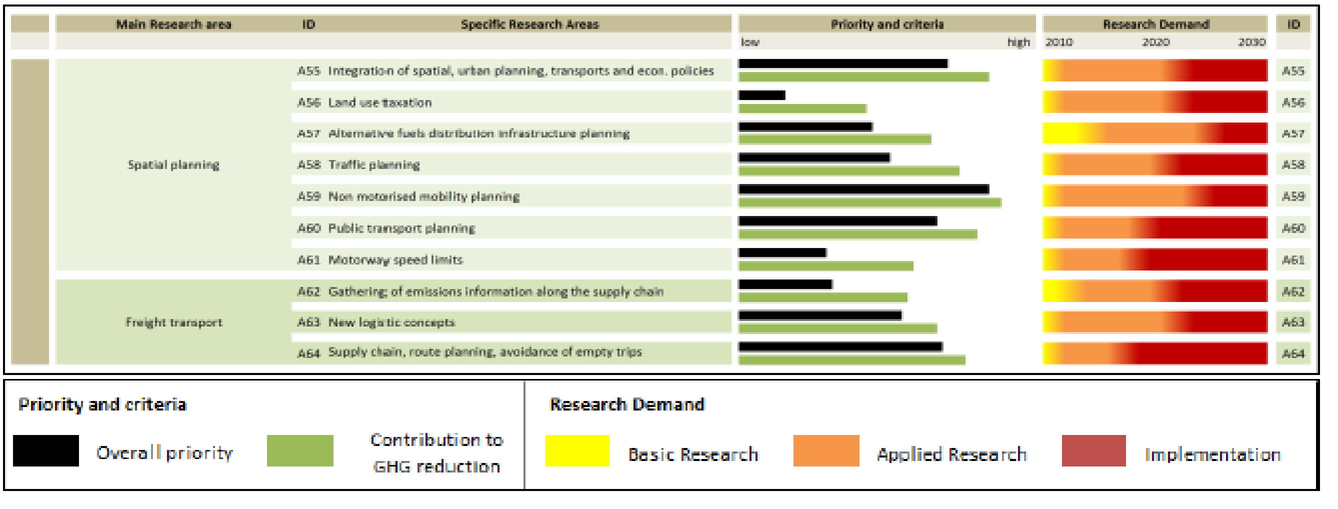


FIGURE 8:PLANNING AND SYSTEMS

Social and behavioural measures

Within transport policy, a distinction is often made between 'hard' (infrastructural, planning) and 'soft' (information, incentives, etc.) measures (e.g., House of Lords, 2011). In general, both are required in order to change transport behaviour, but recent years have seen increased interest in 'soft' measures because of they are low-cost and can produce immediate effects. In contrast, planning and many technological changes are likely to have more effect in the medium to long term (e.g., Köhler et al., 2010; House of Lords, 2011). This timescale issue was emphasised in our expert interviews. For example, one UK interviewee stressed the need in the short-term to implement social and behavioural measures (e.g., car sharing, road charging) to reduce vehicle kilometres, in order to achieve national carbon emission targets.

One NGO-interviewee pointed out the importance of research on specific conditions of behaviour change, such as the change of mobility culture and image of different modes of transport, and research on effects of different behaviour change measures, like education, campaigning, incentives or fiscal measures. Another expert also stressed the importance of research on specific impacts of political measures: decisions on taxation could be made on a more transparent base, if detailed studies on the

behavioural effects of fiscal measures would be available. Several social and behavioural measures are listed in the table below. These include economic, informational, service-focussed, and technological measures to achieve more efficient behaviour, modal shift, and/or reduced demand. The expert consultation results reveal that priorities for R&D within the behavioural/social domain include: shifting from products to services (i.e., car/bike-sharing, A65), workplace/school travel planning (A72), eco-driving (A73) and education (A71). Motorway pricing (A68) was given the lowest priority, and was seen as offering fewer co-benefits than other measures. Economic policies (e.g., fuel taxation, congestion charging) are rated as somewhat less feasible than other measures, perhaps reflecting their lower public acceptability pre-implementation (e.g., Whitmarsh et al., 2010). All areas were considered to reach full implementation in the next few years.

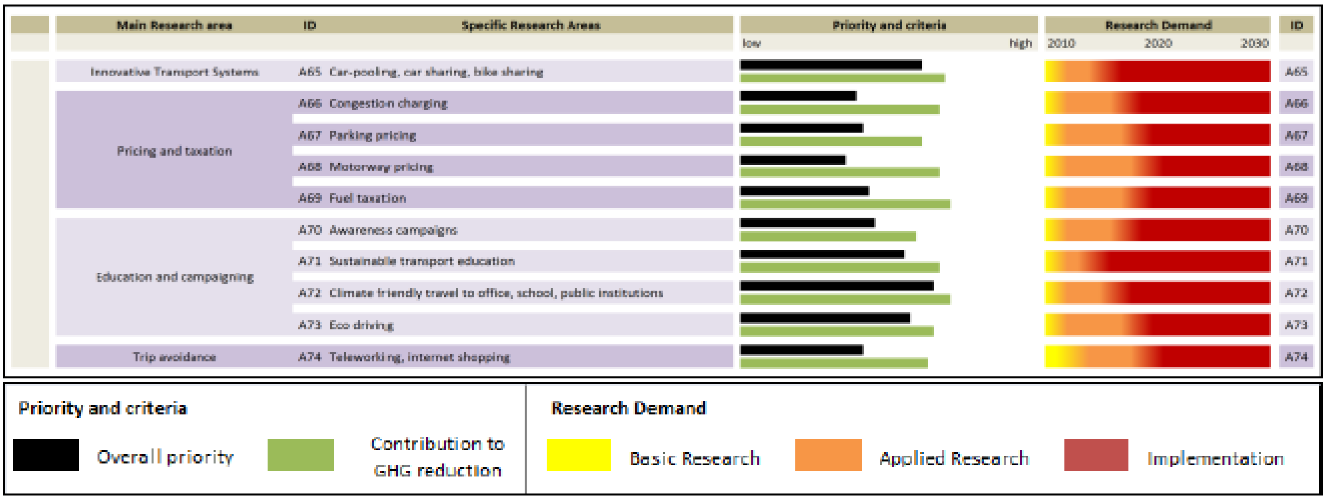


FIGURE 9: SOCIAL AND BEHAVIOURAL MEASURES

Industry and Economy

While the research areas in the field “Social and Behavioural measures” focus on the effects of measures or political instruments on the mobility decisions of the users of means of transport, the section “Industry and Economy” deals with the impacts of measures and instruments on business actors, like vehicle manufacturers or transport service providers. Since these measures may affect the business models and the margins of these companies, lobbying is a crucial factor in this field of transport policies, as one NGO-interviewee pointed out. According to the review of EU-funded research projects (REACT D3.3) and the comments of interviewees, research funding in this field is relatively low. According to the opinion of one interviewee, this may also be due to the structure of research funding in the European Commission: the thematic DGs would rather not engage in policy research in this field to avoid disagreement. Still, as the experts mentioned, there is a need for studies on the specific effects of the different types of measures and policy instruments, which can inform decision makers about the most effective regulation. The highest overall priority was given to the specific research area of European Regulation on Emission Performance Standards (A75), while the other areas received lower ratings.

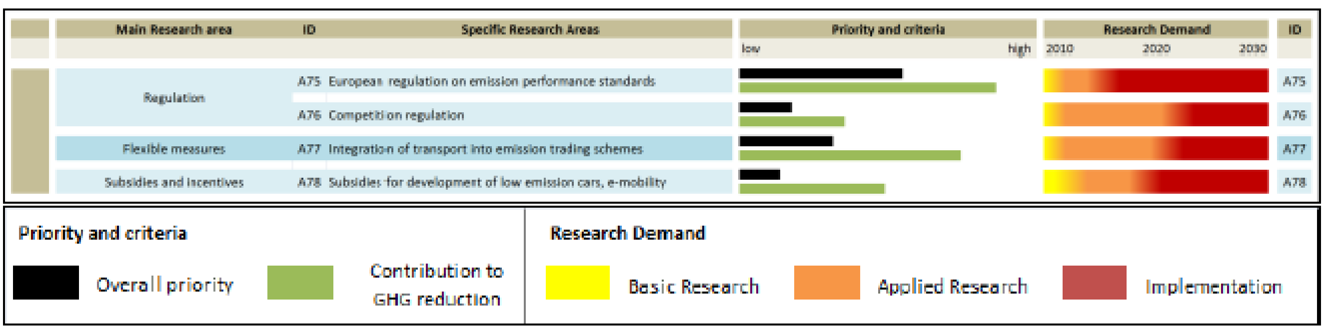


FIGURE 10 : INDUSTRY AND ECONOMY

Policy recommendations

As an important premise, it was underlined that research is, by definition, exploratory and as such it may fail. This is obviously conflicting with market players' interests and needs to be addressed by high level policy makers who can steer funding schemes on the merit of research needs, rather than on the basis of market demand. It is also market players' responsibility to cross out the still enduring resistances about the role of anthropogenic GHG emissions towards climate change: consistent results have widely demonstrated the responsibility of CO2 and its role in global temperature increase. Most of the interviewees agree on the fact that resistances largely depend on economic interests. In order to produce a change in society a significant road is to continue on communicating evidences and to internalize market players as primary actors in raising the change. As the White Paper suggests, "EU research needs to address the full cycle of research, innovation and deployment in an integrated way through focusing on the most promising technologies and bringing together all actors involved".

In addition, a general and big challenge, is to educate society. Until recently, the dominant model was one of infinite growth, production and consumption. This idea has to change in people's mind, and environmental values fostered, and habits changed. An exhaustive effort should be carried out, informing, educating and teaching the society on new and more sustainable ways of life. This emphasises the value and urgency of non technological measures geared towards climate-friendly transport: "Growing out of oil' will not be possible relying on a single technological solution. It requires a new concept of mobility, supported by a cluster of new technologies as well as more sustainable behaviour" (The White Paper on Transports).

As regards the role of EU policy for research, many experts underlined the gap existing between EU-funded research is and the National political agendas. A possible solution to shorten this gap would the strengthening of the role of the DG RTD as an independent research broker for policy research, with an own research agenda on policy research, instead of mostly conducting technological research.

Besides this, the role of EU in establishing roadmaps and orientating the market is essential. For instance, the automotive sector, that is one of the largest private investor in R&D in Europe, would have little interest in promoting the shift towards non fossil propulsion systems: national governments and EU are a key factor for a decarbonised transport sector. One of European Public Private Partnerships of the European Economic Recovery Plan, announced by the European Commission in 2008, is the Green Cars Initiative whose objective is to support R&D on technologies and infrastructures that are essential for achieving breakthroughs in the use of renewable and non-polluting energy sources, safety and traffic fluidity (EC, 2008).

In conclusion, people and politicians should get used to several parallel solutions instead of a "silver bullet" solution: it is a mix of both technological improvements and social changes that would make reduction of GHG possible. Also European competition needs not to focus on just one technology but carry on a basket of solutions without giving Asiatic or fast developing countries monopolies over strategic technological devices or resources. It has been highlighted, moreover, that among the several possible solutions, the most expensive are often the most efficient for GHG reduction, for instance phasing out dirty energy production or redesigning cities. Clearly, costs make such solutions less preferable in a difficult crisis period. .

Some experts also state that although engineers often agree on those long-term sounding solutions, politicians are mainly advised by economists, who fail to see the long term benefits of improving, for instance, rail infrastructure, and concentrate on the relevant short term up from costs instead.

Furthermore, European policy makers have to consider the society's perspective, in the sense that they have to be aware of societal implications of any option: for instance, a switch to Electric Vehicles, may imply a mass unemployment of car mechanics/car maintenance sector which will of course will have to come with a greening of the electricity supply; a not fully responsible promotion of biofuels may cause serious and undesired effects of people's food provision and quality of life.

3.2 Supporting the Public Funded Initiatives

To achieve the objective of supporting the public funded initiatives, three main tasks were carried out: (a) Mapping existing initiatives and programmes in the area of climate-friendly transport; (b) Benchmarking National funding procedures in Europe and identifying 'best practice', and (c) Developing a common set of indicators for carbon impact of transport. The two full databases (i.e., both projects and funding schemes) can be found in the REACT CIP at:
http://www.react-transport.eu/index.php?option=com_docman&task=cat_view&gid=59&Itemid=61&lang=en

a) Mapping funding schemes and European Funded projects

The mapping process consisted of two elements: (a) Identification and categorisation of EC-funded research programs in climate-friendly transport projects (6th and 7th Framework programs) and (b) Identification and categorisation of national and regional initiatives in climate-friendly transport within the 27 Member and Associated States. In order to capture relevant information on future initiatives, we also monitored activity of forthcoming projects. This analysis involved documentary and website searches, and supplemented with (where necessary) contact with National Contact Points (NCPs).
Two databases were designed to map (a) EC projects and (b) EC and national funding initiatives, identifying important features and categories in order to describe these projects and funding initiatives. The design of these databases went through various stages until led to its final design and then populated through documentary and online searches (including Cordis, TRKC and national websites).

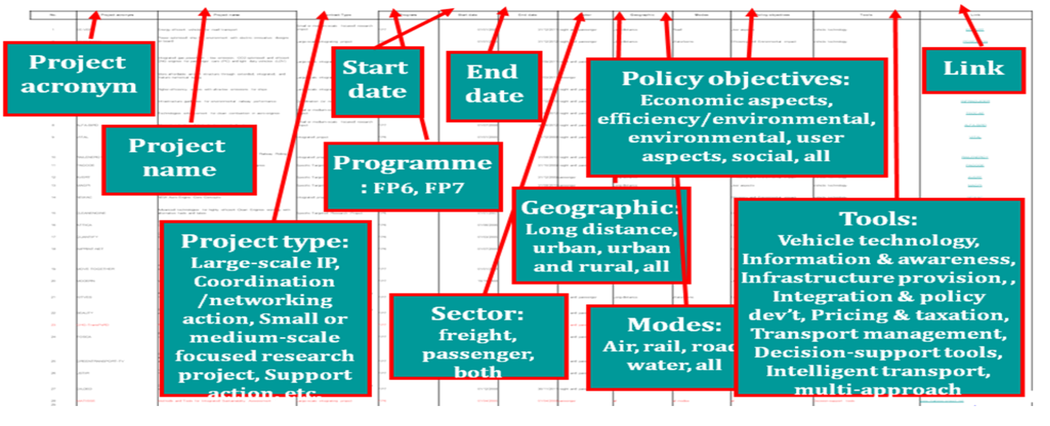


FIGURE 11: EARLY DESIGN OF EC PROJECTS DATABASE

Main Field	Sector	Studies	Existing initiatives and projects	FP6	FP7	Total	Basic Resea… to
	Rail	Impacts of frontal winds and lateral atmospheric turbolences on train aerodynamics, airframe, friction-reducing surface coatings (nanotechnology) Paintless a/c, reduced mass with fibre reinforced polymers, sandwich structure or aluminium car bodies, affordable and attractive interoperable rolling stock	CORFAT (FP7), COMPAIR (FP7), AEROTRAIN (FP7), SAFERAIL (FP7), EXCITING (FP7), MODTRAIN (FP6), GLORIA (FP6), WIDEM (FP6), RAILCOM (FP6), CREAM (FP6), EUDDPLUS (FP6), SILENCE (FP6), INTERGAUGE (FP6), DE-LIGHT TRANSPORT (FP6)	Project cost: 86.91 mil ; Project funding: 47 368 000 ; +GLORIA	Project cost: 20.01 mil ; Project funding: 13.48 mil ;	Project cost: 106.92 mil ; Project funding: 60 848 000 ; + GLORIA	
		Braking energy recovering by heating a fluid or supercapacitors in fixed installation or on board, energy storage by batteries	MODURBAN (FP6), MODBRAKE (FP6)	Project cost: 24.36 mil ; Project funding: 13.1 mil ;		Project cost: 24.36 mil ; Project funding: 13.1 mil ;	
		Optimisation of traction technologies with Insulated Gate Bipolar Transistors (IGBT) and HTSC transforme, transversal flux motors	BRAVO (FP6), ISTU (FP6)	Project cost: 19.27 mil ; Project funding: 5 376 000 ;		Project cost: 19.27 mil ; Project funding: 5 376 000 ;	
		Fuel cell and levitation technology, use of solar panels for on board services (air conditioning, lighting, pantograph raising and electric locking),	PANTOTRAIN (FP7), TIFFE (FP7), EUROPAC (FP6), CATIEMON (FP6), FELICITAS (FP6)	Project cost: 23.2 mil ; Project funding: 13.74 mil ;	Project cost: 7.23 mil ; Project funding: 4.21 mil ;	Project cost: 30.43 mil ; Project funding: 17.95 mil ;	
		Hydrogen engine, natural gas engine or turbines, electrically-assisted internal combustion engines	2020 INTERFACE (FP7), INGAS (FP7), LESSCCV (FP7), ECOQUEST (FP7), HI-CEPS (FP6), GREEN (FP6)	Project cost: 40.71 mil ; Project funding: 21.83 mil ;	Project cost: 32.46 mil ; Project funding: 19.37 mil ;	Project cost: 73.17 mil ; Project funding: 41.2 mil ;	
		energy efficient solutions	INFRAGUIDER (FP7), RAILENERGY (FP6)	Project cost: 14.66 mil ; Project funding: 8 mil ;	Project cost: 1.14 mil ; Project funding: 1.14 mil ;	Project cost: 15.8 mil ; Project funding: 9.14 mil ;	
ogy			INTERAIL (FP7), ALARP (FP7), INESS (FP7), QUIESST (FP7), TURNOUTS				

FIGURE 12:MODIFIED DESIGN OF EC PROJECTS DATABASE

This includes project funding in Euro for all FP6 and FP7 projects, and is now re-structured and categorised according to the Strategic Research Agenda (SRA) categories.

Basic Information									Focus of					
Program Name	Program acronym	Link	Origin	Type of program	Budget	Start date	End date	What is the remit of the scheme (e.g., only transport)?	Sector	Geographic	Modes	Policy objectives	Tools	Main research area
UKERC	UKERC	UKERC	UK	National Research program				Energy						Both
EPSRC - Responsive mode (open call)	/	EPSRC (Open)	UK	National Research Program				Engineering	freight and passenger		all modes		Multi approach	Technical/engineeri research
ESRC		ESRC	UK	National Research program										
The Climate Changes Spatial Planning	CcSP	CcSP	Netherlands	BSIK National Research Program		2004	2011	Environment	freight and passenger	Long-distance	all modes	Environmental aspects	Land-use planning	
TRANSUMO	/	TRANSUMO	Netherlands	BSIK National Research Program		2007	/		freight and passenger	Long-distance	all modes	Efficiency and Environmental impact	Integration and policy development	
Global Air Pollution and Climate Change	NRP	NRP	Netherlands	National Research Program		/	/	Environment	freight and passenger	Long-distance	all modes			
Science for a Sustainable Development	SSD	SSD	Belgium	National Research Program	61m Euro	2005	2012	Sustainability	freight and passenger	Regional	all modes	Efficiency and Environmental impact	Multi approach	
Transport and Mobility		TR	Belgium		8.306.912,02 EUR	1991	1995	Transport						
Sustainable mobility		SM	Belgium		7.762.661,78 EUR	1996	2000	Transport						
Sustainable production and consumption		SPP	Belgium		21.938.576,94 EUR	2000	2005	Travel behaviour						
French transport research programme PREDIT-4	PREDIT-4	Predit	French	National Research Program	+400 M€	2008	2012	All topics						
National loan		Ambafrance	French											
Research Projects of National Relevance	PRIN	PRIN	Italy	National Research Program				All topics						
Industry 2015 - Sustainable Mobility	Industry 2015	Industry2015	Italy	National Research Program	180 mEUR			Engineering	freight		all modes	Economic aspects	Intelligent Transport System	Technical/engineeri research
Danish Council for Strategic Research		DCSR	Denmark	National Research Program	10m Euro total (4m for transport)			Transport						

FIGURE 13: FINAL DESIGN OF FUNDING INITIATIVES DATABASE

The project database work was coordinated with the Strategic Research Agenda (SRA) by mapping all EC projects onto the SRA research area categories. This enabled us to identify where research areas have been the focus of research activities to date, and where gaps exist where research needs to be conducted to address the EU's research needs. This task included elaboration of 374 FP6 projects and 309 FP7 projects – in total 683 projects – in the area of climate-friendly transport. Consistent with the main division within the SRA, projects were grouped into (a) Engineering and Information Technology, and (b) Planning, Social Sciences and Economics.

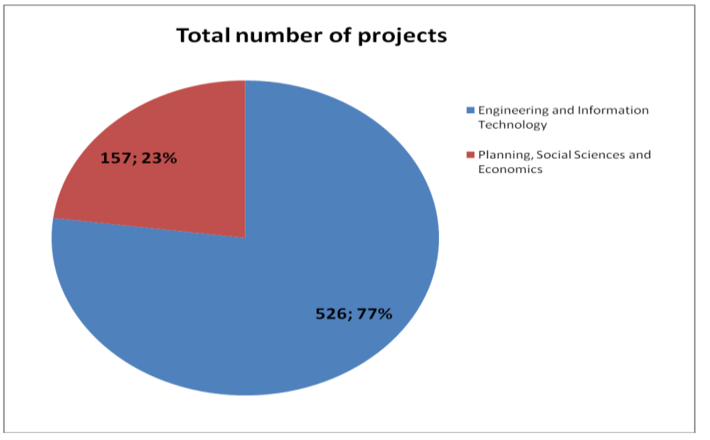


FIGURE 14: FP6 & 7 PROJECTS IN SRA SECTORS

As shown in Figure 14, there is an imbalance in the proportion of projects funded within these two broad areas, with the former (technical) fields receiving far more funding than the latter (social) fields. In relation to amount of funding, Engineering and IT received 2,436m Euro, while Planning, Social and Economic Sciences received only 448m Euro.

Within Engineering and Information Technology, distribution of the relevant projects to transport modes is given in Figure 7. This shows a clear preference for Aeronautics research. Analysis of the amount of funding provided shows that Aeronautics research received 52% (1,276m Euro) of EC climate-friendly R&D engineering funding.

Within engineering/ICT, there is also a general preference for research on Vehicle Technologies, whereas Infrastructure/Environment and Driver research receives substantially less. Within Road transport, Vehicle

research accounts for 69% of R&D; in Rail it is 72%; in Water it rises to 90%; and for Aeronautics, it is as high as 96%.

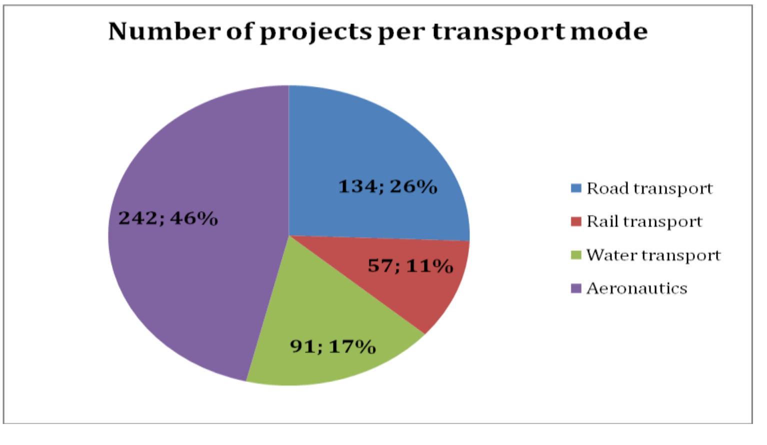


FIGURE 15: FP6 & FP7 PROJECTS CATEGORISED BY TRANSPORT MODE

Figure 16 shows the distribution of projects on climate-friendly transport within Planning, Social Sciences & Economics. This shows that planning/systems research is the most popular approach funded. In respect of the amount of funding received, Planning & Systems received 304m Euro, which reflects 68% of funding for non-technical research.

The main areas of research funded within planning, social sciences and economics are on ‘Integration of spatial planning, urban planning, transportation planning and economic policies’ (140m Euro) and ‘Awareness campaigns’ (78m Euro)

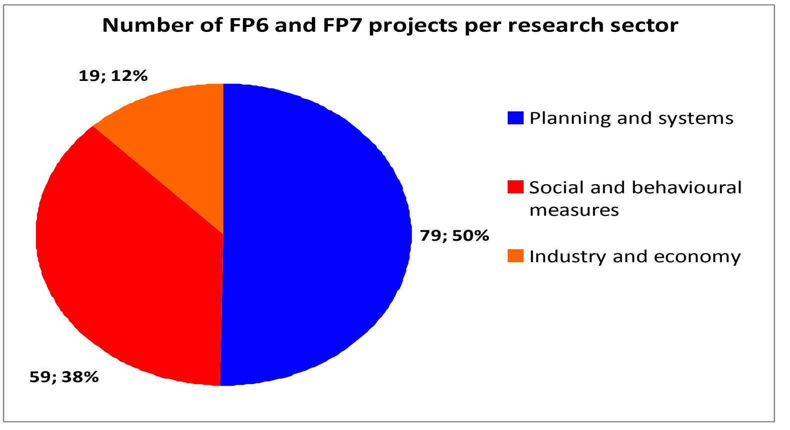


FIGURE 16: DISTRIBUTION OF FP6 AND FP7 PROJECTS ACCORDING TO THE RESEARCH SECTOR

Comparative analysis was conducted as part of this activity to link the SRA Expert Consultation findings with the EC-funded projects analysis. For this comparative analysis, we calculated an average score for experts' ranks (mean of Topsis and AHP ranks) and compared this to the amount of funding provided for each SRA specific area. In summary, we found that there are significant areas of disparity between expert priorities for climate-friendly transport R&D and where EC funding has focussed during FP6 and FP7. Figure 9, below, shows the difference in the ranking between EC project funding and expert priorities.
This analysis showed very clearly that, in general, social science research has been under-funded relative to experts' assessment of what should be funded. This disparity in terms of a preference for technical research has been noted previously (e.g., Grubler & Riahi, 2010). Similarly, road transport has tended to be under-funded, relative to experts' assessment. By contrast, it appears that Aeronautic research has been somewhat over-funded, compared to experts' judgement of priorities for transport R&D.
The examination of the particular topics, on which the two rankings diverged, showed that the topics with the largest differences were: non-conventional hybrid systems, vehicle energy management, hydrogen production from non-fossil sources, intelligent transport systems, and airspace management and control

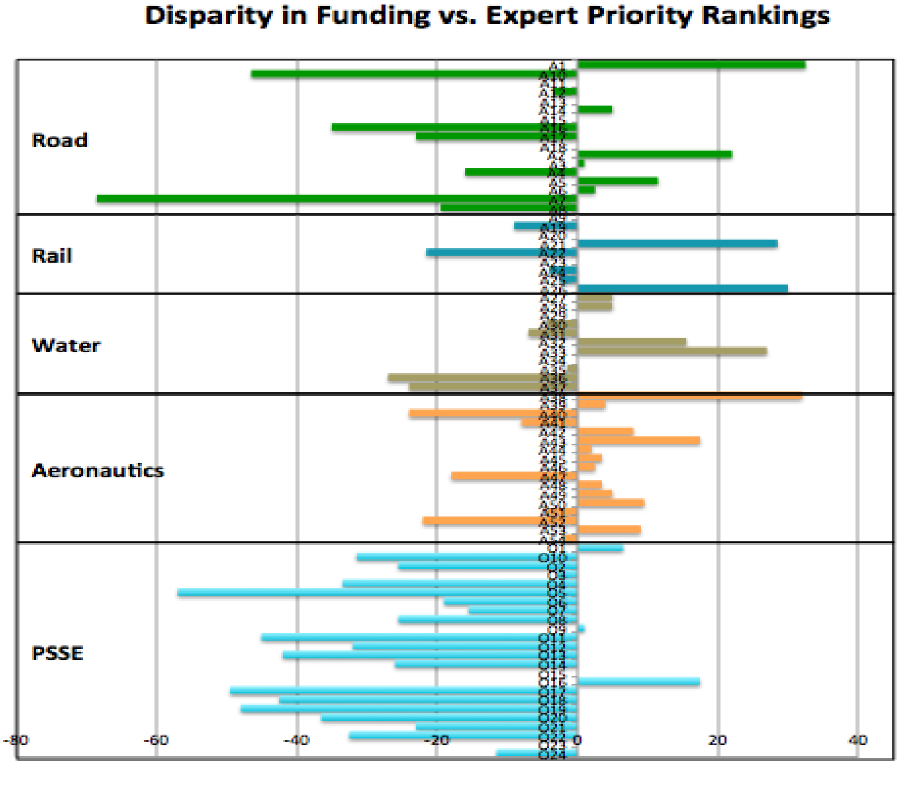


FIGURE 17: DIFFERENCE IN TWO RANKING MEASURES

(a) expert priorities for climate-friendly R&D and (b) amount of EC project funding during FP6 and FP7. Note: Positive figures indicate funding is greater than experts' ranking; negative figures show where funding is lower than experts' rankings.

b) Benchmarking funding procedures

The aim of this research was to examine funding processes and procedures across Europe, focussing on the area of low-carbon transport research. The following questions were addressed:

- What funding schemes exist at European and national levels?
- What (social, economic, environmental) objectives are prioritised in transport funding in different EU countries?
- What type of research (e.g., technological, social) is the focus of low-carbon transport research, and how does this vary across Europe?
- How are priorities and funding criteria identified?
- To what extent is low-carbon transport research across Europe coordinated (i.e., where are synergies, overlaps, and gaps)?
- What procedures exist to ensure the quality and utility of research, how might these be benchmarked, and what examples of 'best practice' exist?

In order to address these questions, a major review of European funding schemes was conducted, utilising a mixed-methods approach. Documentary analysis was complemented by a series of key informant interviews, citizen deliberative focus groups, expert questionnaires, and a targeted call for information.

(a) *Documentary analysis and data sources*

Key policy documents relating to low-carbon transport and research funding were identified from Internet and literature searches. In addition, basic statistics on funding and R&D were gathered from several sources, including the Transport Research Knowledge Centre (TRKC), ERAWATCH, European Science Foundation, Cordis and national websites.

(b) *Interviews, focus groups, survey, and email contact*

Telephone interviews, an email survey, workshops and questionnaires were conducted during 2010 with representative of: academia, R&D; businesses; policy, governmental and non-governmental institutions (NCPs, National agencies for environmental protection, National ministries, National statistical offices, National research funders/ councils, etc.); and citizens. These data collection methods elicited details of extant funding schemes in the relevant country/region, and – where possible – identified how these schemes are developed, as well as respondents' experiences and attitudes to funding low-carbon transport research.

In addition, a survey of transport experts and (UK) citizens was conducted, along with deliberative focus groups with UK citizens, to provide further insights into perspectives of different European groups on low-carbon transport issues and priorities for future transport.

(c) *Quantitative and qualitative data analyses*

Basic descriptive statistics were used to summarise the quantitative data on national R&D (obtained from TRKC, ERAWATCH, and OECD) and to characterise and categorise the funding schemes listed within the funding database. Content analyses of relevant documentary and online resources, and of interviews, emails and discussion fora responses, were conducted to identify key themes and to answer our guiding questions.

To complement the breadth offered by the quantitative analysis, we also provide more in-depth qualitative analysis of funding schemes across Europe, by examining case studies of a range of countries that reflect diverse geographical, political and economic conditions. The rationale for this approach was that it is not feasible given the limited timeframe and resources to provide a detailed analysis of all European countries and regions in respect of how they develop, manage and evaluate their funding agendas and procedures.

(d) *Benchmarking*

In order to identify 'best practice' in funding low-carbon transport research, it was necessary to define what could be considered desirable characteristics and procedures. This was done through a combination of 'bottom-up' (i.e., eliciting and applying criteria from stakeholders) and 'top-down' (i.e., applying pre-defined, published criteria). Both approaches are valuable – the latter more reflective of scientific opinion and/or institutional conventions, and the former a more diverse, socially-robust set of perspectives. In relation to bottom-up identification of criteria, these emerged from data collected via stakeholder interviews, emails, surveys and workshops (b, above). In relation to top-down criteria for evaluating funding schemes, we drew on the academic literatures on science and technology studies (STS), and research and policy assessment, as well as available published criteria within the research funding community. One of the most relevant existing frameworks for identifying criteria and procedures is Integrated Sustainability Assessment (ISA), since it has recently been applied to sustainable transport policy and research. ISA represents a fundamentally holistic and participatory approach to sustainability assessment of policy and research and aims to achieve integration along a number of dimensions. These include integration of: multiple sustainability values and principles, diverse forms of knowledge and expertise, different geographical and temporal scales, quantitative and qualitative data and methods, learning and reflexivity, and proposal design and assessment.

A summary of the main results is presented below:

What funding schemes exist at EU and MS/AS levels?

Analysis of the database indicates that there is great variety across Europe in respect of availability and focus of funding for low-carbon research. In some countries, such as Germany, Sweden, Austria, Switzerland and the UK, there are many available schemes which cover a range of different priorities and approaches/disciplines. This disparity in number of schemes is illustrated in Figure17.

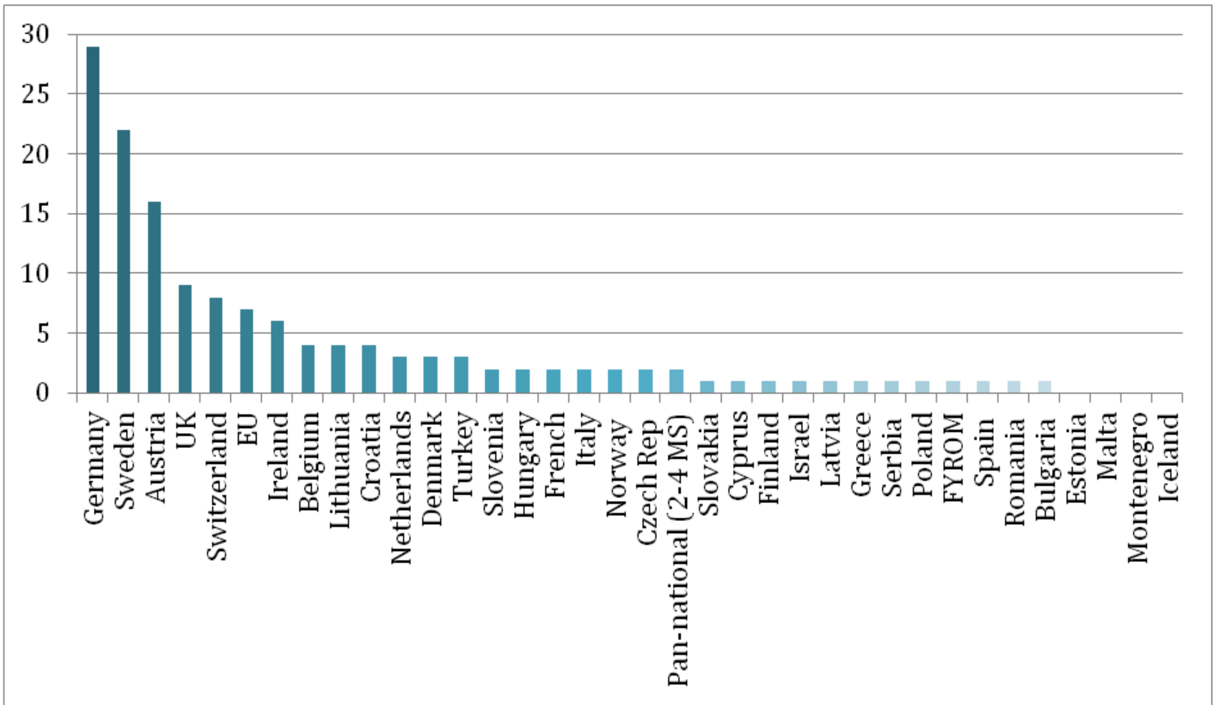


FIGURE 18:TOTAL NUMBER OF NATIONAL AND EU-LEVEL FUNDING SCHEMES ON LOW-CARBON TRANSPORT RESEARCH.

Note: Despite several requests, we have not received information about funding schemes in Bosnia, Portugal or Albania, so these countries are not shown in the figure.

What objectives are prioritised in transport funding in different EU countries?
Analysis of European, MS and AS research agendas suggests there are broadly consistent priorities in transport funding, namely reducing environmental impact, fostering economic growth and competitiveness, and improving safety. Environment, including carbon emissions, is a relatively important concern for most countries, being prioritised by around 30% of schemes .

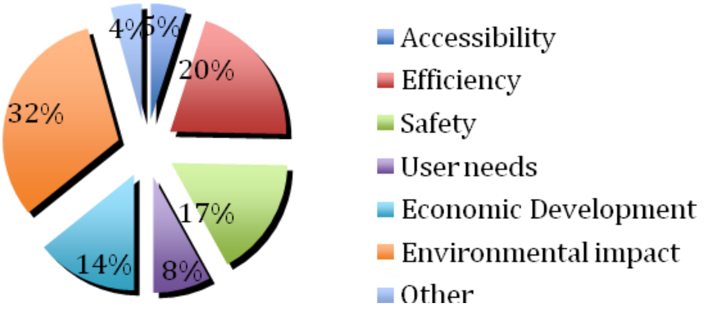


FIGURE 19: PRIORITIES OF NATIONAL AND EU-LEVEL FUNDING SCHEMES FOR TRANSPORT AND ENERGY RESEARCH

Note: Based on analysis of 69 funding schemes (for which information on objectives was available).

What type of research is the focus of low-carbon transport research, and how does this vary across Europe?
Analysis of funding scheme priorities showed a slight preference for technological over social research , but our primary research found both transport experts and citizens consider the most important priorities for sustainable transport to be modal shift and reduced demand measures This appears to reinforce the

imbalance in funding which has been noted previously. Most schemes also support a combination of basic and applied research.

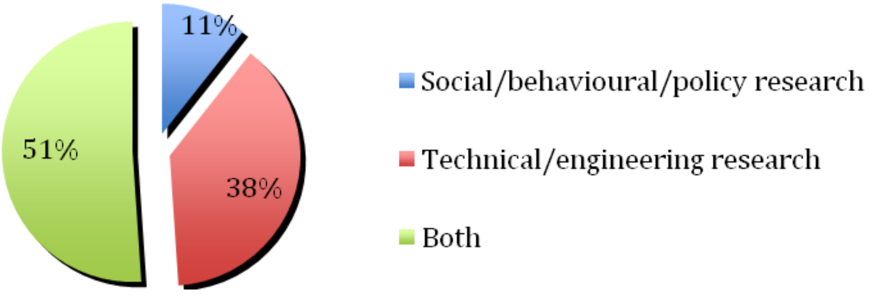


FIGURE 20: RESEARCH APPROACH SUPPORTED BY FUNDING SCHEMES FOR TRANSPORT AND ENERGY RESEARCH

Note: Based on analysis of 47 funding schemes (for which information on approach was available

How are priorities and funding criteria identified?
There is little information publically available about how funding priorities have been developed. They appear to be most commonly derived from national and EU policy priorities, but stakeholder and scientific perspectives are sometimes considered (e.g. in the UK).

To what extent is low-carbon transport research across Europe coordinated?
There are inevitable differing preferences for particular transport technologies and policies across European nations, for cultural, political, historical and geographical (e.g., available resources). Yet our analysis of European, MS and AS research agendas suggests there are broadly consistent priorities in transport funding, namely reducing environmental impact, fostering economic growth and competitiveness, and improving safety. In several cases (e.g., UK), we found a dedicated function within national funding agencies to coordinate research funding development with European funding activities. Elsewhere, there appears to be a tendency to focus on national or sector-specific priorities in transport funding, leading to a more fragmented picture. Although notable examples of coordination exist to

coordinate research, development and dissemination, (including Technology Platforms, ERANET, SETIS, TRKC, Structural Funds, etc.) further efforts appear to be needed to ensure coordination across Europe, and in particular that policy is joined-up in order to achieve (rather than undermine) energy and climate targets. This coordination is all the more important given the importance that transport experts place on European leadership to achieve sustainable transport

What procedures exist to ensure the quality and utility of research, how might these be benchmarked, and what examples of 'best practice' exist?
Our analysis exposed no existing guidelines on funding low-carbon transport, but highlights a number of common aspirations amongst funders and the wider research community in relation to how research *should* be funded (see below).

Guidelines and Best Practice
The analysis of relevant literatures and of funding schemes has exposed no existing guidelines on funding low-carbon transport. However, our research has highlighted a number of common aspirations amongst funders and the wider research community in relation to how research should be funded, and some elements which are unique to funding sustainable, low-carbon transport. Based on these common aspirations, we therefore propose the following indicative guidelines in developing and managing low-carbon transport schemes in Europe:

- Priorities for funding should be co-developed by scientists and societal stakeholders (industry, policy-makers, publics, non-governmental organisations) to ensure research achieves both (a) scientific relevance and quality, and (b) stakeholder relevance and socio-economic impact. This process of co-development should be transparent and organised to enable substantive input from a range of differing perspectives. Current guidelines on public engagement and knowledge transfer should be applied more widely, and examples shared of best practice in these areas. In addition, co-funding from public and private sectors can be used to achieve mutually beneficial objectives, including economically-advantageous low-carbon transport.

- Funding schemes should support a diverse range of research activities and approaches in order to reach scientific and societal objectives in respect of transport and sustainability. This diversity can be achieved through use of interdisciplinary and disciplinary approaches; basic and applied research; quantitative and qualitative methods – reflecting the multiple dimensions of transport and sustainability.
- Funding schemes should develop and apply clearly-defined monitoring and evaluation procedures to ensure accountability and transparency. Where the objective is to reduce carbon emissions from transport, the use of standardised carbon indicators (as well as other measures) can help assess the impact of funded research.
- Funding schemes should develop and apply transparent eligibility criteria and application guidelines, including training and/or guidelines for reviewers of proposals.
- Funding schemes should, where possible, aim to build capacity within the research community (i.e., people-based activities, such as training, networking, coordination), as well as development of ideas and inventions. Related to this, training in communication of research and engagement with stakeholders can assist researchers in ensuring their research has wider societal impact.
- Funding schemes should be developed in consultation with other national and European funders to ensure strategic coordination across themes and programmes. This coordination should also aim to adopt a systems approach, which considers multiple sectors, modes, spatial scales, and methods and tools.

(c) ***Developing a common set of indicators for carbon impact of transport***

A common set of indicators for the carbon impact of measures in the transport sector, is a tool which can contribute to the identification of the carbon reduction potentials of measures in the transport sector. Carbon indicators can be used in an ex-ante assessment, e.g. for the planning of future measures, including research and development. After the implementation of transport measures, policies or programmes, indicators can be used for their evaluation. Indicators for carbon impact can be used for the monitoring of targets in carbon reduction in the transport sector, for the construction of forecasting models or cross-country comparisons of the development of low-carbon transport.

Therefore a common set of indicators for carbon impact was developed according to the following goals:

- Identify relevant indicators to assess carbon impact for the different types of measures and transport modes
- Develop formulae that combine these indicators for specific combinations of modes and measures
- Define the data requirements and suggest data sources
- Discuss the relevance of transport models and compare their eligibility for local policy makers

The methodological approach that was adapted was the following:

(a) *Desk research* (literature based and online) was conducted on indicator development in general, for indicators in the transport sector and for carbon emissions indicators specifically. An additional research focus was on policy fields that make use of carbon indicators in the transport sector, such as research on climate policy financing (NAMAs, CDM). The research found a broad range of methodologies to define indicators and to make use of existing indicators. Finally, the ASIF model, developed by Lee Schipper and others, was selected to analyse the indicators.

(b) *Expert discussion* helped to identify the crucial points in creating an indicator set. During the Rijeka and Milan workshops, facilitated engagement sessions enabled expert stakeholders to feed back on the draft Milestone report developed within the project. This was critical for ultimately producing a more robust deliverable.

(c) *Model analysis* was conducted through desk research, supplemented as required with email/telephone contact with model owners, to identify models that analyse carbon emissions from transport and to produce a database highlighting their main characteristics (scope, audience, inputs, outputs, etc.).

The study developed a set of indicators for the assessment of CO2 reductions induced by measures to promote sustainable transportation: It identified the ASIF model as appropriate to display CO2 emissions. CO2-emissions are the product of four main indicators: Activity, Modal Split, Energy Intensity and Fuel Carbon Content. Formulae for the calculation of these indicators as well as data sources for the factors necessary have been provided and methods for the implementation of calculation models have been developed.

Because of the complexity of the transport sector, changes in any of the indicators have side effects on other indicators: Rebound and multiplier effects have been discussed and further literature on how to make use of multiplier effects has been provided. Therefore, the potential influence of transport measures on different transport variables has been assessed; the term elasticity, which describes the change induced by a 1% price change, plays a key role here. As a new concept, the temporal dependency of measures has been introduced: Six different possible functions of the temporal development of emission reduction have been identified and approximation strategies have been developed to take these different reduction functions into account.

The second focus was on the analysis of data acquisition. Here it could be seen that data quality varies significantly among the indicators. For some important indicators, e.g. vehicle kilometres, high quality data does not exist, be it on a country or on EU level. We also analysed models in order to assess how far they are appropriate to generate data: Although a number of models for different steps of the emission calculation process exist, (of which one, TRANS-TOOLS is developed as the main EU model, but still has a number of weaknesses), many of them are not used and developed any more, others are too expensive or complicated to be used by local policy makers. It can be concluded that on EU and country level, models for policy evaluation and emission assessment are available, while local policy makers still lack of easy-to-use and at the same time accurate models for emission reporting and policy evaluation, although some projects are in the pipeline. As local communities and cities are the backbone of country- and EU-wide CO2 reporting and at the moment have to rely on course estimation or own models, and as the evaluation of measures is an important factor in transport sustainability, a stronger focus should be put on unique, simple and accurate standards for data acquisition and project evaluation on local level.

As a guideline for the evaluation of the carbon emission reductions of transport projects, the following steps were recommended:

1. Data collection: Collect the data to calculate the actual emissions of a transport system within a certain boundary.
2. Baseline projection / Business-as-usual scenarios: Develop one or several baseline scenarios to assess the emission development without any additional mitigation efforts.
3. Indicator development projection: Conduct an assessment of the future development of indicators by using models, elasticities or other estimations, under the premise that the measure is implemented.
4. Consideration of rebound effects: Estimate the strength of secondary effects on the relevant indicators.
5. Calculation of "with-measure" emission scenario: With the ASIF model, calculate the CO2 emissions under the scenario that the measure is conducted.
6. Calculate the emission reductions: As difference between baseline emissions and "with-measure" emissions, calculate one (or more, if more base scenarios were created) emission reduction estimations.
7. Consider lifetime development: Estimate the lifetime development of the calculated emission reduction(s).
8. Estimate the impact of measure packages: If more than one measure is conducted, these measures interfere with each other and either has a dampening or a multiplying effect. Estimate these effects

9. and calculate the overall emission reduction (with its temporal distribution) induced by the measure package.

The report on indicators concluded a number of recommendations for the evaluation of the carbon emission reductions of transport measures that are relevant for policy makers on regional, national and on EU level:

- Introduction of a unified methodology for data collection and data analysis with regards to transport statistics throughout the EU, especially for passenger road transport and non-motorized transport modes, for which no data acquisition regulation exists. EUROSTAT should be used to harmonize different standards of data collection and acquisition.
- Creation of a common methodology for the carbon impact analysis of transport measures, taking into consideration rebound effects and the temporal variation of the carbon reductions. This methodology should be based on the ASIF model, as it is easily usable and used in most international methodologies.
- User-friendly models for the simulation of future transport system developments should be introduced on a local level. Assessment standards and indicators should be harmonized in the EU. Existing models (such as TRANSTOOLS) should be harmonized and their applicability and user-friendliness should be improved.
- Accounting insecurities such as the Radiative Forcing Index for aviation emissions should be eliminated.

Regarding the relationship to the White Paper for Transport in 2011, linkages can be seen both in a manner of evaluation methods and in a manner of the policy priorities.A comparison of our findings with the policy proposals of the White Paper shows, that in the White Paper (§ 18), the reduction of transport volume is not seen as a key factor - however, is one of the relevant factors in the ASIF model. The importance of this carbon reduction potential was also underlined by the expert consultation of the SRA. Therefore, the issue of transport reduction should be taken into account by EU policy.

Methodologically, several issues are relevant:

- The White Paper states (§20) that actions taken today have a long-term impact on the transport system in 2050. Therefore, a reliable impact assessment methodology is crucial.
- To achieve the emission reduction goals set in the white paper with the most (cost-)efficient means, an ex-ante evaluation of the carbon impact of certain strategies and measures is necessary.
- The introduction of methodologies for the simulation of future transport system developments is not only necessary for the evaluation of carbon impacts, but also for the planning of sustainable urban transport infrastructure, as proposed in §30-32
- However, the white paper lacks a MRV (measureable, reportable, verifiable) approach, which is necessary to measure progress and to set action plans for further measures. The introduction of a carbon footprint for transport is welcomed; a harmonized methodology for the calculation of individual emissions is necessary here.
- We welcome the proposed ex-ante evaluation criteria for transport projects and suggest to expand them to a mandatory environmental assessment, as well ex-ante and ex-post.
- The impact assessment of the proposed measures includes rebound effects and the development of transport activity, modal share, fuel shares and energy intensity, which is good and important. We also acknowledge the range of possible indicator developments. However, no alternative scenarios (e.g. economic crisis or green development path) have been created
- The ex-post assessment of the white paper 2001 should foresee an assessment of the model quality or the data collection standards, as well as explain if the model methodology has changed in the past 10 years.
- The temporal development of measures has not been taken into account.

Summarized, the ex-ante impact assessment of the proposed measures and the ex-post evaluation of the past white paper are very sensible. However, large data and model insecurities remain, as local and national methodologies are not harmonized. We are, therefore, convinced that our proposed methodology can contribute to the harmonization and improvement of measuring and reporting transport measures

3.3 Enhancing the impact of research outcomes from EC funded projects

REACT Event: Shaping Climate Friendly Transport in Europe: Key Findings & Future Directions"
The REACT Consortium organised a very successful Event, in the green transport field, both in terms of participation and scientific impact. The REACT Event took place in 16-17 May 2011, in the Chamber of Commerce of the Belgrade Serbia under the auspices of the Faculty of Transport of Belgrade University.

The REACT Event was structured according to three thematic areas that were linked to the main objectives of the project:

- Future research priorities in climate friendly transport
- Policy interventions in climate friendly transport
- Evaluating policies and measures in climate friendly transport

Participants involved during the preparation, implementation and phases following the REACT Event, included more than 200 people, representing researchers, policy makers and various stakeholders.

Call for papers

A very important part of the REACT Event was the call for papers. This had two main targets: the first was to provide the opportunity to researchers to expose their research findings to their peers and second to raise the importance of the research funded activities for the promotion of scientific knowledge. The potential authors were recommended (but not restricted) to address the following scientific questions:

What should be the focus of future research on low-carbon transport?

Given limited research funding, which research on technologies, policy instruments or Behavioural innovations should be prioritised?

In which ways should the EC and the member states fund and coordinate research for climate friendly transport?

Which policy instruments and measures are promising to achieve carbon reduction in the transport sector?

What are the gaps in existing policy frameworks and policy interventions to achieve climate friendly transport?

Which evaluation methodologies facilitate a quick and cost effective assessment of the benefits?

On which political level should the different instruments be implemented?

How can the EU further contribute to the development of instruments in the member states?

How can we achieve a low-carbon transport system while, at the same time, meeting other environmental, economic and social needs?

How can the impact of climate-friendly policy interventions and measures be assessed (ex ante and ex-post)?

What methodologies and tools are more appropriate for evaluating the cost-effectiveness of measures for carbon reduction in the transport sector?

How to face the difficulties of measuring – e.g. the problem of shifting baselines or of standard values?

The call for papers was published on the REACT Event website and had three main categories each, explaining the prerequisites for submission and the procedure. It was constructed in three main blocks; themes, guidelines and relevant template. The template for papers was the one of IEEE.

The call for papers was sent to all relevant networks and stakeholders including FP6 and FP7 participants.

The Scientific Committee, consisting of 19 renowned scientists, successfully evaluated 75 papers and abstracts while 69 of them were presented in the parallel sessions of the conference. The papers actually marked the continued progress in climate friendly transport theory and practice leading to greatly improved application in science and our lives

REACT Competition

To accelerate further networking and maximise awareness-raising of research results, a competition on the most innovative project with the greatest impact on reducing GHG emissions was launched.

The general aim of the competition was to identify and to communicate the most relevant projects and studies on transport and mobility that are having or will have a significant impact on reducing GHG emissions, thus contributing to the wider dissemination of research results.

The REACT Competition was run in an open manner where any type of ideas having an impact on strategic research in the climate friendly transport area were considered and all project coordinators for FP6 and FP7 projects were invited to subscribe. The main objective was to select three successful researchers (1 winner, 2 runners-up) who were given the opportunity to present their idea at the REACT Belgrade event in May 2011.

The competition was run through the website; therefore setting up the web portal infrastructure was the first action point. The next step was to publish the criteria for the competition and in parallel to encourage researchers' participation by sending personal invitations and press coverage on the subject.

The participants had to register and fill in an on-line form that illustrated some important elements of the project. General description of the project

1. Project contribution to reducing GHG emissions
2. Project contribution to achieving other SRA criteria (e.g., social benefits)
3. Elements of innovation
4. Other important aspects

The responsible/coordinator of each project was asked to evaluate then all the other projects included in the same set, by the means of a peer review mechanism. To encourage project coordinators to familiarise themselves with as many projects as possible each person responsible for the project participant had to vote for at least seven project and not to vote his/her own one. The votes received by each projects were used to calculate a unique indicator, composed by the average of the votes received and the number of votes gathered. Three final ranks were therefore produced: a general one and another two, corresponding to the two pillars. The awarded projects were the first in the general rank and the first for each specific

rank. The award ceremony took place in concomitance with the REACT Belgrade Final Conference (16-17 of May).

The REACT competition in total gathered 33 EU projects while four of them were excluded from the final evaluation. Of the 29 remaining projects, ten belonged to the *Planning, Social Sciences and Economy* pillar and 19 to the *ICT and Engineering* pillar of the REACT SRA. The voting procedure collected a total of 389 votes, with an average of around 13 votes for each project.

In the following table, statistics of the REACT Competition are provided with the exclusion of four projects which violated the rules for the Competition:

STATISTICS	
Total number of projects*	29
Total Planning, Social Sciences and Economics number of Projects	10
Total ICT and Engineering number of Projects	19
Total number of votes received	389
Minimum number of votes received per project	9
Maximum number of votes received per project	22
Minimum average of votes received per project	1.54
Maximum average of votes received per project	3.31

FIGURE 21: STATISTICS OF THE COMPETITION

The calculation determined a final rank. The REACT Competition awarded the first classified of the final rank and two runners-up, one for the ICT and Engineering pillar and one for the Planning, Social Sciences and Economics pillar.

The general winner of the REACT Competition was the ENFICA-FC project; the two runners-up, placed 2nd and 1st in their relative categories, were ID4EV for ICT – Engineering and CIVITAS POINTER for Planning, Social Sciences and Economics. . ENFICA-FC project, whose acronym stands for ENvironmentally Friendly Inter City Aircraft powered by Fuel Cells, aims at demonstrating the possibility of obtaining a more/all electric aircraft through the integration of fuel-cells technology as main power-supply system. During the three years research activity, a fuel-cell based power system was, developed and installed in a ultra-light aircraft. This innovative aircraft took its maiden flight on the 20th May 2010 in Reggio Emilia (Italy). More information can be found at http://www.enfica-fc.polito.it/.

The three winners presented their project during the last day of the Conference, which helped to raise further awareness on their research results. At the same time, the Competition was a great occasion for REACT Consortium for disseminating results, exchanging knowledge among researchers and establishing interesting relations with other EU project coordinators.

4. Impact, dissemination and exploitation

The REACT project had its main focus in supporting activities on green transport research, acting as a facilitator in bridging different communities and stakeholders under the same "roof" in order to actually cultivate a new cooperative approach for more effective solutions. REACT brought into the forefront of the European Union and Associated States' consultation procedures, the importance of a Strategic Research Agenda in climate friendly transport, working in the direction of Kyoto considerations. According to the new goals set in Horizon 2020, the focus will be put on 1) cultivating an excellent research base, 2) creating an industrial leadership and competitive frameworks and 3)trackling societal challenges. REACT had both quantititave and qualitative impacts on all three generic priorities set by the White Paper and the Horizon 2020.

More specifically, REACT had an impact on three main axes which are linked with the priorities:

Tackling Societal Challenges: Climate friendly transport and mobility issues are a topic of strategic importance for everyday life, with major impact on quality of life. Furthermore, environmental measures define substantially the life of the next generations and the very existence of the planet, as we know it. In general, collaborative research has extensive societal impacts contributing to faster advancement of science and existing problem solving. Also, it provides a sense of urgency and importance about climate friendly transport. The research common initiatives are the cornerstone of developing stronger relationships among different countries, providing the proper ground for joint fore-thinking activities. React project boosted the formulation of scientific MS – AS and international networks and capitalized on these networks in delivering the Strategic Research Agenda to be adopted by public stakeholders, in order to diffuse the innovation approaches into the society, more effectively. REACT project's mechanisms and coordination activities stimulated and revived the notion that societal partners can contribute actively to define research priorities on environmental friendly transport of tomorrow.

Industrial Leadership and competitiveness to boost economy:
Within REACT, networked research Communities and stakeholders with actually different origins, background and economic constellations created a critical mass in climate friendly transport, bringing together research networks for conducting research in transport. This might generate future economic impacts as research is ranked first as a competitive tool for sustainable development. The REACT event cultivated a vivid interest around the subject of green transport which led to the development of new project ideas.

Research Base: Networked scientists and companies were supported in the creation of breakthrough knowledge and excellence. Specifically, both ICT tools and human networks were exploited in order to stimulate research and innovation as to cater the society needs and ethics. The exchange of scientific knowledge and the support of collaborative efforts stimulated the potential of accelerating the scientific excellence of research teams. The various activities (brainstorming processes, expert consultations, events and competition) stimulated the generation of new research ideas while brought researchers together into teams around green transport subjects. The stakeholders database brought together hundreds of scientists who were kept informed about the developments in the area of climate friendly transport and contributed to its formulation by participating in REACT (event, consultations, workshops). As an ultimate result, rEACT event , which was attended by a great part of the database, had a major impact into the research community as it constituted a very useful resource of knowledge gathering research findings out of seventy five projects. Moreover, within the framework of the Event, scientific papers[3] and innovative ideas were presented and published bringing to light experiences and best practices of EU countries and countries non members of the EU.

To sum up, as defined in Horizon 2020, the future transport system will be seamless, competitive and sustainable in order to bring the maximum economic and social benefits to the citizens. REACT impacted on all three objectives by the following concrete actions:

- Creation of a Knowledge Repository of articles and reports which assisted a large number of scientists in exploring the climate friendly transport area
- Networking of Scientists (event, consultations, online, workshops, competition) Knowledge Sharing (public funding schemes database, FP6 & 7 projects database, competition)
- Assisting the public bodies to better channel funding resources by developing a map (report) on the existing funding schemes

It is anticipated that all the abovementioned activities resulted in generation of new ideas for an improved transport system

The objectives of REACT's dissemination plan were the following:

- To establish effective mechanisms for continuous dissemination and to disseminate research as widely as possible;
- Build awareness of the project among a wide but defined group of audiences and user groups;
- Raise awareness about the project and its results at international, national, and regional level;

- Influence specific policies or policymakers around key aspects;
- Help all users involved to confront and reconsider their opinions and attitudes;
- Inform, consult and involve all relevant stakeholders in order to secure commitment to the project;
- To distribute public React deliverables outside the consortium as they become available;
- To promote project progress and outcomes so that they can find their way into mainstream practice;
- To actively participate in conferences, workshops, seminars and other events to actively promote the results of REACT project;
- To establish permanent links with other projects and initiatives to achieve multilateral synergies;

[3] The proceedings of the peer reviewed process of the Event are available for download from the REACT project website

The activities of dissemination in REACT intended to present what REACT was working on and the results achieved. The basic dissemination strategy comprised a combination of various channels, in order to distribute the results and create awareness on the topics they covered. Several channels for disseminating information and results about REACT were used. The selection of modalities and ways varied in relation to the communication targets. The main dissemination activities of REACT included: conferences, teleconferences, meetings, workshops, emails, articles, posters, publications and the creation of the project logo and project website in order to reach the largest number of professionals and lay audience. Particular attention has been devoted to the specific characteristics of the various target groups identified to be the main beneficiaries of the dissemination: the activities have been targeted and customized in order to fit with their profile, demands and expectations.

The main dissemination activities and tools can be summarized as follows:

Cooperative Information Platform (CIP)
The REACT website has been developed in month one and it will be maintained for four years after the end of the project. The CIP-working server (1) comprised of a protected platform for internal collaboration and document sharing only. Contracts, management documents, agendas and minutes as well as other confidential and not public documents can be found in this repository.
The REACT CIP-web portal (2) provided:

- all public information about the project itself (e.g. Scope, Strategy, Work-Packages, Partners, Deliverables, News, Events, Links) as well as
- a Knowledge Base Repository for more efficient information availability and
- a set of networking tools dedicated to the user and invited experts of REACT CIP

The figure below presents the CIP user interactions

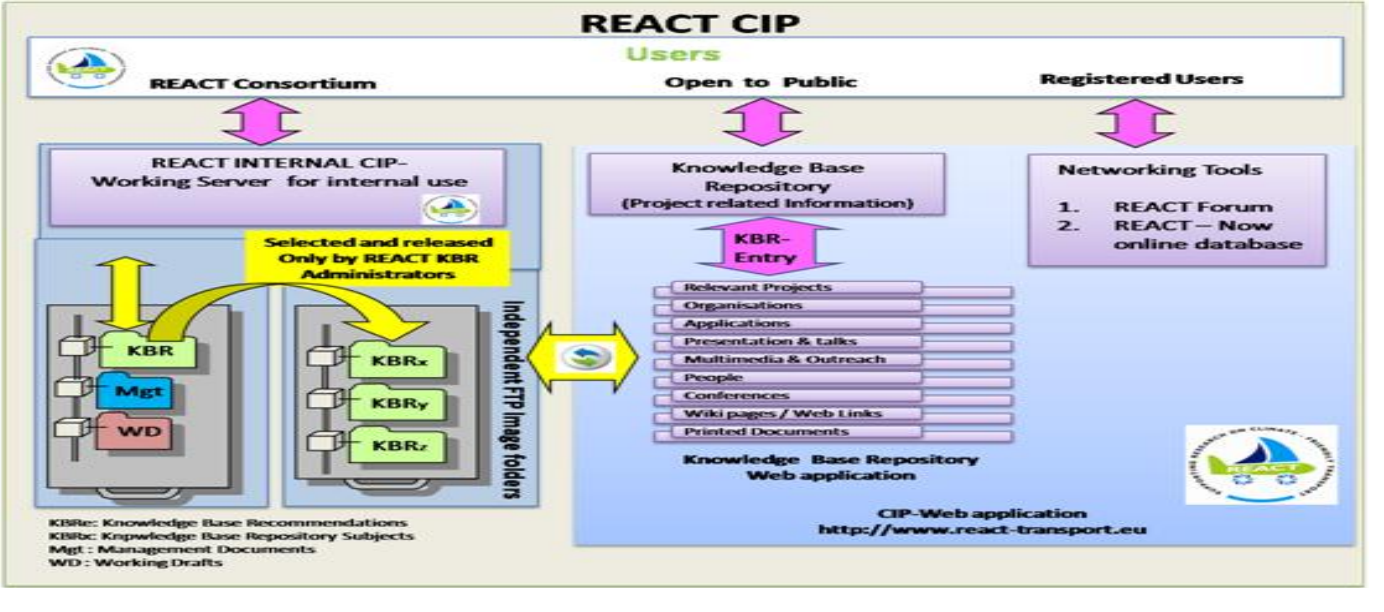


FIGURE 22: REACT CIP

The main dissemination and networking tools integrated into the website were the following:

- The REACT Brainstorming tool. The brainstorming tool was an innovative platform that allowed the invited experts to provide interactive and transparent consultations online, integrating input from various users.
- The REACT online competition tool. The online competition tool provided facilities of extensive review of existing research, interaction with other projects and voting techniques.
- The REACT Stakeholder Data Base and expert communication lists. An extended database with information and contact details of relevant stakeholders constitutes the first element of an unofficial climate friendly transport research community.

- The informational activities of the website through the e-newsletter facility (total of 8 newsletters were produced and distributed), the REACT news section (total of 40 press releases were drafted and published)
- The Knowledge Base Repository tool that hosts more than 160 files and provided more than 22.000 downloads for visitors and extended users

Events, Conferences, Workshops
REACT partners represented the project in more than 70 national and international conferences (including conferences outside Europe) and workshops where they presented papers and made announcements, distributed leaflets and also submitted articles in scientific publications. In total 8 publications were made during the lifetime of REACT

First Expert Workshop
The Faculty of Maritime Studies of the University of Rijeka was the host of the first “Expert Workshop” which was held on 29th June 2010 within the project Supporting Research on Climate-friendly Transport (REACT). The REACT Project is funded by the European Community within the 7th Framework Programme (EU FP7).

The workshop was attended by thirty six eminent scientists, researchers and experts in the field of transport and environment from ten countries. The scientists were from renowned European institutes and universities. The aim of the workshop was to create a long-term vision and strategic research plan for environmentally sustainable transport, which contribute to the development of a comprehensive European strategy for environmentally sustainable transport.

The workshop participants were split into focus groups and they were asked to express their opinion on the future technologies and Research Agenda themes through brainstorming sessions, round table discussions and questionnaires. The results of the workshop were analyzed and presented to participants for further discussion and then initiated a wide debate across the European research and professional community, using a brainstorming web tool specifically for this purpose made by a group of researchers from the Faculty of Maritime Studies in Rijeka.

Second Expert Workshop
The second workshop took place in Milan, February the 8th, 2011 at the Politecnico di Milano - Dipartimento di Elettronica e Informazione.

The REACT Milan workshop attracted almost 30 experts, stakeholders, local policy makers and academics from different European countries

The workshop's main objectives and thematic areas on which invited experts were asked to contribute and elaborate were:

- the articulation of a long term vision and a Strategic Future Research Agenda on climate-friendly transport that will concur in developing a European strategy on that issue; In particular experts were asked to evaluate the results of the first round of the Expert Consultation, in order to define a
- level of priority for each specific reearch area to be submitted to Experts within the second round of the Consultation;
- the definition of a set of indicators to illustrate the climate impact of transport technologies and mobility approaches. This set of indicators was foreseen to be a calculation tool to identify the carbon reduction potential of measures in the transport sector.

Outcomes of the discussion and the consequent remarks derived from the Strategic Research Agenda Thematic Focus Group were further discussed together with all participants at the end of the Milan workshop. The valuable feedback collected by the invited experts during the workshop on SRA has been evaluated and processed, in order to help shape the structure and content of the Second Round of the

Expert Consultation. The comments received during the second Thematic Focus Group on carbon indicators were actually used for improving the REACT deliverable on carbon indicators.

REACT Conference

As indicated above, the REACT conference comprised a very important event for the transport scientific community. Conference participants had the opportunity to attend informative scientific presentations, participate in open discussions on emerging research issues in climate friendly transport, and join study visits to local transport and innovation organizations. During the conference participants were informed about the latest developments of some of the most important research trends in Europe as well as the EU's future funding priorities and vision towards a common European transport policy. The REACT Event, as presented before, published a call of papers. This provided the opportunity to researchers to expose their research findings to their peers and also raised the importance of the research-funded activities for promotion of the scientific knowledge.

The REACT conference focused on and analysed mainly three thematic fields that integrated the need for further promotion of research and the importance of successful policy implementation. During the plenary and six parallel sessions, experts and participants confirmed the belief that research in new technologies combined with an integrated adoption of best case policy interventions can lead to substantial cuts in greenhouse gas emissions in Europe.

REACT had as a driving principle of all exploitation activities to utilize the research and networking results for the benefit of all project stakeholders including the consortium members. Based on the status of project partners, two types of exploitation activities will occur: commercial and academic. Commercial exploitation aims at transferring REACT results into new services. Non-commercial exploitation is mostly carried out by universities and research organisations and aims at increasing visibility of research results, identifying research open questions and existing gaps, improving teaching standards and enhancing the research curriculum with generation of new project ideas.

The following table summarises the exploitable knowledge and the exploitable results that are generated in the REACT project respectively.

Exploitable Knowledge	Exploitable services or measures	Sectors of application	Partners involved
Strategic research agenda	The stakeholders' contribution	Partners' internal organisation Research community, European Commission	All
Carbon Indicators	Benchmarking of existing tools and methodologies	Partners' internal organisation Research community, NGOs, European Commission	All
Funded Programmes & Initiatives	A list of funded initiatives	Partners' internal organisation Research community, Market (SME & Large companies), European Commission	All

Stakeholders' network	Database	Partners' internal organisation	All
Online dialogue tool	Forums	Partners' internal organisation Research community, European Commission	All

Contact

Partners:
Coventry University Enterprises Ltd
(Coordinator), www.coventry.ac.uk, UK

Wuppertal Institute for Climate, Environment and Energy,

Contact Information:
Eleni Anoyrkati
Project Manager
Coventry University Enterprises Ltd
International Business & Technology

www.wupperinst.org, Germany

GeoImaging Ltd, www.geoimaging.com.cy, Cyprus

Poliedra - Centri di Conoscenza e Formazione del Politecnico di Milano, www.poliedra.polimi.it Italy

Arachni Olokliromenes Efarmoges Pliroforikis kai Rompotikis EPE, www.arc-i-tech.eu, Greece

University of Belgrade, Faculty of Transport and Engineering, www.sf.bg.ac.rs , Serbia

University of Rijeka, Faculty of Maritime Studies, www.pfri.uniri.hr, Croatia

Cardiff University, www.cardiff.ac.uk, UK

OIKON Ltd- Institute for applied Ecology, www.oikon.hr, Croatia

Website : www.react-transport.eu

Transfer
The TechnoCentreCoventry University
Technology Park
Puma Way, Coventry CV1 2TT
Mobile: +44(0)7974984863
Fax: +44(0)24 7623 6024
Email: e.anoyrkati@coventry.ac.uk

Bibliography

ACARE. (2004, October). Strategic Research Agenda. Available at: http://www.acare4europe.com

Asian Development Bank - ADB (2009). Transport and Carbon Dioxide Emissions: Forecasts, Options Analysis, and Evaluation. By Lee Schipper, Herbert Fabian, and James Leather. ADB Sustainable Development Working Paper Series, No. 9, December 2009. Available online at: http://www.adb.org/documents/papers/adb-working-paper-series/adb-wp09-transport-CO2-emissions.pdf

Banister, D. (2005). Unsustainable Transport: City Transport in the New Century, Routledge.

Bureau of Infrastructure, Transport and Regional Economics (BTE, 2010): Transport elasticities database. Available from http://www.BITRE.gov.au/tedb/

Cascetta, E. (2001).Transportation Systems Engineering: Theory and Methods, Springer Netherland.

Chapman, L. (2007). Transport and climate change: a review. Journal of Transport Geography, 15 (5), 354-367.

CSI / Cement Sustainability Initiative (2009). Development of State of the Art-Techniques in Cement Manufacturing: Trying to Look Ahead, available from http://www.wbcsdcement.org/pdf/technology/Technology%20papers.pdf

CTF (2009): CTF/TFC (2009) Clean Technology Fund Results Measurement System. CTF/TFC.3/8. Annex 3: Guidelines for Calculating GHG Benefits of CTF Investments in Transport Sector. Available online at: http://www.climateinvestmentfunds.org/cif/workingdocuments/129.

Deliverable: D3.1 National & Regional Funding Initiative Report (climate-friendly transport); REACT Project, 2010. Available from www.react-transport.eu

DIN (Deutsches Institut für Normung – German Institutes for standards certification, 2011): DIN EN 16258

EC (European Commission) (2001). European transport policy for 2010: time to decide. COM (2001) 370. http://ec.europa.eu/transport/strategies/2001_white_paper_en.htm

EC (European Commission) (2003). A European initiative for growth investing in networks and knowledge for growth and jobs, Final Report to the European Council

EC (European Commission) (2010). European Work Programme 2010 FP7 on Transports (including aeronautics). Available at: http://cordis.europa.eu/fp7/wp-2010_en.html

EC (European Commission) (2011). Transport 2050. Transport 2050. Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system.

COM(2011) 144 final http://ec.europa.eu/transport/strategies/2011_white_paper_en.htm
EC (European Commission), (2009). Communication on Investing in the Development of Low Carbon Technologies (SET-Plan).

http://ec.europa.eu/energy/technology/set_plan/doc/2009_comm_investing_development_low_carbon_technologies_en.pdf

EEA (European Environmental Agency) (2009). Greenhouse gas emission projections (CSI 011). http://www.eea.europa.eu/data-and-maps/indicators/greenhouse-gas-emission-projections/greenhouse-gas-emission-projections-assessment-3#toc-0

ERRAC. (2007). Strategic Rail Research Agenda 2020. Available at: http://www.errac.org

ERTRAC. (2010). Strategic Research Agenda 2010. Available at: http://www.ertrac.org

European Expert Group (2011, January). Future Transport Fuels. Available at: http://ec.europa.eu/transport/index_en.htm

European Parliament. (2009, April). Directive 2009/28/EC. Available at: http://eur-lex.europa.eu

Eurostat (2008): Methodologies used in surveys of road freight transport in member states and candidate countries. Available from http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-RA-08-009/EN/KS-RA-08-009-EN.PDF

Eyring, V., Isaksen, I.S., Berntsen, T., Collins, W.J., Corbett, J.J., Endresen, O., Grainger, R.G., Moldanova, J., Schlager, H., Stevenson. (2010). D.S. Transport Impacts on Atmosphere and Climate: Shipping, Atmospheric Environment, 44(37), pp. 4735-4771.

Fuglestvedt et al. (2007): Climate forcing from the transport sectors, available from http://www.pnas.org/content/105/2/454.full.pdf+html

Fulton, Lewis (2001). Saving Oil and Reducing CO2 Emissions in Transport: Options and Strategies. Available from http://unfccc.int/files/meetings/workshops/other_meetings/application/pdf/fulton.pdf

Gibson, R.B., et al., (2005). Sustainability assessment: criteria, processes and applications. London: Earthscan.

Global Environment Facility – GEF (2009): Investing in Sustainable Urban Transport: The GEF Experience. Available online at: http://www.thegef.org/gef/sites/thegef.org/files/publication/Investing-Urban- Transportation_0.pdf

Green Alliance, (2007). Investing in our future: A European budget for climate security. ec.europa.eu/budget/reform/library/contributions/o/20080126_O_2

Grubler, A. & Riahi, K. (2010). Do governments have the right mix in their energy R&D portfolios? Carbon Management, 1 (1),79-87

Grubler, A. & Riahi, K. (2010). Do governments have the right mix in their energy R&D portfolios? Carbon Management, 1 (1),79-87

House of Lords Select Committee on Science & Technology (2011). Second Report of Session 2010-12. Behaviour Change Report. The Stationery Office, London. Available from: http://www.publications.parliament.uk/pa/ld201012/ldselect/ldsctech/179/179.pdf

IHT (Institution for Highways and Transportation) (1997). Transport in the Urban Environment, William MacKay.

Institut für angewandte Sozialwissenschaft GmbH – Infas / Deutsches Zentrum für Luft- und Raumfahrt e.V. – Institut für Verkehrsforschung – DLR (2010): Mobilität in Deutschland 2008, Ergebnisbericht. Struktur – Aufkommen – Emissionen – Trends. Im Auftrag des BMVBS. Bonn/Berlin. Available from http://www.mobilitaet-in-deutschland.de/pdf/MiD2008_Abschlussbericht_I.pdf

Köhler, J., Wietschel, M., Whitmarsh, L., Keles, D. & Schade, W. (2010). Infrastructure investment for a transition to Hydrogen automobiles. Technological Forecasting & Social Change, 77, 1237–1248.

Methodology for calculation and declaration on energy consumptions and GHG emissions in transport services (good and passengers transport); German version prEN 16258:2011. Available from http://www.nadl.din.de/cmd;jsessionid=BC2BFE617ECFC392585EBA81B04D5F45.4?artid=138210917&bcrumblevel=2&level=tpl-art-detailansicht&committeeid=117152656&languageid=en

Nykvist, B. & Whitmarsh, L. (2008). A multi-level analysis of sustainable mobility transitions: Niche development in the UK and Sweden. *Technological Forecasting & Social Change, 75*, 1373–1387

Oum, Waters, Yong (1990). A Survey of Recent Estimates of Price Elasticities of Demand for Transport, report for the World Bank, available from http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1990/01/01/000009265_3960928230924/Rendered/PDF/multi_page.pdf

Rajan, S.C., (2006). Climate change dilemma: technology, social change or both?: An examination of long-term transport policy choices in the United States. Energy Policy, 34 (6), 664-679.

Rothengatter, W. (2010). Climate change and the contribution of transport: Basic facts and the role of aviation. Transportation Research Part D: Transport and Environment, 15 (1), 5-13.

Russel D, Jordan A, (2009), "Joining up or pulling apart? The use of appraisal to coordinate policy making for sustainable development" Environment and Planning A 41(5) 1201 – 1216
Schäfer A., Heywood, J.B., Jacoby, H.D. & Waitz, I.A. (2009). Transportation in a Climate-Constrained World, MIT Press.

Schipper, L; C. Marie-Lilliu (1999): Transportation and CO2-Emissions: Flexing the link, A Strategy for the World Bank. Washington

Sheate, W.R., et al., (2008). Sustainability assessment of future scenarios: methodology and application to mountain areas of Europe. Environmental management, 41 (2), 282– 299.
TRKC, (2009). Transport and the Environment. Transport Research Knowledge Centre http://www.transport-research.info/Upload/Documents/200908/20090818_124030_53136_TRKC_Transport_and_the_Environment.pdf.

UBA (2010), CO_2-Emissionsminderung im Verkehr in Deutschland – Mögliche Maßnahmen und ihre Minderungspotenziale, available from http://www.umweltdaten.de/publikationen/fpdf-l/3773.pdf

Uhereka, E., Halenkab, T., Borken-Kleefeld, J. et. al. (2010). Transport impacts on atmosphere and climate: Land transport. Atmospheric Environment, 44 (37), 4772-4816.
UNECE (2008): Annual Bulletin of Transport Statistics for Europe and North America. Available from http://live.unece.org/fileadmin/DAM/trans/main/wp6/pdfdocs/ABTS2008.pdf

UNFCCC (2010): Approved Baseline and Monitoring Methodologies. Available online at: http://cdm.unfccc.int/methodologies/PAmethodologies/approved.html (20.7.2010).
Victoria Transport Policy Institute (VTPI, 2010): Transportation Elasticities, available from

www.vtpi.org/elasticities.pdf

Waterborne TP, (May 2011). Strategic research agenda: Waterborne Transport & Operations Key for Europe’s Development and Future, Overview - Issue II,

Whitmarsh, L. & Köhler, J. (2010). Climate change and cars in the EU: the roles of auto firms, consumers, and policy in responding to global environmental change. Cambridge Journal of Regions, Economy and Society, in press.

Whitmarsh, L., Swartling, A., & Jager, J., (2009). Participation of experts and non-experts in a sustainability assessment of mobility. Environmental policy and governance, 19, 232–250.

Whitmarsh, L., Swartling, A., & Jager, J., (2009b). Participation of experts and non-experts in a sustainability assessment of mobility. Environmental policy and governance, 19, 232–250.

Whitmarsh, L., Turnpenny, J. & Nykvist, B. (2009). Beyond the regime: can Integrated Sustainability Assessment address the barriers to effective sustainable mobility policy? Journal of Environmental Planning & Management, 52(8), 973 - 991.

Whitmarsh, L., Turnpenny, J. & Nykvist, B. (2009a). Beyond the regime: can Integrated Sustainability Assessment address the barriers to effective sustainable mobility policy? Journal of Environmental Planning & Management, 52(8), 973 - 991.

Wuppertal Institute for Climate,Environment, Energy – WI (2009a), EMEEES bottom-up case application 14: Vehicle Energy Efficiency. By Susanne Böhler, Frederic Rudolph. Supported by Intelligent Energy Europe. Wuppertal

Wuppertal Institute for Climate,Environment, Energy – WI (2009b), EMEEES bottom-up case application 15: Modal Shifts in Passenger Transport. By Susanne Böhler, Frederic Rudolph. Supported by Intelligent Energy Europe. Wuppertal

Wuppertal Institute for Climate,Environment, Energy – WI (2009c), Analyzing Rebound Effects, available from www.wupperinst.org/uploads/tx_wibeitrag/WP177.pdf

Wuppertal Institute for Climate,Environment, Energy – WI (2009d), EMEES Work package 6.1: Harmonised calculation of energy savings for the EU Directive on energy end-use efficiency and energy services: development and assessment of a combined bottom-up and top-down approach. By P.G.M. Boonekamp (ECN) and S. Thomas (Wuppertal Institute) , available from http://www.evaluate-energy-savings.eu/emeees/en/publications/reports/EMEEES_WP61_report_090430.pdf

Wuppertal Instiute for Climate, Environment, Energy – WI (2010), Exploring standardised baselines for CDM and other carbon finance mechanisms in transport. Report for the Project “Applicability of Post 2012 Climate Instruments to the Transport Sector (CITS)” on behalf of the Asian Development Bank. By Urda Eichhorst, Wolfgang Sterk, Susanne Böhler, and Hanna Wang-Helmreich. Draft, August 2010. Wuppertal

Xenias, D. & Whitmarsh, L. (2010). Measuring support for sustainable transport policies and technologies. British Psychological Society Social Psychology Section Conference, Winchester (Sep 7th-9th 2010)