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MOBIDAYS
Sustainable Mobility Days

SPECIFIC SUPPORT ACTION
SIXTH FRAMEWORK PROGRAMME
PRIORITY 6.2
SUSTAINABLE SURFACE TRANSPORT

Publishable Report

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1 Project execution

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1.1 Introduction

The report intends to provide an overview of a selection of the projects on sustainable mobility funded by the European Commission (EC). In order to explore, discuss and disseminate the results obtained and the improvements required in the field of sustainable surface transport, the project clearly identifies three main areas: socio-economic and environmental aspects, infrastructure and vehicles. To complete the overview, the major European and non-European demonstration projects on sustainable transport were analyzed.
Some of them were presented during one of the three conferences organized in the framework of the MOBIDAYS projects, other ones were chosen because considered relevant to the analysis. To individualize which projects contributed to make the transport more sustainable, the MOBIDAYS consortium drew up a definition of Sustainable mobility, taking into account the different aspects of sustainability and mapping the projects on the basis of this definition. Thus, some criteria of project selection is described, the outputs of the conferences organized in Prague, London and Rome are presented and an analysis of the projects has been reported in this document for each topic. The considered aspects are the research contents, the consortium, the results, the market readiness.
Finally, some comments about the barriers to access information about the projects are reported and some solutions to overcome them are proposed.

1.2 Sustainable transport: definition

Sustainable mobility is such if supports the simultaneous achievement of long-term economic growth, social welfare and environmental protection.

This translates into a number of policy objectives that a sustainable transport system, in the EU and elsewhere, has to simultaneously contribute to. A list of the main objectives in accessibility, environmental and economic points of views is here provided:

1. Ensure mobility equity and accessibility: high-quality at affordable prices for all users;
2. Ensure a high level of safety and reliability in mobility of people and goods;
3. Promote the efficient combination of different transport modes (co-modality);

4. Contribute to the reduction of resource utilization, thus including energy (reducing the consumption of fossil fuels), land and materials;
5. Contribute to increasing the use of renewable energy sources and local feedstock;
6. Limit emissions and waste within planet's absorption capacity for avoiding local air pollution and eco-system degradation, and limit transport noise;
7. Contribute to the reduction of emissions of CO_2 and other GHGs;

8. Promote innovation and the development of transport technologies that are competitive on global markets;
9. Increase the rate of economic return for all stakeholders, including those employed in the mobility/transport sector as well as the end-users of transport services, be they individuals or businesses;
10. Contribute to regional development.

1.3 European research on Socio economic Barriers to sustainable mobility

1.3.1 Overview of the considered projects

The criteria for the project selection process were i) their research relevance for the topic (socio-economic barriers to sustainable mobility), ii) respect of the research audience for the project team and iii) published outputs of the relevant EU funded projects. One limitation that at the same time served as a selection criterion was the possibility to get information about the project in the public domain (project web pages, published articles in scientific journals etc.).
From about 250 projects, we selected 46 projects which were referred to in the brochure on "European Research on Socio-Economic Barriers to Sustainable Mobility". Nine projects were presented at the Prague conference.
Table 1 summarizes the projects depicted in the brochure. More details on those projects including their linkages to sustainable mobility objectives are further elaborated in project analysis below.

Table 1. Summery table of the projects on Socio-economic barriers

Acronym	Full name	FP (EC Framework Programme)	Coordinator	Partners (number of partners)	Website	Budget (M€)		Project timing
						Total	EC contribution	
ACCEPTH2	Public acceptance of hydrogen transport technologies	5	Imperial College London, Department of Environment	7	www.accepth2.com	0.3	0.3	01.01.2003-30.06.2005

AFFORD	Acceptability of Fiscal and Financial Measures and Organizational Requirements for Demand Management	4	Government Institute for Economic Research (VATT)	10	no longer available	1,1	0,7	01.02.1998-31.12.1999
ARTISTS	Arterial Streets towards Sustainability	5	Lund University	16	http://www.tft.lth.se/artists/	2.2	1.7	01.12.2001-30.11.2004
ASI	Assess Implementations in the frame of Cities-of-tomorrow	5	Factum OHG	5	n.a.	0.4	0.4	01.02.2003-31.05.2005
ASSESS	Assessment of the contribution of the TEN and other transport policy measures to the midterm implementation of the White Paper on the European Transport Policy for 2010	DG-TREN	Transport & Mobility Leuven	7	http://ec.europa.eu/transport/white_paper/mid_term_revision/assess_en.htm	n.a.	n.a.	2005
CIVITAS-CARAVEL	TRAVELLING TOWARDS A NEW MOBILITY	6	Genova municipality	21	http://www.civitas-initiative.org/project_sheet?lan=en&id=3&PHPSESSID=84a39d7e8defe7231306751bd7	27.6	13.2	01.02.2005-01.02.2009
CIVITAS-MOBILIS	Mobility initiatives for local integration and sustainability	6	Tisséo SMTC	32	www.civitas-mobilis.org	21.8	9.3	01.02.2005-01.02.2009
CIVITAS-SMILE	Clean and better transport in cities	6	Malmö municipality	27	http://www.civitas-initiative.org/project_sheet?lan=en&id=1	27.5	15.4	01.02.2005-30.01.2009
DESIRE	Design for Inter Urban Road Pricing Schemes in Europe	5	Tispt consultores em transportes. inovação e sistemas	17	http://www.tis.pt/proj/desire.htm	2.7	1.3	01.09.2000-28.02.2003
ENV-e-CITY	Towards an Environmentally Viable Electronic City	ECONTENT	Aristotle University of Thessaloniki	10	no longer available		1.7	01.01.2002-31.12.2003
EURoPrice	Energy Efficiency of Urban Road Pricing Investigation in Capitals of Europe	SAVE 2	University of Dublin. Trinity College	2	n.a.	0.9	0.4	01.02.1997-31.01.1999
FATIMA	Financial assistance for transport integration in metropolitan areas	4	ITS University of Leeds	6	http://www.its.leeds.ac.uk/projects/fatima	0.8	0.5	01.04.1997-30.09.1998

GRACE	Generalization of research on accounts and cost estimation	6	ITS University of Leeds	15	www.grace-eu.org	3.1	2.4	01.07.2005-31.12.2007
HEATCO	Developing Harmonised European Approaches for Transport Costing and Project Assessment	6	IER Uni Stuttgart	14	http://heatco.ier.uni-stuttgart.de	1.5	1.3	29.02.2004-29.05.2006
HYWAYS	European Hydrogen Energy Roadmap	6	L-B-Systemtechnik Gmbh	34	http://www.hyways.de/	7.9	4.0	01.04.2001-31.03.2007
HyFLEET:CUTE	Hydrogen for clean urban transport in Europe	6	DaimlerChrysler AG	31	www.global-hydrogen-bus-platform.com	43.0	19.0	10.01.2006-09.09.2009
IASON	Integrated assessment of spatial economic and network effects of transport investments and policies	5	Netherlands Organisation for Applied Scientific Research - TNO	10	n.a.	n.a.	n.a.	01.04.2001-31.12.2003
LUTR	Land Use and Transportation Research	5	University of Leeds		www.lutr.net	0.3	0.3	01.06.2001-31.12.2003
MC-ICAM	Implementation of Marginal Cost Pricing in Transport – Integrated Conceptual and Applied Model Analysis	5	Government Institute for Economic Research	14	www.its.leeds.ac.uk/projects/mcicam/		1.8	01.04.2001-30.06.2003
NOE BIOENERGY	Overcoming Barriers to Bioenergy	6	VTT Valtion Teknillinen Tutkimuskeskus	8	www.bioenergynoe.org	8.1	8.0	01.01.2004-31.12.2008
NPF URBAN TRANSPORT	National Policy Frameworks for Urban Transport	DG-TREN	ISIS France	3	www.npf-urbantransport.org	n.a.	n.a.	01.01.2003-31.12.2005
OPTIMA	Optimisation of policies for transport integration in metropolitan areas	4	University of Leeds	6	www.its.leeds.ac.uk/projects/optima/	0.8	0.5	01.12.1995-31.05.1997

PATS	Pricing acceptability in the transport sector	4	Transportes, inovacao e sistemas a.c.e.	9	n.a.	0.7	0.4	01.01.1999-30.6.2000
PLUME	Planning and urban mobility in Europe	5	Transport and travel research	41	www.lutr.net	1.7	1.7	01.11.2002-31.07.2005
PREMIA	Effectiveness of measures to accelerate market introduction of biofuels and hydrogen	6	Vito	6	www.premia-eu.org	n.a.	n.a.	01.06.2004-31.05.2007
PRIMA	Pricing methodologies acceptance	4	Inregia AB	8	n.a.	0.7	0.3	01.01.1999-30.04.2000
PROBIODIESEL	Overcoming non-technological barriers	Intelligent Energy/Alterner	Acciona Biocombustibles	5	www.probiodiesel.com	n.a.	n.a.	2006-2008
PROGRESS	Pricing ROad use for Greater Responsibility, Efficiency and Sustainability in citieS	5	BCC-Bristol city council	29	www.progress-project.org	18.2	7.2	01.06.2000-31.05.2004
PROMPT	New means to promote pedestrian traffic in cities	5	Technical research centre of Finland	7	http://prompt.vtt.fi/	1.5	0.7	01.03.2000-31.12.2003
PROPOLIS	Planning and research of policies for land use and transport for increasing urban sustainability	5	LT Consultants, Finland	8	www.ltcon.fi/propolis	1.6	1.0	01.01.2000-30.6.2003
PROSPECTS	Procedures for recommending optimal sustainable planning of european city transport systems	5	University of Leeds	8	http://www.ivv.tuwien.ac.at/forschung/projekte/international-projects/prospects-2000.html	2.1	1.3	01.02.2000-31.01.2003
RECORDIT	Real cost reduction of door-to-door intermodal transport	5	ISIS - Istituto di Studi per l'Informatica e i Sistemi	9	www.recordit.org		1.5	01.01.2000-31.12.2001

REFUEL	planning the road ahead for biofuels	Intelligent Energy/Alterner	ECN	7	www.ecn.nl/refuel	n.a.	n.a.	2006-2008
SAMI	Strategic Assessment Methodology for the Interaction of CTP Instrument	4	VTT - Technical Research Centre of Finland	10	n.a.	0.9	0.7	01.06.1997-31.05.2000
SCENESUSTECH	Scenarios for sustainable society: car technology systems and the sociology of embedded technologies	4	Trinity College Dublin	4	n.a.	n.a.	n.a.	01.02.1998-31.01.2000
SPARTACUS	System for planning and research in towns and cities for urban sustainability	4	LT - Consultants Ltd.	5	http://www.ltcon.fi	n.a.	n.a.	01.05.1996-31.07.1998
SPRITE	Separating the intensity of transport from economic growth	5	University of Leeds	4	www.its.leeds.ac.uk/sprite	n.a.	n.a.	01.04.2000-30.06.2001
STEPs	Scenarios for the Transport system and Energy supply and their Potential effects	6	Buck consultants international b.v.	14	www.steps-eu.com	0.9	0.9	15.01.2004-14.07.2006
SUTRA	Sustainable Urban Transportation	5	Environmental Software and Services GmbH (ESS)	8	www.ess.co.at/SUTRA/	2.5	1.3	01.07.2000-01.07.2003
TRANSPLUS	Transport, planning, land-use and sustainability	5	ISIS - Istituto di Studi per l'Informatica e i Sistemi	18	http://www.transplus.net/	3.2	2.0	01.04.2000-30.11.2003
TRANS-TOOLS	TOOLS for Transport forecasting and Scenario testing	6	TNO - Netherlands Organisation for Applied Scientific Research	8	http://www.inro.tno.nl/transtools	1.4	1.2	01.10.2004-01.10.2006

TRIAS	Sustainability Impact Assessment of Strategies Integrating Transport, Technology and Energy Scenarios	6	Fraunhofer-gesellschaft zur förderung der angewandten forschung	4	www.isi.fraunhofer.de/trias	1.1	0.6	01.04.2005-31.03.2007
UNITE	Unification of accounts and marginal costs for transport efficiency	5	University of Leeds	20	www.its.leeds.ac.uk/unite	0	3.2	01.01.2000-30.09.2002
VIEWLS	Clear views on clean fuels	5	SenterNovem	19	www.viewls.org	2.1	1.2	01.02.2003-31.01.2005
WALCYNG	How to enhance walking and cycling instead of shorter car trips and to make these modes safer	4	Lund Institute of Technology	10	http://www.tft.lth.se/research/walcyng.htm	0.9	0.5	01.03.1996-31.8.1997
ZEROREGIO	Lombardia & Rhein-Main towards Zero Emission: Development & Demonstration of Infrastructure Systems for Alternative Motor Fuels (Bio-fuels and Hydrogen)	6	Infraserv GmbH & Co. Höchst KG	16	www.zeroregio.com	18.0	7.5	15.11.2004-15.11.2009

1.3.2 Conference objectives and outputs

The conference on Socio-economic barriers to sustainable transport took place on June 18, 2007 in the Charles University headquarters, Ovocny trh 3, Prague. The conference was organized by the Charles University Environment Centre in Prague.

The aim of the conference was to introduce European projects on the selected socio-economic barriers to sustainable transport, their main findings and recommendations. Simultaneously, problems observed during the implementation of these projects and the possibility of their overcoming was discussed.

The economic aspects of sustainable mobility included competitiveness and economic development aspects, comprising the following topics: direct and external costs of transport; transport investment appraisal; regulation of transport services; transport infrastructure pricing; drivers of demand for transport; links between transport, land-use planning and regional development; development of scenarios and evaluation of policies.

The social aspects dealt mainly with equity and accessibility issues, meaning that the benefits of transport strategies should be distributed reasonably equally (social inclusion) and various facilities (employment, shopping, leisure etc.) are easy to reach.

The conference was dominated by two prominent themes – assessment of transport trends and impacts, and breaking dependence on oil. Particularly, results of research and demonstration projects from the 5th and 6th Research Technological Development and Demonstration Framework Programme (RTD FP) were presented.

Speaker selection process

First we contacted 30 researchers working on 16 European projects from 11 European countries to have a presentation at the conference. Finally we managed to have a presentation about 9 European projects. We chose the projects according to their research relevance for the topic, respect of the research audience and published outputs of the relevant EU funded project. Mr. Henrik Gudmundsson was contacted through the electronic registration system (from the questionnaire).

Altogether about 90 participants from various EC countries took place at the conference. They were researchers, students, policymakers, ministerial officers (the Czech Ministry of Transport, Ministry of Environment, Ministry of Industry and Trade) and NGO representatives.

Table 2 gives an overview of speakers and selected projects presented at the conference.

Table 2 Speakers and projects presented at the Prague conference

Name	Institution	Institution quarters	Projects presented	Title of presentation
Michael Wegener	Spikermann & Wegener, Urban and Regional Research	Germany	STEPs	The Challenge of Energy Scarcity for Regions and Cities in Europe
Henrik Gudmundsson	Danish Transport Research Institute	Denmark	IMPACT	Research in barriers for implementation of sustainable mobility

Rainer Friedrich	IER University of Stuttgart	Germany	HEATCO	Harmonised European Approaches for Transport Costing and Project Assessment
Reinhold Wurster	HyWays Coordination Office	Germany	HyWays	A European Hydrogen Energy Roadmap
Georges Feltz	City of Luxembourg	Luxembourg	CUTE and HyFLEET:CUTE	The operators' view and experiences
Ashok Rastogi	Becker Technologies	Germany	ZERO REGIO	Lombardia & Rhein-Main towards Zero Emission
Kes McCormick	IIIEE Lund University	Sweden	Noe-Bioenergy	Overcoming Barriers to Bioenergy
Juliane Muth	Volkswagen AG	Germany	RENEW	Renewable Fuels for Advanced Powertrains
Luc Pelkmans	VITO - Flemish Institute for Technological Research	Belgium	PREMIA	Impact Assessment of Measures to Support the Market Introduction of Biofuels

Conference minutes

The conference participants were welcomed by professor Bedrich Moldan, director of the Charles University Environment Center on behalf of organizers, and professor Jan Skrha, vice-rector of the University. Professor Moldan in his introductory speech emphasised that transportation should not only contribute to sustainable development but should become sustainable in itself. He noted that in order to mitigate negative impacts of transport, notably on human health and the environment, every transport mode potential should be employed, both for single mode and in co-modality or in shifting the traffic to more sustainable modes. The energy security issue represents an urgent challenge to a substantial improvement of energy efficiency in the transport sector and as well as development of alternative fuels and powertrains.

Professor Fabio Orecchini from Interuniversity Centre for Research on Sustainable Development (CIRPS) at Sapienza University of Rome introduced the MOBIDAYS project. He defined the goal of the project as twofold – to support the dissemination of EC funded research results and applications/demonstrations dealing with sustainable mobility topics but at the same time to

analyse likely gaps and inconsistencies in the research focus that should be addressed in the next phases of implementation of the 7th Framework Programme.
The introductory section was closed by Mr. Martin Skarka from the Technology Centre of the Academy of Sciences of the Czech Republic. He summarized transport research topics under the 7th Framework Programme.
In the following discussion a few key issues such as a difference between transport and mobility or the importance of accessibility were mentioned. It was also pointed out that a lot of sustainable mobility related research is funded under the Framework Programmes not only in transport research but also other socio-economic topics.
The next section devoted to assessment of transport trends and impacts was opened with the presentation of the STEPs project by professor Michael Wegener from Dortmund based consultancy Spikermann & Wegener. According to modelling done in the project rising energy prices will lead to substantial changes in mobility of households and firms that will affect economic development of large parts of Europe. Furthermore, it will lead to internal re-organisation of cities to accommodate them to high density mixed-use. An optimal approach to mitigate these impacts should be complex and should include infrastructure pricing, investments in public transport and integrate transport and land-use planning.
Mr. Henrik Gudmundsson from the Danish Transport Research Institute presented ongoing project IMPACT that is a part of TransportMistra program, funded by Swedish Mistra Foundation. This project deals with implementation research applied to sustainable mobility particularly focusing on five case studies (EC Biofuel Directive, UK 10-year plan for transport, Stockholm Congestion Charging, "Ørestad" regional planning in Copenhagen, and TetraPak). Main research themes include long-term effects, multi-level governance, new public management, and the role of expertise.
Professor Rainer Friedrich from Institute for Rational Use of Energy at University of Stuttgart presented harmonized guidelines for assessment of transnational project developed in HEATCO project. Such guidelines should aid answering whether a transport project is worthwhile from an overall societal point of view and what alternative is most desirable. The guidelines provide methodology for monetizing following effects – accident risk, air pollution, noise, greenhouse gas emissions, and travel time/congestion.
The hydrogen section of the conference was opened by Mr. Reinhold Wurster from Ludwig Bölkow Systemtechnik who presented European Hydrogen Energy Roadmap developed in the project HyWays. The roadmap foresees that the commercialisation phase will start from 2015 onward and than by 2050 hydrogen and fuel cell will be dominant technologies in passenger car transport. However, there is a need for strong policy support and fast technical learning for achieving such objective.
Mr. Georges Feltz from City of Luxembourg presented experiences gained from operation of hydrogen buses in the projects CUTE and HyFLEET:CUTE. The overall positive evaluation when hydrogen buses were as reliable as new conventional buses is only affected by relatively low reliability of filling stations and spare parts delivery. Despite relatively high average consumption of hydrogen buses the operators deem them as viable solution in the medium term.
Last speaker of this section Mr. Ashok Rastogi from Becker Technologies introduced ongoing project ZERO REGIO aimed at development and demonstration of hydrogen technology in passenger cars in two demonstration sites – Rhein-Main and Lombardia. The project will among other assess competitiveness issues both from consumer and societal perspective, acceptance and regulatory matters.
The biofuel section was opened by Kes McCormick from the International Institute for Industrial Environmental Economics at Lund University who presented Bioenergy Network of Excellence. The case studies made in this project helped to identify the key barriers – economic conditions, know-how, institutional capacity and supply chain co-ordination. As the key triggers in biofuel

market development the project identifies national government commitment and excise duty exemptions or reductions.
Mrs. Juliane Muth from Volkswagen AG presented ongoing project RENEW aiming at development of future generation biofuels. The project looks at both environmental and economic performance of different production processes. Provisional results taking account of different regional biomass potential and production costs shows that on macroeconomic level second generation biofuel production can bring positive effect both in terms of economic growth and employment.
Mr. Luc Pelkmans from Flemish Institute for Technological Research (VITO) presented outcomes from recently finished project PREMIA. This project assessed effectiveness of measures to support alternative fuels on the EU level. Current experiences show that countries with low economic strength and those with low agricultural potential tend to lack in biofuel production and consumption but the actual success also depend on role of agriculture in economy, strength of lobby groups and government commitment.
In the final discussion professor Moldan pointed out that when we are thinking over different aspects of sustainable mobility we should keep in mind the whole picture. This means that we have to avoid embracing policy prescriptive approach and be open to new innovative solutions that may emerge in near future.
During the lunch break there was a press conference with professors Orecchini and Wegener, Mrs. Muth and Mr. Feltz who gave short presentations on respective projects to attending journalists.

1.3.3 Projects analysis

The analysis is structured around the sustainable mobility objectives as formulated by the MOBIDAYS project consortium. Socioeconomic barriers as described in the brochure cover three relatively autonomous topics – social barriers, economic barriers and transport-energy linkages.

We start with a descriptive analysis of projects dealing with socio-economic barriers that were included in our database of RTD projects funded by EC. About one half of 46 projects mentioned in the brochure deal with mobility in cities. This heterogeneous category covers broad range of activities from urban planning to demonstration projects. The objective of 12 projects was transport and land use planning, 10 projects focused on transport pricing and/or transport infrastructure appraisal, 8 projects dealing with energy sources (mainly renewables). A primary concern of 4 projects was the accessibility issue; the demarcation between transport/land use planning and accessibility is however to large extent arbitrary. Another four projects focused on assessment tools. Public acceptance was predominantly addressed in 3 research projects. In addition, 4 demonstration projects were also covered.

Further we tried to link the projects to specific sustainable mobility objectives what is somehow challenging task as the majority of projects addresses at the same time more than one specific sustainable mobility objective. Here, we identified that some 35 projects addressed mainly or partly the objective of sustainable mobility to ensure mobility equity and accessibility. The focus of 23 projects was the options for the reduction of resource utilization (predominantly via land use planning). Some 17 projects put emphasis on limiting pollution (airborne emissions, noise etc.). Development of renewable energy sources was dominantly dealt with in 12 projects with some of them also appearing among 10 projects that were primarily focused on reduction of CO2 and other GHG emissions.
In about 10 projects a particular attention to balanced and efficient use of different transportation modes (co-modality) was given. Innovation and development of transport technologies formed a substantial part of 7 projects. According to our assessment only 6 projects put some emphasis on contribution to regional development a virtually none of projects under scrutiny touched the issue of transport safety (except for pricing/appraisal purposes).

Table 3 Project linkages to sustainable mobility objectives.

Acronym	equity & accessibility	safety & reliability	co-modality	energy & land use	renewable energy	emissions & noise	CO2 emissions	technology & development	economic return	regional development
AcceptH2	*				*	*				
AFFORD	**		*	*		*				
ARTISTS	**		*	*						
ASI	*					*				
ASSESS										
CIVITAS										
CIVITAS-CARAVEL	*		*	*		**				
CIVITAS-MOBILIS					**	**	*			
CIVITAS-SMILE	*		*		**	**				
DESIRE	*								*	
ENV-e-CITY						*				
EURoPrice	*								*	
FATIMA	*								*	
GRACE	*								*	
HEATCO	*								*	
HyWays					*	*	*	**		
HyFLEET:CUTE						**		**		
IASON	*			*					*	
LUTR	*			*						
MC-ICAM	*								*	
NoE BIOENERGY				*	**		*	*		
NPF Urban Transport	*			*	*	*	*	*		*
OPTIMA	*			*		*				
PATS	**								*	
PLUME	*			**						
PREMIA				*	**		*			
PRIMA	*								*	
ProBIODIESEL					*		*		*	
PRoGRESS	*							**		
PROMPT	**		*	*						
PROPOLIS	*			*						
PROSPECTS	*			*						
RECORDIT	*		*							*
REFUEL					**		*			*
SAMI	*									
SceneSusTech	*		*	*						
SPARTACUS	*			*		*				

SPRITE	*		*	*						
STEPs	*			*	*					*
SUTRA	*			*		*				
TRANSPLUS	*			**						*
TRANS-TOOLS	*		*	*	*	*	*			*
TRIAS	*			*				*		
UNITE	*					*			*	
VIEWLS				*	**	*	*		*	
WALCYNG	*		*	*						
ZeroRegio						*	*	**		

Notes: ** – key objective of the project, * – one of the objectives of the project

In terms of project budget the most finance intensive were large-scale demonstration projects (CUTE/HyFLEET:CUTE, CIVITAS projects), while the less finance intensive were projects dealing with transport (and land use) planning, infrastructure pricing and its acceptance (ref Table 1).

With respect to consortium balance the core team was usually formed around universities and research centres, usually cooperating with one or more consultancies. Due to our focus on socioeconomic themes in sustainable mobility it is not surprise that participation of industry is rather limited. Looking at the consortium balance in terms of representation of EU member states according to participating institution affiliation the most active countries are Germany, UK and Italy. There were also four new member states (Hungary, Poland, Romania and Czech Republic) participating in some of the projects.

Table 4 Consortium balance according to participating institution country

Country	Score
Germany	31
UK	29
Italy	28
Netherlands	22
Austria	19
Spain	18
Finland	16
Sweden	16
France	15
Greece	14
Belgium	13
Portugal	13
Hungary	9
Denmark	8
Poland	8
Romania	3
Ireland	3
Czech	3
Luxembourg	1

Among project coordinators those coming from UK, Germany, Sweden and Finland were slightly overrepresented.

Unlike with technically oriented projects the outputs of those dealing with socioeconomic topics are rarely tangible ones (e.g. prototype) and thus we searched for application in the form of

publications in scientific journals and books, use of guidelines, models and other tools. Similarly, due to the primary focus of projects on decision-making sphere there is rather limited scope for evaluation of project outputs' market readiness.
The remaining part of this section provides overall assessment of the projects in one common format describing both research objectives and achieved results and their exploitation.

Table 5 Analysis: Socio-economic projects

Acronym	Research content	Consortium balance	Achieved results	Exploitation of the results	Potential exploitation of results	market readiness
Projects on social aspects related to accessibility, equity and land use planning A bulk of projects dealing with social aspects of sustainability was referred to in the brochure. Majority of them were part of the Land use and transport cluster (LUTR) funded in FP5 in the City of tomorrow programme. A few projects from FP4 are also included (WALCYNG, SPARTACUS).						
SPARTACUS	Develop and apply a comprehensive analytical modelling framework in order to formulate and evaluate long term strategies for sustainable urban development, especially in Europe	FI, ES, DE, UK, IT; consultancies, universities	Strategic urban land-use and transport planning system based on MERPLAN model and using GIS as a platform to produce environmental, social and economic urban sustainability indicators that can be used in assessing policy options and when searching for new and effective ways to attaining urban sustainability, decision support tool USE-IT	The planning system has been used for assessing alternative strategies in Helsinki, Naples and Bilbao; book chapter in Planning Support Systems in Practice (Springer, 2002), journal articles (Transportation Research Record)	Strategic urban land-use and transport planning system	n.a.
WALCYNG	Develop guidelines for enhancing walking and cycling, in order to replace shorter car trips and to make the walking and cycling modes safer	SE, AT, ES, FI, NO, DE, IT, NL; universities, research institutes, consultancies	Inventory report on existing solutions for pedestrians and cyclists, WALCYNG quality scheme, a quality assessment scheme for improvement of walking and cycling facilities	Likely wide, but no published academic papers were found	Guidelines for planning, evaluation of measures for vulnerable road users and for lobbying	n.a.
PROPOLIS	Research, develop and test integrated land use and transport policies, tools and comprehensive assessment methodologies in order to define sustainable long-term urban strategies and to demonstrate their effects in European cities	FI, UK, DE, BE, ES, IT; consultancies, universities	Software tools and the interfaces - enhanced urban land use and transport models and new GIS and Internet based modules, decision support tool	Operational PROPOLIS system has been set in Helsinki, Dortmund, Vicenza, Naples, Bilbao, Inverness and Brussels, journal articles (International Journal of Urban Sciences)	Software tools with additional urban sustainability indicators	n.a.
PROSPECTS	Provide cities with the guidance which they need in order to generate optimal land use and transport strategies to meet the challenge of sustainability in their particular circumstances.	UK, AT, FI, SE, UK, NO, ES; universities, consultancies	Decision-Makers' Guidebook outlining the approach to decision-making, the policy options, and the support tools available, Methodological Guidebook provides more extensive advice on the support tools for evaluation, forecasting and analysis, Policy Guidebook	Journal articles (EJTIR)	Dynamic land-use/transport model SPM and evaluation/optimization procedure to assess the effects of complex strategies formed by policy instrument combinations	n.a.

PROMPT	Concrete objective is to develop new innovative tools and generic solutions to promote walking in cities for city actors involved in urban planning and design as well as decision-making	FI, FR, IT, NO, CH, BE; universities, research institutes	Created a planning framework to encourage walking in cities including a Guidebook. Clustering of problems (scarce space, interference with motorists, lack of outdoor equipment etc.) and families of solutions (dedicated policies, improved public transport, developing green nodes etc.).	publication on LUTR cluster projects (Mashall S., Banister D. (eds.) Land Use and Transport: European Research Towards Integrated Policies, Elsevier, 2007)	guidebook	n.a.
TRANSPLUS	Analysis of best practice and planning tools aimed at reducing private car use, fostering public and non motorised transport modes	IT, UK, AT, BE, DE, NL, FR, SK, MT, PL, RO; universities, research institutes, consultancies	More than 20 cities were analyzed in depth about their integrated transport and land-use monitoring activities, a set of indicators to evaluate combined land use and transport policies, good practices have been identified and fed into Guidelines: achieving sustainable transport and land use with integrated policies	Publication on LUTR cluster projects (Mashall S., Banister D. (eds.) Land Use and Transport: European Research Towards Integrated Policies, Elsevier, 2007), journal article (International Planning Studies)	Use of the Guidelines	n.a.
SUTRA	Develop and apply an indicator based approach compatible with Agenda 21 and common indicators for urban sustainability for a baseline analysis, ranking and benchmarking, use traffic equilibrium modelling, air quality modelling, economic analysis and energy systems analysis and modelling for case studies	AT, PT, GR, PL, AR, DE, IT, IL; universities, industry	Better information basis, planning and decision support tools designed for the direct use by city administrations, integrated system VADIS for the simulation of urban air pollution in city centres.	Publication on LUTR cluster projects (Mashall S., Banister D. (eds.) Land Use and Transport: European Research Towards Integrated Policies, Elsevier, 2007), journal articles (Cybernetics and Systems)	Use of modelling tools case studies in Buenos Aires, Gdansk, Genoa, Geneva, Lisbon, Tel Aviv, and Thessaloniki	likely
PLUME	Addressing issues of Land-Use and Mobility Planning - User Needs and Barriers to Implementation, Identification and Synthesis of Solutions, benchmarking	AT, ES, GR, NL, PT, SE, UK, IE, RO, PL; universities, research institutes, consultancies	Set of indicators for benchmarking of integrated processes in urban and mobility planning including implementation of Aalborg Charter commitment.	Publication on LUTR cluster projects (Mashall S., Banister D. (eds.) Land Use and Transport: European Research Towards Integrated Policies, Elsevier, 2007)	Building local sustainability	n.a.
ARTISTS	The project aims at encouraging new ways of thinking about how arterial streets are conceptualised, designed and managed, as part of the overall street system. This requires a rethinking of how the various functions of the arterial street are reconciled a	SE, DK, UK, GR, ES, PT, HU; universities, municipalities, consultancies	Comparative assessment of European arterial streets, guidance for planners and decision makers when reconstructing arterial streets. Compiled a set of pilot indicators for assessing street 'performance' as a classification tool. 40 case studies in 9 countries	Belfast (?), publication on LUTR cluster projects (Mashall S., Banister D. (eds.) Land Use and Transport: European Research Towards Integrated Policies, Elsevier, 2007)	Guidelines for re-designing of arterial streets to improve the physical environment of the corridors while contributing to the implementation of more sustainable urban transport systems	n.a.
ASI	Selection of five City-of-Tomorrow implementation-sites in different parts of Europe and to find out how Quality of Life (QoL) aspects are assessed and taken care in these areas. To develop a toolbox to assess the LQ effects of proposed and implemented policies and	AT, IT, CZ, NL; universities and research institutes	Toolbox for the assessment of QoL in connection with urban planning, transport and mobility; relational databank and guidelines for practitioners	Publication on LUTR cluster projects (Mashall S., Banister D. (eds.) Land Use and Transport: European Research Towards Integrated Policies, Elsevier, 2007)	Urban and transport planning	n.a.

	measures was developed and tested based upon the results of the evaluation					
Projects on assessment related to transport policies The relatively heterogeneous category of projects dealing with assessment includes project developing modelling and benchmarking tools, producing scenarios and integrated assessment. We cover two projects from FP4 and another two from FP5, three projects from FP6 and a DG-TREN funded assessment of European Transport Policy White Paper.						
SAMI	Define and develop decision models (presented in a report and an interactive computer program) which can be used in relation to the interactions between policy instruments/measures and identified CTP targets	FI, UK, PT, AT, NL; research institutes, universities, industry	Set of core tools including multicriteria, quantitative and qualitative evaluation software package SAMIsoft.	Software package SAMIsoft has been used several times to support policy decisions in Europe; publications (e.g. Trans Res D)	Software package SAMIsoft	n.a.
SceneSusTech	The project explores the relationship between urban citizenship and urban transport in working out series of parallel case studies of four medium sized European cities with developing of scenarios showing the social consequences of alternative forms of transport in its city	IE, GR, IT, FI; universities, research institutes	Scenarios for transport policy for 4 case study areas (Athens, Bologna, Dublin, Helsinki). The project finds that there is only weak evidence that reducing car usage contributes to social cohesion, but stronger evidence that reducing car dependency contributes to social inclusion	Journal articles (International Journal of Urban and Regional Research, Theory Culture Society, European Societies)	In designing transport policy	n.a.
IASON	To improve existing assessment procedures by building a practical assessment framework for integrative evaluation, reviewing existing methodologies of assessment and identifying issues that are critical for a successful application.	NL, UK, DE, HU, FR; universities, research institutes, consultancies	Development of two assessment model - SASI (quasi production function model) and CGEurope (general equilibrium model) for transport project appraisal	Network effects and total economic impact in transport appraisal, James J. Laird, John Nellthorp and Peter J. Mackie, Transport Policy, Volume 12, Issue 6, November 2005, Pages 537-544	Book chapter Wolfgang Schade, Werner Rothengatter: Research Issues in Transport Economics: Dynamics, Integration, and Indirect Effects, in: Applied Research in Environmental Economics, Physica-Verlag	Harmonised IO dataset for EU18 and CEE-13
SPRITE	Identify measures to allow economic growth to continue while minimizing the environmental and other negative impacts from transport; exploring the concept of transport intensity using questionnaire and focus groups	UK, DE, IT; universities, consultancies	Based on detailed survey of over 100 experts and series of panel discussions the project identified 7 most promising measures to influence transport intensity, these relate to efficiency, logistics and transport innovation; pricing policies; command and/or liberalization policies; changes in the economy; and the emergence of integrated strategies	Journal articles (e.g. European Journal of Transport and Infrastructure Research)	In sustainable transport policies	n.a.

TRANS-TOOLS	Produce a European transport network model covering both passengers and freight, as well as intermodal transport, which overcomes the shortcomings of current European transport network models.	NL, IT, DE, DK, BE; universities, research institutes, consultancies	European transport network model that covers both passenger and freight transport with interactions to economic and impacts models. Built around ArcGIS framework enabling modelling on network level	n.a.	Trans-Tools model may be used for assessment of construction and improvement of infrastructure, implementation of charging systém or changes in transport costs (e.g. tax or price increase)	Yes
STEPs	Develop, compare and assess possible scenarios for the transport system and energy supply of the future taking into account the state of the art of relevant research and such criteria as the autonomy and security of energy supply, effects on the environment and economic, technical and industrial viability including the impact of potential cost internalization and the interactions between transport and land use	NL, UK, DE, IT, ES, PT, BE; universities, research institutes, consultancies	Analysis of the political, economic, social and technological (PEST) drivers that are prevalent in spatial development, energy use, freight transport and passenger transport, future trends in freight and passenger transport, identification of the main indicators for quantifying energy use in transport	Journal articles (Engineering Sustainability, Networks and Spatial Economics)		
ASSESS	Preparatory works on the mid-term review of the White Paper on the European transport policy	BE, PL, NL, IT, UK, DE, TR; universities, consultancies and research institutes	In-depth review of European Transport Policy	Served as background document for mid-term review of the White Paper on the European transport policy	n.a.	n.a.
TRIAS	Integrated assessment of transport technologies and transport energy supply together with economic, environmental and social impacts. Applied models will act at European scale (EU25) and will include: POLES for energy modelling, ASTRA for transport modelling and integrated sustainable assessment, VACLAV for detailed transport modelling and Regio-SUSTAIN for small scale analysis of environmental impacts	DE, IT, BE; research institutes, universities	Long-term outlook for global transport and energy demand, scenario-based pathways for transport, technology and energy to promote sustainability in the EU.	n.a.	Transport and land use planning	n.a.
Projects on external costs, appraisal and transport accounts There were 5 projects included in our analysis focusing on external costs, transport project appraisal and building of transport accounts – 3 of them in FP5 and 2 in FP 6.						
MC-ICAM	Defining optimal (full, first-best) end states in the short, medium and long term compared to current situations – for all main passenger and freight modes, covering both urban and interurban issues, and taking account of relevant technological, institutional and national contexts	UK, FI, NL, IT, NO, GR, DE, BE, HU, SV, IL; universities, research institutes, consultancies	Impacts of pricing system as a function of its scope, optimal prices in phased implementation, impacts of differentiation, impacts of the use of revenues, long-term impacts through land use	Journal articles (Transport Policy), book Measuring the Marginal Social Cost of Transport (Elsevier, 2005), chapter in Road Pricing, the Economy and the Environment (Springer, 2008)	Options for achieving co-modality	n.a.

UNITE	Unification of accounts and marginal costs for Transport Efficiency-developing pilot transport accounts for all modes, for the EU15 and additional countries; providing a comprehensive set of marginal cost estimates relevant to transport contexts around EU	UK, BE, DE, IT, FI, SE, AT, NL, ES, FR, CH, PT, GR; universities, research institutes, consultancies, industry	Empirical estimates of marginal costs for key cost, benefit and revenue categories, various contexts around Europe, a wide range of passenger and freight modes, guidance on future approaches to the development of transport accounts, pilot transport accounts for 18 countries	Further elaborated in GRACE project, served as input for EC Handbook on estimation of external cost in the transport sector (2008)	Guidance on transferring marginal cost estimates to new contexts, update of national accounts	n.a.
RECORDIT	Design a comprehensive methodology for the calculation of real (internal +external) costs of intermodal freight transport, analyze current charging and taxation systems to understand price formation mechanisms, analyze technical and organizational cost reduction options	IT, UK, GR, DE, FR, NL, DK; research institutes, universities	Three corridors analysed - Patras - Brindisi - Milano - Munich - Hamburg and Gothenburg, tri-modal transport chain between Genova - Basel - Rotterdam and Manchester, door-to-door intermodal chain along the corridor Barcelona - Lyon - Torino - Verona - Budapest and Warsaw	Journal articles (e.g. European Journal of Transport and Infrastructure Research), served as input for EC Handbook on estimation of external cost in the transport sector (2008)	Interactive software enabling to estimate the costs. identified priority areas where intermodal costs could be reduced through a better organization of services and a more effective and systematic use of efficient technologies	n.a.
HEATCO	Develop widely accepted and harmonized set of guidelines for the strategic environmental and economic impact assessment of EU transport projects and policies	DE, UK, HU, IT, NL, DK, CH, NO, ES, GR, CZ, AT,SE; universities, consultancies, industry	Review of current practices, guidelines for assessment of transport projects, monetary estimates for key impacts - noise annoyance, value of travel time savings	Endorsed by DG REGIO in Guidance on methodology for CBA for programming period 2007-2013, input for EC Handbook on estimation of external cost in the transport sector (2008)	Assessment of large transport projects	n.a.
GRACE	Undertake new case study research to address gaps in the existing level of knowledge of marginal social costs for road, rail, air and water borne transport develop and refine the methods of using transport accounts to monitor the implementation of transport pricing reform	UK, DE, PL, IT, BE, HU, ES, SE, CH; universities, consultancies, research institutes	Marginal cost case studies for road and rail transport, air and water transport. Guidance on effective trade off between pricing systems that give appropriate incentives by portraying variations in marginal social cost in time and space in detail and pricing systems that are easily understood and acted upon	Input for EC Handbook on estimation of external cost in the transport sector (2008)	For pricing policy	n.a.
Projects on pricing and its acceptance We have referred to 8 projects dealing with transport pricing and its acceptance – 5 of them were funded in FP4, 2 in FP5 and one was a part of DG-TREN SAVE programme.						
AFFORD	The project aims to show that marginal cost pricing in combination with other fiscal and financial measures can in practice effectively internalize transport externalities such as congestion and environmental impacts, and can regulate demand in a way that is socially efficient and equitable	FI, UK, GR, IT, DE, ES, NO; universities + consultancies	Empirical analysis of public acceptability of pricing strategies shows that as expected current acceptability is rather low. The factors that influence degree of acceptability the most were social norms, expected personal outcome and perceived effectiveness	Journal articles (Schade J, Schlag B: Acceptability of urban transport pricing strategies, Transportation Research Part F: Traffic Psychology and Behaviour, Volume 6, Issue 1, March 2003, Pages 45-61)	e.g. in designing demand management schemes	n.a.

PRIMA	Assessing the acceptance of road pricing schemes in 8 cities, evaluate different scheme designs, develop guidelines for removing barriers to implementation using three theoretical approaches - decision support theory, public choice theory and policy games.	SE, NL, CH, FR, ES; consultancies, research institutes, universities	The project provides a descriptive overview of different obstacles affecting the design of optimal road pricing scheme and outlines decision-making processes in case study cities. The project concludes that public attitudes towards road pricing is rather negative - no urban pricing scheme under investigation finds even 30% acceptance	Disseminated in IMPRINT-EUROPE, used in DESIRE and quoted in Viegas JM: Interurban road charging for trucks in Europe, Research in Transportation Economics Vol. 11, Elsevier, 2005	In designing urban pricing schemes	n.a.
PATS	Identify the reasons behind the attitude of acceptance/non-acceptance of transport pricing, and the arguments that support those standpoints; Find the means and measures to increase its acceptability; Identify the legal and political barriers to the implementation of pricing schemes, analyzing the distributional impacts, and designing acceptable pricing schemes and policy packages, taking account of efficiency and fairness issues	PT, UK, SE, AT, NL, CH, FR, DE; universities, research institutes, consultancies	The project concludes that the acceptability of transport pricing may be more dependent on practical institutional issues, convictions and beliefs of the stakeholders than on its economic foundation.	Journal articles (Journal of Transport Economics and Policy), chapters in Transport Projects, Programmes and Policies - Evaluation Needs and Capabilities (Ashgate, 2003)	Socio-economic principles for price acceptability, design acceptable solutions for pricing packages, recommendations for Transport Pricing Strategies	n.a.
OPTIMA	Optimisation of policies for transport integration in metropolitan areas	UK, IT, AT, FI, NO; universities, public transport operators	Project defines combinations of policy measures to achieve optimum economic benefit in urban transport system using modelling methods and coupled with questionnaire to assess the feasibility and acceptability of optimum strategies. The most frequent concerns relate to financial feasibility and also to existing legislative barriers (e.g. to road pricing)	Journal articles (Transportation, Transport Policy)	Provides relative benefit (over the nine case study cities) of each measure with respect to the two objective functions used - Economic Efficiency Function (EEE) and Sustainability Objective Function (SOF)	n.a.
FATIMA	To identify the benefits to the private sector of optimal urban transport strategies, to determine the differences between strategies optimized using public funds and those optimized within the constraints imposed by private funding initiatives, to to propose mechanisms by which private sector funding can be provided so as to achieve appropriately optimal transport strategies while maintaining quality of operation, and to use the results to provide more general guidance on the role of private sector funding for urban transport	UK, FI, AT, IT; universities, research institutes	Recommendations for the design of optimal transport strategies, for the involvement of the private sector, methodological recommendations and recommendations for further research	Journal articles (Transportation, Transport Policy), conference presentations (e.g. CORP 2001)	For designing transport strategies	n.a.

DESIRE	Assessing distance based inter-urban road pricing in Europe, focusing on heavy vehicles and considering future extensions towards other type of vehicles, provide guidelines for the design of those schemes and ways to overcome its implementation difficulties	PT, UK, AT, CH, DE, BR, BE, HU, NL FR; universities, consultancies, research institutes, industry	The project highlights the need to move towards variabilization of motoring costs - larger part of cost should be linked to actual use. Estimates of impacts of application of road tolls - on freight transport (no modal shift is envisaged), GDP (majority of additional costs absorbed in the sector), environment and safety (restructuring of vehicle fleet).	Published as Viegas JM "Interurban road charging for trucks in Europe", Research in Transportation Economics Vol. 11, Elsevier, 2005	Introducing of pricing scheme	n.a.
PRoGRESS	Demonstrate and evaluate the effectiveness and acceptance of integrated urban transport pricing schemes to achieve transport goals and raise revenue	UK, IT, SE, NO, FI, DK; municipalities, uni, research institutes, consultancies	One operational road pricing scheme, five demonstration schemes to simulate charging systems (initially three of them had to be fully operational systems) and a modelling study. In about 60 lessons learned for consultation and information, legal and legal and institutional issues, technology and transactions, enforcement and user acceptance were elaborated	Journal articles (Transport Reviews, Journal of Transport Geography, Mobilities)	Designing and implementation of electronic toll systems	n.a.
EURoPrice	The project focused on the following European capital cities as test sites: Dublin, London, Athens and Budapest where road pricing pilot-actions and associated modelling will be designed and implemented except in Budapest where modelling alone will be conducted	IE, GR, UK, HU	Road pricing pilot-actions and/or pricing effects modelling in Dublin, London, Athens and Budapest	Europrice network (Phase II working until 2002) - http://www.europrice-network.org/	For designing urban pricing scheme	n.a.
Projects on socioeconomic aspects of biofuels and hydrogen A selection of research projects focusing on socioeconomic aspects of biofuels and hydrogen include two FP5 projects (VIEWLS and AcceptH2), 3 FP6 projects (HyWays, NoeBioenergy, and PREMIA), and two Intelligent Energy/Alterner projects.						
VIEWLS	Collect and analyze data, potential, scenarios, markets and trade of biofuels	NL, GR, DE, SE, HU, CZ, HU, FR, AT, DK, ES, RO, CA, US; universities, research institutes, consultancies	Provides estimates of GHG reduction potentials from biofuels - for current biofuels in range of 30-50% for second generation in range of 50-90%. Given the high prices of oil substantial amount of biomass may be produced in competitive way in Europe without food and wood production if Eastern European agriculture undergoes re-structuring	Further elaborated in REFUEL project	BioTrans model	n.a.

AcceptH2	To assess public acceptance of hydrogen transport technologies and economic preferences towards the potential and actual use of hydrogen buses by conducting 'before' and 'after' economic valuation studies in London, Berlin, Luxemburg, Perth and Oakland.	UK, DE (and non-EU); universities and consultancies	A questionnaire survey carried out in four cities – Berlin, London, Luxembourg, and Perth (Australia) revealed on the one hand a generally unconditional support to large scale introduction of hydrogen buses, which was, on the other hand, not apparent in an increase in willingness to pay of extra bus fares – on average only 0.35 € per bus user	Journal articles (Journal of H2 Energy, Energy Policy), conference presentations (Hydrogen & Fuel Cell Futures 2004, European Hydrogen Energy Conference 2005, 15th World Hydrogen Energy Conference, 13th EAERE Conference)	Guidelines for operators 'How to run effective hydrogen demonstration projects'	n.a
HyWays	An integrated project to develop the European Hydrogen Energy Roadmap	DE, UK, NO, ES, NL, IT, FR, PT; universities, research institutes, consultancies, industry	European Hydrogen Energy Roadmap and recommendations for stakeholders concerning realistic regional options to build the hydrogen energy infrastructure. The proactive introducing of hydrogen into the energy system would reduce total oil consumption by the road transportation sector by 40% between 2008 and 2050	Journal articles (International Journal of Hydrogen Energy), conference presentations (IEA workshop, International Conference on the Sustainable Automobile)	In policy-making	n.a.
PREMIA	Assessment of effectiveness of support programmes to facilitate and secure market introduction of alternative fuels in the EU	BE, ES, GR, FI; research institutes	Identification of drivers to development of biofuel market - dominantly by country specific conditions including the strength of agricultural sector, industry and lobbies. Provide detailed assessment of measures taken by eight member states: Austria, Czech Republic, France, Germany, Poland, Spain, Sweden and the United Kingdom	Interim results used as input for EC Biofuels Progress Report	In setting biofuel policies	n.a.
NoE BIOENERGY	Technology development and implementation, policy actions and market strategies in the field of bioenergy. cover all processes, components and methods necessary for establishing successful "bioenergy chains" to produce heat, electricity and biofuels for t	FI, SE, AT, PL, DE, FR, NL; universities	The case studies expose four points about barriers to bioenergy. First, there are no absolute barriers to realising the potentials of bioenergy in the EU. Second, it is non-technical challenges that are hindering bioenergy rather than technical issues.	Kes McCormick, Tomas Kåberger: Key barriers for bioenergy in Europe: Economic conditions, know-how and institutional capacity, and supply chain co-ordination, Biomass and Bioenergy, Volume 31, Issue 7, July 2007, Pages 443-452	Development of efficient policies for renewable energy development	n.a.
ProBIODIESEL	Promote biodiesel as a competitive and commercial product, including assessment of social acceptability in Germany, France and Spain	ES, AT, DE, GR; consultancies, industry, universities	Ongoing	n.a.	n.a.	n.a.

1.4 European research on vehicles for sustainable mobility

1.4.1 Overview of the considered projects

This section of the London conference dealt with sustainable vehicles. Starting off with the database compiled by the MOBIDAYS consortium, the IST further worked to find projects connected with the vehicle innovation and individualized the 170 projects reported in the MOBIDAYS brochure on vehicle projects classified in the following way:

- Conventional Internal Combustion Engines
    - Diesel and Gasoline
    - Alternative Fuels
- New Combustion Modes
- Hybrid – Electric Vehicles
- Fuel Cell Vehicles
    - 5.1 Fuel cell stacks and related technologies
    - 5.2 Integration and applications to road vehicles
- New Materials and Manufacturing Processes
- Vehicle noise
- Vehicle Safety
- New Vehicle Design Concepts – Urban Mobility

The conference brought together researchers working on various in-vehicle technologies aimed at achieving sustainability in transport. Key outcomes of a selection of EC-funded projects were presented by the invited speakers, as the way to stimulate the discussion among all participants on what these projects have achieved, what their practical applications have been, what their pitfalls are, and what priorities should be set for future research and demonstration activities in the EU.
The emphasis has been put on advances of powertrain technologies towards zero and near-zero emissions; including hybrid-electric architectures combined with either fuel cells, or internal combustion engines with innovative low emission combustion modes and multi-fuel capabilities.
Speakers were invited in a personal basis, after the general coordinator of Mobidays has sent a general invitation to a wide mailing list of coordinators of European funded projects. Due to the very limited time available, the program of the conference included the presentation of only five projects, as reported in Table 6.

Table 6 Project summery. Projects on vehicles

Acronym	Full name	FP (EC Framework Programme)	Coordinator	Partners (number of partners)	Website	Budget (M€)		Project timing
						Total	EC contribution	
FRESCO	European development of a fuel-cell, reduced-emission scooter	5	ECN - Frans Willem SARIS	3		0.3	0.3	01.01.2003-30.06.2005
HOST	Human Oriented Sustainable Transport	6	CIRPS - Interuniversity Research Centre of Sustainable Development – Fabio Orecchini	9	http://www.hostvehicle.eu/		2	01.01.2005-31.12.2007

HyHEELS	Hybrid high-energy electrical storage	6	Siemens, DE	12	http://wwwa.vito.be/hyheels/	4.7	2.6	01.11.2005-31.10.2008
SPACElight	Whole space combustion for diesel light duty vehicles	5	IFP-Innovation, Énergie, Environnement	7		4,1		2001-2003
PROCURA	Alternative Fuel Vehicle Procurement: EU project PROCURA	EIE programme	Ecofys	11	www.procura-fleet.eu			

1.4.2 Conference objectives and outputs

The second part of the conference addressed to the potential of vehicle technologies for sustainable mobility. The emphasis was on advances of power train technologies towards zero and near-zero emissions; these include hybrid-electric architectures combined with either fuel cells, or internal combustion engines with innovative low emission combustion modes and multi-fuel capabilities. Other vehicle technologies, such as materials to reduce vehicle weight and life cycle costs, safety technologies and other design features, has also been addressed particularly those showing a high potential for improving sustainability in transport.
Among the 250 projects, 170 were considered in the conference brochure and five were selected for the conference oral presentations. They are funded by the 5th and the 6th Framework Programmes and one is supported by the EIE programme.

Table 7 Conference presentations. Vehicle section.

Name	Institution	Institution quarters	Projects presented	Title of presentation
Frank De Brujin	ECN-Energy research Centre of the Netherlands	Netherlands	FRESCO	FRESCO
Federico Villatico	CIRPS - Centro Interuniversitario di Ricerca per lo Sviluppo Sostenibile	Italy	HOST	HOST
Erik Verhaeven	VITO - Flemish Institute for Technological Research	Belgium	HyHEELS	HyHEELS
Christian Angelberger	IFP Powertrain Engineering	France	SPACElight	SPACElight
Michaela Mönter	NTDA Energía	Spain	PROCURA	PROCURA

Some outcomes from the conference:

- To check the other projects concerning the same area was recommended.
- To gather & summarize the EU and national projects the following information are individualized as fundamental:
  - general information: title/project name, author(s), contact person(s), project website, affiliation(s), comm. authority and period
  - technical information: category (university, research institute or industry), study level (component, energy subsystem or system), research setup & goals, component provider(s) and useful links, main findings and results.

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- With regard to the technical aspects, strong emphasis on developing innovative technologies sometimes makes project objectives difficult to achieve, in the sense that objectives have sometimes become over-ambitious

It is worth to report that one of the consequences of the conference was the collaboration between the company called APG Traffic Management and the PROCURA project. The represent of APG present at the conference contributed to the public consultation on Certification issues within the PROCURA Project

1.4.3 Projects analysis

The analysis performed during this period addressed the scientific research and technological development efforts made in Europe in all areas of knowledge and which contributed, either independently or in synergy with each other, to the development of new in-vehicle technologies.
In addition to engine related, further technologies have been considered, which have the potential to decrease CO_2 emissions. Examples are gear-shift indicators, tire pressure monitors, efficient air-conditioning and light-weight car parts to ensure a steady further carbon reduction in the coming decade. Materials and manufacturing processes are additional areas of research which allow giving a step forward.
A recent study refers that the additional manufacturer cost required to go from a mild 5% to a strong weight reduction 30%, increases ten times, as taken from the FP6 project Super LIGHTCAR/ SLC (Sustainable Production Technologies of Emission reduced Light-weight car concepts). Even though, vehicles are now reaching the market, which managed substantial performances at the expense of low weight strategies. High class vehicles such as the new BMW series 5 makes use of an aluminium 2,0 litre Diesel engine blocks. But, of much relevance is the fact that Japanese industry is bringing such measures into low class vehicles, such as the new Mazda 2, which integrates weight savings in the electrical cables, cooling, fuel supply and exhaust systems and suspension Another big environmental problem issued by road transport is the noise generated by traffic and vehicles, particularly in urban areas. Overall noise reduction calls for innovative technologies for per-vehicle noise reduction. Although interior noise remains a top priority for buyers, exterior noise will be the dominating noise issue in vehicle design requiring addressing topics such as tyres, engine, exhaust and intake systems and vehicle driving conditions.
Besides socio-economic and environmental issues, sustainable transportation also considers safety as a specific goal.
In the context of the aforementioned, the analysis of in-vehicle technologies for sustainable development considered the following topics:

- projects leading to the latest developments in spark-ignition and compression-ignition engines, including those burning alternative fuels;
- innovative combustion modes for lean burning of fuel, e.g., Homogeneous Charge Compression Ignition (HCCI) and Control Auto Ignition (CAI);
- the developments towards hybrid-electric powertrain architectures with, either a combustion engine, or a fuel cell vehicles, respectively;
- the projects addressing new materials and manufacturing processes;

- noise;
- vehicle safety and
- new vehicle design concepts, particularly those leading to innovative urban vehicles and integrated mobility systems.

The analysis has been based on the deliverables of the several EU funded projects analysed so far, as well as on personal discussions with researchers and industries. In addition, the organization of a half-day conference provided the opportunity to join together experts and general public; as well as the participation in conferences and dedicated workshops provided additional valuable means to accomplish the analysis.
Considering the projects reported in the brochure, the most necessary research topics to improve current vehicle technologies are analysed and up to the current point of the analysis, positive and negative aspects of innovative vehicles have been identified as follows:

- Direct injection diesels have been contributing significantly to the European strategy for reducing CO_2 emissions from cars and will continue to improve their environmental performance as particulate matters are being standardized, emissions of nitrogen oxide will further diminish and cleaner fuels are introduced in the coming years. Today, Diesel benefits and costs fall between gasoline engines and gasoline electric hybrids. The environmental benefits of the diesel engine extend also to light and medium and heavy trucks. In these sectors there is no competition that can match diesel's level of efficiency.
- SI engine downsizing has become a primary concern in Europe as the commitment made by the European automobile manufacturers to reduce average carbon dioxide emissions, but other areas emerge with the potential to better optimize yet conventional designs: spray-guided DISI is under development as a next-generation DISI system for gasoline engines to contribute to improving fuel consumption and the homogeneous charge compression ignited (HCCI) now emerges as a fuel-efficient, low NO_x combustion process.
- New lean-burn combustion modes, e g., CAI and HCCI offer the advantage of diesel efficiency, e. g., low CO_2 and high specific power output, with virtually no soot or NOx. However, combustion control is complex and so it remains a research area with no full CAI-HCCI engines yet being demonstrated. Partial HCCI systems may reach the market in about 5 years in premium cars. But a pure HCCI engine would work best in an application were it can run at constant speed like in a series-hybrid where the combustion engine only drives a generator. Both of these engine types are still at least 5-10 years from production.
- All European car manufacturers have been involved in the research and development of hybrid engines and many models are expected to reach the market very soon, including the hybrid diesel car, which combines the best ICE technology with electric boosting. Short term possibilities will use alternative fuels or lean burn combustion technologies, while hydrogen and fuel cell engines will follow in the longer term. However, the hybrid-electric configuration of a powertrain allows combinations tailored for different usage, driving locations or circumstances and consumer preference. It is forecasted that technological developments will look in this direction.
- Fuel cells can be a long term solution, but before Fuel Cell Vehicles (FCVs) reach the market, significant research and development is required to reduce cost and to improve performance. Cost is a key challenge in the transport sector, in terms of both purchase and operation. Both the fuel cell and hydrogen storage could be more than ten times more expensive than their conventional counterparts if introduced today. But other challenges still remain, including robustness of the product in the hands of the public, training of maintenance technicians, and satisfying authorities and users that the technology is safe. Hybrid-electric powertarins making use of FCs will allow pave the way towards the final technological solution.
- Lightweight construction and innovative composite materials are already demonstrating their potential as a result of extensive R&D efforts in materials science, life-cycle analysis, and the

development of Computer-Aided Engineering (CAE) techniques. More developments are now expected from the synergistic integration of different materials and processing technologies in hybrid structures which make use of the best properties of each. Larger strides towards modular, lighter and more recyclable vehicles are expected from now on due to the big advances that nano sciences are giving towards the development of raw materials, joining technologies and manufacturing processes. A recent study refers that the additional manufacturer cost required to go from a mild 5% to a strong weight reduction 30%, increases ten times, as taken from the FP6 project Super LIGHTCAR/SLC (Sustainable Production Technologies of Emission reduced Light-weight car concepts). Even though, vehicles are now reaching the market, which managed substantial performances at the expense of low weight strategies. High class vehicles such as the new BMW series 5 makes use of an aluminium 2,0 litre Diesel engine blocks. But, of much relevance is the fact that Japanese industry is bringing such measures into low class vehicles, such as the new Mazda 2, which integrates weight savings in the electrical cables, cooling, fuel supply and exhaust systems and suspension.

- Traffic noise is an important environmental noise source in Europe. The noise caused by the interaction between tyre and road can be mostly achieved by development of sustainable transport infrastructures, but vibration levels and noise emitted by the engine are important constrains to take into account in the development of engine components for lower fuel consumption and CO2 emissions. It is foreseen that the synergy with novel materials will play a key role.
- Critical scientific and technological expertise has been mobilized for the development of new technologies for the safety of, not only vehicle users, but of road users in general. Very active R&D is currently under way in the area of information and communication technologies (ICT) to accelerate the deployment of Intelligent Integrated Safety Systems that use information and communication technologies in intelligent solutions, in order to increase road safety and reduce the number of accidents on roads. However, the development of accurate human machine interface is still an important area of research to get the best out of informative systems.
- Automotive manufacturers are beginning to think radically about new ways to provide urban mobility for all; the potentials of hybrid-electric powertrains for integrated solutions are being explored and new approaches to electric vehicles are now emerging based on small automated electrical vehicles as an alternative to the private passenger car. However, it is forecasted that electric vehicles, either battery or fuel cell driven, will soon be considered as optimum solutions for urban mobility, as they show substantial emission and primary energy benefits, and thus CO2 reduction and well-match integrated traffic management concepts. In this context, new advanced energy storage systems are still needed to achieve extended range with low volume and weight at low cost.

The innovations which will have the most impact on automotive engineering in the future are expected from three technology sectors: powertrain (alternatives including electric vehicles), safety (active collision avoidance systems) and navigation. In this context, the future automobile still has much to benefit from research on energy (development of alternative fuels) and sustainable development (through new designs for clean vehicles), as well as intelligent materials, production methods and the information society. Despite cost has always been the major challenge faced by automotive designers and engineers, its importance is now rising again after several years of decline, due to the impact on affordability and on global competitiveness raised by increased technological incorporation.
Taking into account the aspects individualized by the MOBIDAYS consortium, the projects presented at the conference are analyzed more in details, as follows.

FRESCO project The recent project FRESCO (European development of a Fuel-cell, Reduced Emission SCOoter) considered the application of a fuel cell to a scooter. Scooters are a very

popular means of transport in major European Cities and urban areas. However, equipped with 2-stroke internal combustion engines, their use brings also serious pollution and health burdens. Powering with fuel cells would be an attractive alternative, but present fuel cell systems are hard to accommodate in the limited space available in a scooter. The specific challenge of the FRESCO project proved the viability of the clean fuel cell propulsion for small vehicles, by developing a dedicated system and by integrating it in a modern mass-production type scooter. The technological achievements comprise a compact water-cooled PEM fuel cell stack, a super capacitor peak-power device, an innovative electric motor and traction converter allowing for regenerative braking, and a smart system concept minimizing hardware needs for power and control electronics. No patents form the project
But other applications are emerging in the European market with the latest technological developments: the Danish Technology Consortium (DTC) recently announced the presentation of its new two-seat passenger car, the Hywet, equipped with a 13kW electric motor powered by a combination of a high temperature, PEM fuel cell stack, and a rechargeable lithium-ion battery, allowing for a range of 160 km and maximum speed of 80 km/h.
The lessons learnt during the project are reported:

- The development of system components and the system itself within the same project should be prevented
- Up till now, many components are not specifically developed for fuel cell systems:
  - Too large, too heavy
  - Consume too much energy
  - Release components that lead to fuel cell poisoning (e.g. lubricants)
  - Not robust enough

HOST project (Human Oriented Sustainable Transport). HOST is a vehicle designed to work 24 hours per day in urban areas, based on the concepts of flexibility and modularity. Both concepts reflect the human activity in an urban area imposing upon the vehicle's design an exchangeable typology that make it suitable to perform several different missions. The possibility to easily vary the platform main dimension enables HOST to be equipped with very different bodyworks, thus providing new services for mobility and goods transportation in towns, organising in a sustainable and more rational way the urban motorised traffic. The hybrid electric powertrain of HOST is the main feature making it a vehicle oriented for the urban environment: being mission oriented, the combustion engine can be optimized to operate at steady state to produce the exact energy required for the vehicle to accomplish the missions for which it is designed. In this way the engine always operate at peak efficiency conditions, being put to work whenever the batteries State-of-Charge reaches a minimum threshold and shutting off whenever a maximum threshold is reached.
The consortium is composed by nine partners from 7 different countries. Of them, three are Universities and 6 industries.
At the end of the project the main deliverable will be the prototype of the HOST powertrain which is equipped with a drive-by-wire system controlling the electric motor wheel (also in remote control mode).

HyHEELS project provides an UltraCap energy storage system for the use in hybrid and fuel cell vehicles, which satisfies all properties necessary to make an integrative component. Powerful and reliable energy supply is crucial to fulfil the stringent requirements of start up and acceleration in the future generation of hydrogen fuel cell powered passenger cars. Ultracapacitors can fill these requirements but need to be adapted to future automotive hydrogen applications, satisfying the requirements of cost, efficiency, safety and reliability. HyHEELS intends to provide all necessary information to enable the integration of ultracapitors into the fuel cell vehicle architecture based on the current state of the art technology. However, safety and reliability of commercially

available supercapacitors decline at temperatures above 40°C, which are frequently encountered within fuel cell powered vehicles.
The workplan foresees:

- UltraCap modules
    - Development of UltraCap module suitable for automotive applications
- UltraCap controller
    - Development of advanced controller for UltraCap module necessary to satisfy future requirements of all automotive applications
- Advanced research, testing & evaluation
    - Confirmation and validation of initial requirements by simulations and modelling
    - Assessment of added value of UltraCap with possible applications together with environment impact
    - On the road testing with several types of existing hybrid vehicles equipped with UltraCap modules

The work already performed is:

- UltraCap modules
    - Build of a standard cell module for hybrid and fuel cell vehicles
        - Compromise between energy content and scalability
        - For middle and high power applications
        - Maximum operating voltage
        - Modules developed and tested
    - Test plan is worked out to approve modules and to document product development process
    - UC module main components / functionalities:
        - Cell
        - Housing
        - Cooling system
        - Controller
- UltraCap controller
    - Complete diagnosis of energy storage for future vehicle applications
    - Potential free voltage measurement
    - Charge balancing system to maintenance individual cells to avoid
        - Overcharge of mismatched cells
        - Inhomogeneous temperature distribution within module
        - Exceeds 2.8 V over a longer period
        - Decrease of expected life time of capacitor
        - Lost in capacity
        - Increase of the internal resistance
    - Requirements on the UltraCap controller for different applications (passenger car, heavy duty) were completely analysed and compiled
    - Best configuration of one UltraCap module was determined
- Advanced research, testing & evaluation
    - Confirmation and validation of initial requirements by simulations and modelling
    - Several templates and formatted documents to ensure common approach generated and received data was reviewed
    - Simulations (passenger car, heavy duty) were performed
    - Report on recommendations by other research
    - Possible opportunities for dissemination were identified

The achievements are:

- Gathering and compilation of requirements for UltraCaps and controller
- Advanced UltraCap development and testing

- Advanced packaging
- Ultracap controller development with set up of evaluation board include cell balancing and voltage measurement
- Concentration on other research with first consideration regarding to design simulations of the power train
- Life time tests at different conditions and basic work on carbon to define characteristics with
  goal to increase capacitance density and operating voltage
- Voltage measurement realized
- First balancing tests performed
- Feedback from the other WP's by start-up of collection input data from OEM's
- Gathering of information with dedicated input datasheets for each test vehicle
- Requirements to allow proper integration of new UltraCap modules and instrumentation
- Collection of recommendations from other projects
- Identification of possible opportunities for dissemination
- Collection of LCA inputs

SPACElight project investigated the combination of several engine and injection technologies andimpl emented them on single-cylinder engine concepts up to final economic and technical assessment of the in-vehicle on the road potential. The objectives were to meet EURO 4 emissions limits without fuel sensitive after treatment for NOx and/or particulates, while maintaining the low CO2 emissions advantage of the best state of the art diesel engines.
Space light was a R&D projects maily oriented to HCCI Diesel application for automotive. The other EC funded projects on HCCI generic combustion research are:

- 4-SPACE (1998-2000) carried the basic research. The engine concepts was developed in the Gasoline CAI project
- D-ULEV IntegrationPlatform (2001-2004)
- Hy-SPACE (2002- 2004) which carried out the Diesel HCCI R&D for truck & bus
- EUCAR CO2PERATE program
- Some outcomes exploited for the FP6 NICE project, subproject A1.

The HCCI (or LTC) has demonstrated very good potentials to reduce engine-out emissions Considering the on laboratory single cylinder engines. More investigations have to be carried out on its real-world implementation and the multi-cylinder application have to be deeply studied with wide operating range (realistic compromise between NO_x/PM, CO_2, HC/CO, noise, interaction with after-treatment, costs, compatibility with alternative fuels).
Its wide introduction into the market will depend on EU pollutant legislations.

PROCURA project which was launched right after, assist the market development of alternative fuels and vehicles through the establishment of large scale demonstration projects, aiming to provide a thorough understanding of the barriers and issues associated with the market penetration of alternative fuels and respective vehicle technologies in Europe. PROCURA also includes bio-diesel and natural gas vehicles and the work programme further addresses the development of models for large-scale procurement of such vehicles. Moreover, PROCURA also aims to set up novel ways of facilitating green fleet procurement via GreenLease schemes, organizing secondhand market development, and designing a certification system for Alternative Fuel Vehicles.
Some of the barriers individualized to the alternative fuel vehicles (AFV) are:

- Lack of Infrastructure
- Maintenance & Repair
- Market Knowledge
- Purchase costs

- Changes in consumer's driving behavior
- Lack of second-hand market

Some of the proposed solution are:

– Creating central buyer pools for Infrastructure maintenance and repair facilities buyer power (purchase cost)
– Dissemination of Best practices & Provide state of the art manuals/tools
– Incentive systems & Financing schemes
– Application of the Incentive systems & Financing schemes
– Pilot case studies

In the frame work of the project manuals will be produced. They will be on

- Market Barriers for Large-Scale AFV Procurement
- Infrastructure development for AFVs
- Training Guidelines for Maintenance and Support of AFVs
- User manual for fleet owners concerning AFVs
- Available incentive systems

Acronym	Research content	Consortium balance	Achieved results	Exploitation of the results	Potential exploitation of results	market readiness
FRESCO	Application of a fuel cell to a scooter. *The Objectives are:* • Clean fuel-cell propulsion for scooters • Proof viability by integrating in mass-production type • State-of-the-art performance & comfort, 0.8 m/s², 75 km/hr & 100 km *The Technical Content proposed:* • Innovative system layout with variable rail voltage and regenerative braking • Innovative liquid-cooled 6 kW fuel cell stack • Dedicated 6kW / 120 kJ supercap module with no need for balancing • Integrated bi-directional traction converter • Composite 700 bar hydrogen tank • Vehicle integration, roller bench and circuit testing	4 industries	The realization of the scooter which worked for 10 laps and it reached 50 km/hr. A dedicated PEM was designed for the scooter application • 80 cells • 7.0 kWe • 55 V / 130 A	Results were exploited for: -Piaggio Zip hybrid scooter -Battery powered Zero Emission Urban Shuttle -HydroGem project	The developed PEM could find other applications. One of the lessons learnt is: the development of system components and the system itself within the same project should be prevented	-Deployment of fuel cell vehicles to consumers is a bridge too far. -Captive Fleets are the right entry point (H2 fuelling easier) -Costs need to be much lower than at present. Government funding is crucial for first entry
HOST	HOST is a vehicle designed to work 24 hours per day in urban areas, based on the concepts of flexibility and modularity. The possibility to easily vary the platform main dimension enables HOST to be equipped with very different bodyworks, thus providing new services for mobility and goods transportation in towns, organising in a sustainable and more rational way the urban motorised traffic. The hybridelectric powertrain of HOST is the main feature	3 university 6 industries	Realization of the powertrain prototype. Series hybrid power system. Drive-by-wire system. Electric motor wheel application.	The project is leading to international collaborations to realize a full vehicle prototype.	The diesel engine could be substitute by a FC propulsion system. The concept of a power train which can be emploied for several applications can found further application	Towards a market application, the necessary next step is the realization of the whole vehicle, and after that a miniseries production.

HyHEELS	- Development of an improved energy supply concept for fuel cells based on advanced, powerful Ultra Capacitors (UltraCap's). - Development of advanced UltraCap module for integration into fuel cell vehicle architecture - Advanced research, simulation, installation, and evaluation of UltraCap modules on test benches and existing Hybrid Vehicles	9 Companies /Centre 3 Universities	Development in: -UltraCap modules -UltraCap controller -Advanced research, testing & evaluation Confirmation and validation of initial requirements by simulations and modeling is carried out. Several templates and formatted documents to ensure common approach generated and received data was reviewed. Simulations (passenger car, heavy duty) were performed. Report on recommendations by other research is proposed.	Applications of the technology already on 2 buses and 5 cars. Possible opportunities for dissemination have been already identified	High potential applications in automotive sector.	Close to market application. The objective is to obtain a price of 1€ cent/F.
SPACElight	Investigated the possibility of achieving a wide range of controlled Homogeneous Charge Compression Ignition (HCCI) with near zero NOx and PM emissions while keeping the high efficiency and full load performance level of the best state of the art passenger car diesel engine.	5 Industries 2 Universities	Analysis to Lean out the mixture in the cylinder (early/late injection, multiple injections, new injector technology) and to reduce temperature, levels in the cylinder (high exhaust gas recirculation)	HCCI (or LTC) has demonstrated very good potentials to reduce engine-out emissions	On-going research concerns its real-world implementation	Its wide introduction into the market will depend on EU pollutant legislations
PROCURA	It intends to assist the market development of alternative fuels and vehicles through the establishment of large scale demonstration projects, aiming to provide a thorough understanding of the barriers and issues associated with the market penetration of alternative fuels and respective vehicle technologies in Europe.	1 Municipality 2 Universities 8 Industries	Development of models which are tailored to specific technology stages adapted to national demands, aspects and barriers composed of four principal variables: type of fuel, buyer pools (procurement partners), incentive systems & obligations to green procurement, third party involvement and financial schemes. Progress in certification	Pilot case in Valentia involving 85 Flexifuel vehicles for public transport. The private and public transport companies are working together. Dissemination of the project results.	The results could be applied for incentive systems & obligations, certifications.	Some of the project tools are already available

In sustainable point of view, the projects presented at the vehicle section of the London conference have addressed the aspects as schematically reported in Table 8.

Table 8 Projects linkages to sustainable mobility objectives. Vehicle projects

Acronym	equity & accessibility	safety & reliability	co-modality	energy & land use	renewable energy	emissions & noise	CO2 emissions	technology & development	economic return	regional development
FRESCO		*		**	*	**	**	**		
HOST	*	*	**	**		**	**	**		
HyHEELS		*		**		*	**	**		
SPACElight						*	**	**		

PROCURA				*	*	**	**			

The analysis concludes with the future prospects found.
While Mobidays proceeded and the present report was updated, a proposal was made by the European Parliament to alter the target of 125gCO2/km envisaged by the European Commission to 125gCO2/km and o postpone it from 2012to 2015.
It is the common sense that vehicles will continue to be majority fuelled by Diesel and gasoline and a decline is foreseen only by 2060 when synthentic and biofuels will start to emerge to be dominant by 2100. It is then clear among the several actors (vehicle manufacturers, politicians and legislators and end users) that much can still be gained from technological improvements in conventional internal combustion engines, including the use of alternative fuels and the development of new combustion modes or powertrain strategies. Hydrogen will continue to be a minor energy source up to 2100. These trends are expected to be similar worldwide and the strategies adopted in the different continents will only differ due to the diverse market trends: while 70% of the passenger vehicles marketed in the United States of America has between 6-8 cylinders, 80% of the vehicles market in Asia has 3-4 cylinders. In the meanwhile, technological developments are still necessary and worth to make gasoline engines as efficient as Diesel engines and Diesel engines as clean as gasoline engines.
Major improvements in lean combustion modes, such as HCCI/CAI, will allow decreasing fuel consumption at the same time as addressing major pollutant emissions. Homogeneous combustion is bringing a renewable interest in multi point fuel injection as a low cost injection system allowing improved and controlled mixing but calls for fundamental research in atomization, spray-wall impingement phenomena to address the use of alternative fuels. In what concerns SI engines, the impact of downsizing is enormous, either in small vehicles as in upper class vehicles. Small size SI engines account for a significant proportion of the European market and a technological breakthrough is necessary to recover the competitiveness of small SI engines relatively to Diesel engines. CRF forecasts that, starting from a 1.4 liter engine, downsizing strategies will allow decreasing GHG emissions to below 120gCO2/km, while even stronger downsizing strategies starting with 1.2 litre engine will allow going below 100gCO2/km. The reduction of pumping losses will allow further improvements: electronic valve control and direct injection systems will be the main technological players. Upper class vehicles have a larger potential to accommodate the yet high cost technological solutions. Despite the small market and km shares, upper class vehicles account for 27% share of CO2 emissions and can, therefore, be used as demonstrators to pave the way towards more competitive integrated solutions making use of hybridisation, combustion management, electronic engine control and after-treatment.
Progresses in Diesel engines have a huge potential for environmental improvements, as the Diesel market reached 50% of the European market in 2006. It is suggested a technology breakthrough is required to meet the CO2 targets. The challenge is that the technology has to be accepted by the market, which urges for the development of low cost after-treatment systems. Improvements are yet expected from fuel injection systems, but fuel injection pressures above 2000 bar require further developments of the already current available piezo injectors. The fuel is the current problem and, despite NOx catalysts and SCR systems came to solve the problem, major hurdles still need to be overcome due to the negative effects those systems have in the overall efficiency of the engine, as well as due to their sensitivity to fuel properties. The development of more efficient after-treatment technologies is required to overcome the increased NO_x emissions caused by engine downsizing. But low cost systems are required to make clean diesel engines accepted in the market. This calls for research in innovative particle trap systems, filtration of ultra-fine particles, multi functional reactors, which can be efficient for HCCI combustion modes.
Larger downsize ratios than those already achieved require the ability to increase the temperature at the turbine inlet; to increase the efficiency of the turbocharger and to enlarge the mapping of the

turbo-charging and can be realized by integrating the design of the turbocharger with the manifold.
The integration of the engine with the after-treatment system should be considered as a way to decrease the overall complexity with a positive impact in production costs. "Cold Combustion" is a technique suggested by FEV and Renault to put together the current developments towards efficient engines and after-treatment devices, which urges for scientific research on the shape of injectors, advanced cooling systems and improved mixing.
It is unanimous that adequate fuels have to be developed to limit GHG emissions without increasing the other pollutants. Project **NICE** already addressed the CSC fuel with high benefits in PM emissions, but a new fuel is now proposed by VW, which has been observed in test engines to give virtually zero NOx emissions. But further research is required to develop fuel specifications; to adapt the hardware to the fuel; to look to the transient operation and to integrate NOx aftertreatment.
Engine design and fuel development should be taken together in an integrated approach, making use of technological approaches available to control mixing and combustion. But the best balance between several technological solutions must achieve the market acceptability. In this context, Renault suggests that the combined CI-HCCI concept can be controlled in a 2-stroke engine for spontaneous combustion to occur at the top dead centre. Such a new combustion mode, combined with the use of variable valve timing, advanced boosting and adjustment of fuel injection, allows increasing efficiency with noise levels below 72 dB.
Improved capabilities of computer simulations are required to decrease the costs associated with prototyping and systematic experimentation. This calls for advanced combustion models with coaxial injectors with nozzle variable geometry; models to accurately describe cyclic variations which can capture NO_x and control strategies for multivariant parameters.
From the point of view of the fuel, standardisation of GHG emissions for alternative fuels is required to assess the benefits of biofuels and synthetic fuels. An initiative has been launched in France leader by IFP, the **seminar IFP/IDAME**, where European and American researchers joined efforts to discuss appropriated methodologies. But convergence has not yet been achieved in the European Union and challenges remain to develop a unique methodology to calculate GHG emissions and to implement it.
In view of the discussion for the application of "in use compliance" (IUC) in Euro 6 regulations, it is necessary to develop accurate sensors for OBD measurements.
European citizens are becoming more sensitive to local environmental problems and local authorities lean to legislate specific environmental targets for urban environment. In this context, urban mobility pushes research to address the specific problems raised by traffic congestion: new technological concepts are necessary to be developed to integrate the vehicle with traffic management systems, taking into account emissions and safety of drivers and pedestrians. Innovation is expected to come from Information Technologies and electric powertrains.
From a worldwide point of view, Japan is currently the country with the lowest target of CO2 emission. But it is worth noting that predictions reported by CARB forecasts that Europe will join Japan in the lead of environmental restrictions in a scenario extending up to 2016.
Anyway, a commonly accepted suggestion to stimulate further improvements is to give credits to car manufacturers who accomplish with emission values below the legislated targets.

1.5 European research on infrastructures for sustainable mobility

1.5.1 Overview of the considered projects

The EC has been funding research on infrastructures for sustainable transport since soon after a European Union transport policy started to develop. The first EC White Paper on transport was published in 1992. Accordingly, several projects relevant to the sustainable transport theme were

funded under the non-nuclear energy programmes JOULE (R&D) and THERMIE (demonstration). Moreover, within FP4 (1994-1998) a research programme was specifically dedicated to transport: the "research for sustainable mobility". EC transport policy has since continued to develop, with a new transport White Paper published in 2001, and its mid-term review issued in 2006. In parallel with these developments, in FP5 (1998-2002) sustainable mobility projects have been increasingly funded, mostly under the Energy, Environment and Sustainable Development (EESD) theme; some projects were also funded under the Competitive and Sustainable Growth (GROWTH) theme. In FP6 (2002-2006) the main theme under which sustainable mobility projects were funded is Theme 6: Sustainable Development, Global Change and Ecosystems; within this theme, of particular importance are Thematic Priorities 6.1 "Sustainable Energy Systems" and 6.2 "Sustainable Surface Transport"; a number of projects which are relevant to the development of technologies for sustainable mobility were also funded under other Priorities as well horizontal themes.

In MOBIDAYS, the coordinator and the other partners have started their research by building a database of all projects relevant to sustainable mobility, as defined in MOBIDAYS, which were funded as part of the programmes mentioned above. This database was built starting from the CORDIS database of EC-funded projects and consisted of a list of 224 projects. In this chapter only those projects addressing infrastructures for sustainable mobility are discussed.

We first selected out of the database only those projects that were deemed relevant to the theme of infrastructures for sustainable road transport, and we integrated these with other relevant projects listed in the following EC-funded project synopses:
"European Bio-Energy Projects 1999-2002";
"European Fuel Cell and Hydrogen Projects 1999-2002";
"European Fuel Cell and Hydrogen Projects 2002-2006";
"European Hydrogen and Fuel Cell Projects" (2004)

The relevance of the selected projects to the theme of infrastructures for sustainable mobility was evaluated based on the projects' descriptions available from the above sources and, where available, from the projects' websites. Moreover, due to our expertise in the field, we were already aware of several projects in the area of sustainable mobility and therefore previous knowledge was also used when selecting relevant projects. This resulted in the selection of a total of 32 projects for further consideration and analysis; these are listed in alphabetical order in the table below:

Table 9 Project summery. Projects on infrastructures

Acronym	Full name	FP (EC Framework Programme)	Coordinator	Partners (number of partners)	Website	Budget (M€)		Project timing
						Total	EC contribution	
AER-GAS	A New Approach for the Production of a Hydrogen-Rich Gas from Biomass: An Absorption Enhanced Reforming Process	5	ZSW, Germany michael.specht @zsw-bw.de	9	www.aer-gas.de	2.4	1.4	36 months
BIOCAT	Catalyst Development for Catalytic Biomass Flash Pyrolysis Producing Promising Liquid Bio-Fuels	5	CERTH, Greece Prof Lacovos Vasalos cperi@cperi.certh.gr	8	n/a	2.5	1.3	36 months Jan 2002 – Dec 2004
BIOENERGY CHAINS	Bio-Energy Chains from Perennial Crops	5	CRES, Greece Pavlos Gavrilides	10	n/a	n.a.	n.a.	45 months Dec 2001 – Aug 2005

	in South Europe		dfousek@cres.gr					
BIOGASMAX	Biomethane for Urban Transport	6	Urban Community of Lille, France Pierre Hirtzberger phirtzberger@cudl-lille.fr	31	www.biogasmax.eu	16.9	7.5	48 months Jan 2006 – Dec 2009
BIO-HYDROGEN	Development of a Biogas Reformer for Production of Hydrogen for PEM Fuel Cells	6	PROFACTOR, Austria Dr Johann Bergmair	10	www.profactor.at	1.4	0.8	24 months Jul 2005 – Jun 2007
BIOTOX	Pyrolysis Oil Toxicity Assessment for Safe Handling and Transport	5	CIRAD, France Jacques Valeix	3	n/a	0.5	0.4	30 months Jan 2003 – Jun 2005
CATLIQ	CHP Plant Based on Catalytic Liquid Conversion Process	5	FLS Miljoe, Denmark Preben Tolstrup	3	n/a	2.4	1.2	36 months Jan 2002 – Dec 2004
CHRISGAS	Clean Hydrogen-rich Synthesis Gas	6	Växjö University, Sweden Sune Bengtsson sune.bengtsson@power.alstom.com	20	www.chrisgas.com	15.6	9.5	60 months Sept 2004 – Aug 2009
DIPROWASTE	Enhanced Production of Methane from Anaerobic Digestion with Pre-processed Solid Waste	5	Ingenieurbüro Dobelmann & Kroke Jürgen Dobelmann	6	n/a	1	0.5	24 months Jan 2003 – Dec 2004
ECHI-T	Large Bioethanol / ETBE Integrated Project in China and Italy	5	ETA Florence, Italy	13	n/a	n.a.	n.a.	n.a.
FERMATEC	Development of a Biotechnological High Yield Process for Ethanol Production Based on a Continuous Fermentation Reactor	5	TECNIA, Portugal Antonio Ferreira	10	n/a	1	0.5	32 months Jan 2003 – Aug 2005
GASASH	Improvement of the Economics of Biomass/waste Gasification by Higher Carbon Conversion and Advanced Ash Management	5	VTT, Finland Mikko Kara	8	n/a	2.4	1.2	36 months Nov 2002 – Oct 2005
GENHYPEM	Proton-Exchange Membrane based Electrochemical Hydrogen Generator	6	Université Paris-Sud, France Prof Pierre Millet	9	www.genhypem.u-psud.fr	2.5	1.3	36 months Oct 2005 – Sep 2008
Hi2H2	Highly efficient, High temperature, Hydrogen production by Water Electrolysis	6	EDF, France Dr Philippe Stevens Philippe.stevens@edf.fr	4	www.hi2h2.com	1.77	1.1	36 months Aug 2004 – Jul 2007
HYDROSOL-II	Solar Hydrogen via Water Splitting in Advanced Monolithic Reactors for Future	6	CERTH, Greece Athanasios Konstandopoulos	5	n/a	4.3	2.2	48 months Nov 2005 – Oct 2009

	Solar Power Plants							
HYMOSSES	Advanced Hydrogen Storage Material	5	Ernst Hammel: hae@electrovac.com	10	n/a	4.3	2.4	36 months Nov 2002 – Oct 2005
HYSTORY	Hydrogen Storage in Hydrides for Safe Energy Systems	5	IFE, Norway jiri.muller@ife.no	9	n/a	4.2	2.4	36 months Nov 2002 – Oct 2005
HYSTRUC	Demonstration and Testing of an Innovative 30 bar, Low Cost, Small Size Pressure Electrolyser (PME), in the MW Power Range, for the Cost Efficient Production of Electrolytic Hydrogen	5	MTU, Germany rolf.brand@mtu-online.com; Pietro.d'Erasmo@hydro.com	3	n/a	7.4	3.1	42 months Feb 2003 – Jul 2006
HYTHEC	Hydrogen Thermochemical Cycles	6	CEA, France Mr Alain Le Duigou aleduigou@cea.fr	6	www.hythec.org	2.9	1.9	42 months Apr 2004 – Sep 2007
HYVOLUTION	Non-thermal Production of pure Hydrogen from Biomass	6	Agrotechnology & Food Innovation BV, The Netherlands Dr Pieternel Claassen	22	www.hyvolution.nl	14.2	9.9	60 months Jen 2006 – Dec 2010
HY2SEPS	Hybrid hydrogen – carbon dioxide SEParation Systems	6	FORTH, Greece Dr Vladimiros Nikolakis	7	http://hy2seps.iceht.forth.gr	2.5	1.5	36 months Nov 2005 – Oct 2008
-	Local and Innovative Biodiesel	6	EREN, Spain Mr Ricardo Gonzalez Mantero gonmanri@jcyl.es	12	http://www.fedarene.org/publications/Projects/Contrat/Biodiesel/home.htm	1.4	0.7	24 months Jan 2004 – Feb 2006
NATURALHY	Preparing for the Hydrogen Economy by using the existing Natural Gas system as a catalyst	6	Gasunie, The Netherlands Mr Onno Florisson o.florisson@gasunie.nl	40	www.naturalhy.net	17.2	11	60 months May 2004 – Apr 2009
NEMESIS	New Method for Superior Integrated Hydrogen generation System	6	DLR, Germany Mrs Antje Woerner	9	n/a	3.9	2.2	36 months Dec 2005 – Nov 2008
NICHES	New and Innovative Concepts to Help European transport Sustainability	6	POLIS, Belgium Mr Sylvain Haon	7	www.niches-transport.org	1	1	29 months Nov 2004 – Mar 2007
NILE	New improvements for lignocellulosic ethanol	6	IFP (Institut Francais du Petrole)	21	www.nile-bioethanol.org	12.8 M€	7.7 M€	48 months Oct 2005 – Sept 2009
SOLHYCARB	Hydrogen from solar thermal energy: high temperature solar chemical reactor for co-production of hydrogen and carbon black from natural gas cracking	6	CNRS, France Dr Gilles Flamant	11	http://www.promes.cnrs.fr/ACTIONS/Europeenes/solhycarb.htm	3.2	2	48 months Mar 2006 – Feb 2010
SOLREF	SOLar steam REForming of methane rich gas for synthesis gas production	6	DLR, Germany. Dr Stephan Moller stephan.moeller@dlr.de	9	www.solref.dlr.de	3.45	2.1	45 months Apr 2004 – Dec 2007
SUPER-HYDROGEN	Biomass and Waste Conversion in Supercritical Water for the Production of Renewable Hydrogen	5	Biomass Technology Group, The Netherlands Bert van de Beld: Vandebeld@btgworld.com	7	n/a	2.5	1.4	52 months Dec 2001 – Mar 2006
SOLAR-H	Linking molecular genetics and bio-mimetic chemistry – a multidisciplinary approach to achieve	6	Uppsala University, Sweden Prof Stenbjörn	8	www.fotomol.uu.se/Forskning/Biomimetics/sol	2.3	1.8	36 months Jan 2005 – Dec 2007

	renewable hydrogen production		Styring		arh/index.shtm			
TIME	Technological Improvement for Ethanol Production from Lignocellulose	5	VTT, Finland Prof Juha Ahveinainen	7	n/a	4.3	2.5	40 months Nov 2002 – Feb 2006
ZERO REGIO	Lombardia and Rhein-Main towards Zero Emission: Development and Demonstration of Infrastructure Systems for Hydrogen as an Alternative Motor Fuel	6	Infraserv GmbH, Germany Dr Heinrich Lienkamp heinrich.lienkamp@infraserv.com	16	www.zeroregio.com	21.4	7.5	60 months

It is important to note that all selected projects are from FP5 and FP6 only. The reason for this is that, in general, detailed information on EC-funded projects in the area of sustainable mobility is not easy to obtain; early projects from FP4 and before are even difficult to trace and therefore we did not include these in our analysis. However, even FP5 and FP6 projects, for which records exist on databases and synopses, have posed problems when it came to finding out the results they generated and the commercial viability of the technologies they developed; this is further discussed in Section 5.3 below.

It is also important to mention that the main focus of MOBIDAYS is on RTD projects on sustainable road transport. Therefore, the projects we have considered and included in the above list are mostly projects developing technologies relevant to infrastructures that have the potential to make road transport more sustainable. However, a limited number of demonstration projects were also included, especially those having a significant RTD component. Moreover, some projects of other nature, such as coordination actions, were also considered when deemed particularly important for the commercialisation of the technologies developed by the RTD projects; projects of this type were particularly selected for presentation at the conference in London (discussed in detail in Section 5.2 below), because they offered an overview of the current status of deployment of technologies in the area of infrastructures for sustainable mobility which was deemed particularly valuable to stimulate discussion with the conference attendees.

Finally, it is worth noting that technologies that are relevant to infrastructures for sustainable mobility encompass at least the following:

– Technologies for the production, storage, transmission, delivery and dispensing of alternative, more sustainable road transport fuels.
– Technologies for the optimisation or road transport and the management of demand.

In this research however we mainly focused on infrastructures related to alternative road transport fuels, which is the area where most research efforts have been devoted so far. Apart from one project, we have decided not to address research on infrastructures aimed at optimising road transport and managing demand due to time and resource constraints and also to the fact that projects in this area appeared to be more difficult to trace; however, this is indeed an important area of research, with a potentially significant impact on the sustainability of road transport, which should also be considered for future analysis.

1.5.2 Conference objectives and outputs

The half-day conference on "Infrastructures for Sustainable Mobility" took place at Imperial College, London, UK on 21st September 2007. It was funded by the EC under the SSA MOBIDAYS "Sustainable Mobility Days", and entirely organised by Imperial College.

The conference on "Infrastructures for Sustainable Mobility" was aimed at reviewing achievements and shortfalls of EC-funded research in the area of infrastructures for the production, transmission and delivery of alternative road transport fuels. The idea was to select the most significant projects in the area, invite speakers from organisations participating in these projects to report on their main results and discuss the latter with the public attending the conference.

The MOBIDAYS database of projects was also used to circulate information on the conference to relevant people and to invite coordinators of completed and ongoing projects to fill out a questionnaire and to participate in the conference as speakers presenting results of their projects. Coordinators of the 32 selected projects were specifically targeted in all cases where their contact details were available. In parallel with this, informal input from senior staff at Imperial College was sought on the infrastructures conference programme, with the aim to ensure a balanced representation of all main areas of research and most important projects. Valuable input was received, among others, from Professor John Polak, professor on transport demand and head of the Centre for Transport Studies, and from Dr Jeremy Woods, lecturer in bio-energy.

The process of selecting projects and inviting speakers to present at the conference was therefore hybrid: some of the speakers were selected among those project coordinators who had filled out the questionnaire on the MOBIDAYS website and had expressed interest in presenting their projects at the conference, while others were directly approached based on the relevance of their projects even though they hadn't registered on the MOBIDAYS website.

The final selection of projects to be presented at the conference was based on a number of elements, the overarching criteria being that of covering as broadly as possible the topic of infrastructures for sustainable mobility within the limited time available. For this reason, projects presented at the conference included one which dealt with different types of infrastructures for sustainable mobility being implemented in various European cities (project NICHES), a major hydrogen infrastructure project (project ZERO REGIO) and 3 projects covering the most important biofuels currently being deployed, respectively bio-ethanol (project NILE), biogas (project BIOGASMAX) and biodiesel (project Innovative Biodiesel). The conference sessions were chaired by hydrogen and bioenergy experts from Imperial College, and a panel discussion was also organised at the end in order to further stimulate discussion with the public.

Table 10. Conference presentations. Infrastructure section.

Name	Institution	Institution quarters	Projects presented	Title of presentation
Leire Iriarte	POLIS	Belgium	NICHES	Mainstreaming urban transport innovation
Dr Ashok Rastogi	Becker Technologies,	Germany	ZERO REGIO	Hydrogen infrastructure development and demonstration
Mr Raphael Slade	Imperial College London,	United Kingdom	NILE	Bioethanol in the EU: the NILE project
Ms Sanne Mohr	ENGVA (European Natural Gas Vehicle Association), the	Netherlands	BIOGASMAX	Biomethane for urban transport

Prof Manfred Wörgetter	Bundesanstalt für Landtechnik,	Austria	Innovative Biodiesel	Searching for the "ideal" biodiesel

The conference was widely advertised, mostly by email and on websites, to a large number of potentially interested attendees internationally. Participants to EC-funded projects were adequately targeted; however efforts were particularly made to reach potentially interested people in London and the UK, since they were thought to be more likely to be able to attend the conference. A non-exhaustive list of mailing lists and websites which were used for this purpose is here given:

- MOBIDAYS mailing list with all available email addresses of coordinators of relevant EC-funded projects (mostly FP5 and FP6)
- HFP (European Commission's hydrogen and fuel cell technology platform) website
- Fuel Cell Today website – this is a leading information source on the fuel cell industry
- H2NET – UK hydrogen and fuel cell network mailing list, including a large number of academic and industrial organisations
- UK Energy Institute (EI) – chartered professional organisation, with more than 13,500 individual and 300 organisation members
- UK Low Carbon Vehicle Partnership (LowCVP)
- London Hydrogen Partnership (LHP)
- Imperial College fuel cell network

As a result of the wide promotion of the conference, several emails of potential interested attendees were received, mostly from the UK but also from European and extra-European countries (such as the US and Australia), and a total of around 60 people pre-registered to attend the conference on the MOBIDAYS website.

However, due to fact that the conference was free to attend and there was no no-show fee charged for registered people not attending, several people who had pre-registered on the website (and in some cases also been directly in touch by email confirming their interest in the conference) eventually did not turn up. At the same time, a number of people also came on the day who hadn't previously registered on the project website, this not being a strict requirement for attending the conference. As a result, attendance to the conference was around 70 delegates, from industry, consultancy and academia. Most of the delegates were from the UK, although there were a number of overseas delegates as well. Attendance numbers were overall good, but the organisers were hoping for a higher turnout. The discrepancy between the extensive promotion of the event and relatively limited number of attendees can be explained by the growing number of conferences on sustainable mobility, alternative fuels and similar themes, some of which taking place on similar dates.

By looking at the list of people who attended the conference the following can be inferred:

- A good representation of UK industry and consultancy shows that there is interest among them in finding out more about EC-funded programmes and their outcomes
- Students were also a significant part of the audience, thanks to the event being free to attend
- Most of the delegates were from the UK, which was largely expected as, despite the conference being free of charge, attendees had to pay for their travel expenses.
- Despite repeated invitations, no representatives of London and UK governments attended. This was probably due to the fact that government officials are significantly involved in internal and national programmes and events on sustainable mobility, and didn't have particular incentives to attend a conference such as the one we had organised.
- Finally, apart from the invited speakers and panellists, no representatives of EC-funded project consortia attended the meeting. This was clearly a rather undesirable outcome since

this conference was organised with the idea of providing a venue for discussing outcomes of EC funded research on infrastructures for sustainable mobility in general, and not just the outcomes of the selected project which were presented there. However, due to the fact that no EC officials attended and that this event was not formally endorsed by the EC as one that partners of EC-funded projects had to attend, there was little incentive for partners to come; this is particularly true if we consider that participants of already completed EC-funded projects would have had no budget to cover travel expenses, and that for participants of still ongoing projects this meeting would have added to a busy travel schedule such as that often demanded by EC-funded projects.

Conference outcomes

Selected general messages which are worth reporting from the conference are the following:

- EC investment on hydrogen and biofuels research has been steadily growing over time and many key areas are now covered
- However, projects have also been growing in size (i.e.: number of participants) and this posed problems; in particular, there is a distinct perception that large projects have proved less effective than smaller ones in developing original research
- For the same reason, projects are often not followed up and this limits their potential to generate practical results (it must be pointed out however that the review of projects we have carried out has partially contradicted this statement, as we have come across a number of projects that were following up from successful previous projects)

Selected messages from the conference which are specific to the theme of infrastructures for sustainable road transport are the following:

- Due to the fact that biofuels for transport (and particularly biodiesel and conventional bioethanol) are increasingly being commercialised, there is generally good potential for these projects to generate practically significant results in the near to medium term
- Despite EC-funded research is aiming to broaden the range of feedstock for biofuel production available in the EU, it is still unclear whether production targets will be met without significant imports
- Sustainability of biofuels remains an issue, and much research is still needed
- Based on the experience of hydrogen infrastructure demonstration projects, it is important to actively involve local authorities in the future (e.g.: as project partners) in order to avoid major authorisation problems (however, this has proved a problem so far but may not be a problem in the future, as the cumulative number of demonstration projects grows and regulation, codes and standards are developed accordingly).
- Apart from the many technologies still in the R&D phase, some hydrogen infrastructure technologies are being tested with interesting results

1.5.3 Projects analysis

Strictly linked to the project selection discussed in Section 5.1, a critical review of projects in the area of infrastructures for sustainable mobility was carried out starting from the early months of the project MOBIDAYS. One output of this review is Deliverable 9 “Brochure about infrastructures for sustainable mobility”. Building on Deliverable 9, final findings of this review are summarised below.

Initially we provide a brief discussion of the objectives, targets and, where available, results of the 32 projects we have selected; projects are grouped based on relevant themes, such as fuel types and main production routes. A tabular overview of these projects follows, where the potential for commercialisation of the technologies they have developed and their potential contribution to sustainability of road transport are ranked and qualitatively assessed.

Technologies for production of biofuels for road transport

Energy from biomass can be used in a number of applications, ranging from heating, electricity generation, combined heat and power generation as well as transport. Numerous EC-funded projects have focused on the development of technologies to enhance production, processing and conversion of biomass resources for energy uses, thus including transport fuel production.

Biofuels for transport can be produced from different types of biomass feedstock; however, the same feedstock can often be used for other energy applications as well. More generally, due to the many overlapping pathways available, it is not always possible to clearly distinguish biomass feedstock and technologies relevant to the production of biofuels for transport from those that are relevant to other energy uses. Similarly, it is not always possible to clearly identify biomass production, treatment and conversion research which is only relevant to the production of biofuels for transport.

Here we discuss EC-funded projects on the production of biofuels using a range of different feedstock and routes. Most of these projects are directly aimed at producing biofuels for transport applications, such as biodiesel, bioethanol and biogas; however, some projects are discussed which are mainly aimed at other energy applications but are also relevant to the transport sector.

Energy crops for biofuels production

A number of projects have been funded under FP5 and FP6 on feedstock for biofuels production. Some of these investigate the possibility to introduce new energy crops in Europe which can be used as a feedstock for the production of biofuels for transport.

For example, the 18-month project ECHI-T investigated the possibility to produce biofuels such as bioethanol (but also bio-methanol and bio-hydrogen) from sweet sorghum in Europe; this is a crop commonly cultivated in China but not in Europe. Although a full techno-economic and market analysis was not possible within the scope of the project, it demonstrated that the cultivation of sweet sorghum as an energy crop in Europe is feasible and may be beneficial as a complement to more traditional as well as other innovative feedstock for biofuels; if adopted, sweet sorghum could also allow to increase the utilisation rate of bioethanol production plants thanks to its complementarities to energy crops such as sugar beet.

Of particular interest is the 45-month FP5 project BIOENERGY CHAINS. As opposed to many previous projects only looking at specific aspects of energy crop cultivation, processing or conversion into biofuels, this project has the overall objective of defining and evaluating complete bioenergy chains from biomass production to thermochemical conversion for the production of valuable energy products. Four different crops, carefully selected to provide a year-round availability of raw material, were cultivated in small and large fields in Greece, Spain, Italy and France. The crops were then fully characterised and subjected to a comprehensive test programme of combustion, gasification and fast pyrolysis. The complete chains were evaluated in technical, environmental and economic terms in order to identify the most promising combinations of biomass resources and technologies.

Biofuels production from waste

Apart from energy crops of various types and compositions, a potentially very important feedstock for the production of biofuels are wastes, such as the organic fraction of municipal solid waste (MSW), forestry and agricultural residues, agro-industrial waste and so on. There is a wide range of wastes that could potentially be used as a feedstock for biofuels production and equally numerous are the technologies potentially required for their treatment, conversion and

purification. Several projects have been funded by the EC which look into the possible use of different types of wastes and of alternative technologies for their conversion.

The DIPROWASTE is a 24-month project investigating ways of enhancing biomethane production from anaerobic digestion of urban, agricultural and industrial organic waste by pre-treating the feedstock. The project has demonstrated that ohmic heating pre-treatment can enhance the production of biogas and is economically viable. The pre-treatment technology developed as part of the project is currently being commercially exploited by the project partners for application with certain industrial and agricultural wastes.

Another interesting project focusing on biofuels-from-waste production technology is the 36-month CATLIQ project; this studies an innovative catalytic process that produces a range of fuels (methane, hydrogen, alcohols) from liquid biomass waste such as sewage sludge and manure. One particularly interesting aspect of the project is that the technology under study should allow using aqueous biomass for energy purposes more cheaply and more flexibly than currently established processes. The project aims to develop this technology to a point where it becomes commercially viable.

The 48-month BIOGASMAX project aims to promote the large-scale adoption of upgraded biogas (biomethane) produced from waste as a renewable fuel for transport. Biomethane can be produced from treatment of different types of waste, such as sewage sludge, food waste and organic municipal sold waste, which requires significant treatment prior to disposal anyway. Biogas production improves the environmental efficiency of the waste treatment process while providing renewable, low-carbon and secure fuel for transport. Biomethane is similar to natural gas, therefore it can be transported using the extensive natural gas grid and used in CNG-powered vehicles.
The BIOGASMAX project builds on existing activities in municipal areas in the EU and carries out additional research, development and demonstration activities aimed to achieve the following objectives:

- Prove the technical reliability, cost-effectiveness, environmental and social benefits of biogas as a transport fuel
- Perform large-scale demonstrations to optimise industrial processes, experiment and benchmark new and near-to-market techniques and expand the biogas vehicle fleet
- Identify and assess ways of removing technical as well as non-technical barriers to biogas use in transport
- Disseminate knowledge and best practices in order to increase market acceptance of biogas fuel

The project started in January 2006 and will finish in December 2009. It involves demonstration activities in 5 European cities: Lille (France), Goteborg (Sweden), Stockholm (Sweden), Haarlem (The Netherlands), Rome (Italy), Berne (Switzerland); the regions Lombardy (Italy), Torun and Zielona Gora (Poland) are also involved in the project, mainly as beneficiaries of knowledge transfer from the other partners. For each of these demonstration sites quantitative objectives have been set in terms of the amount of biogas to be produced, upgraded and distributed and on the number of vehicles that will run on this fuel. In particular, in Lille the plan is to expand the production of biomethane at the Organic Recovery Centre to up to 4 million m^3, to inject this in the gas grid and to optimise waterway transport of waste. In Sweden (Goteborg and Stockholm) research will focus on optimising production and upgrading processes, also using new feedstock types, and improving transmission and distribution systems. In Bern and Rome the scale of biogas production and upgrading will increase, and the quality of the gas will be analysed and monitored.

The 36-month GASASH project has the overall objective to develop sustainable and economic systems for the management of ashes originating from biomass/waste gasification and ensuing gas cleaning process. The primary objective is to reduce ash volume and improve ash quality. The improvement of ash quality enhances the potential for their utilisation/recycling as a raw material for other processes. One of the key factors limiting further utilisation of fly ash from gasification is their carbon content. An essential part of the ash quality improvement and ash volume reduction is the improvement of carbon conversion, which also results in higher conversion efficiency of the gasification process itself.

Biodiesel production

Biodiesel is currently the most widespread renewable fuel for transport in Europe and is still growing fast. However, there is scope for further developing technologies for its production; in particular, production can be made more economical and flexible for example by broadening the range of usable feedstock.

The 36-month project BIOCAT aimed to develop an efficient technology for the conversion of biomass to liquid bio-oil, which can be used to produce biodiesel. Biomass pyrolysis is the most promising process for the production of renewable liquid fuels; however, large-scale applications of this technology are not foreseen in the short term, mainly due to the high cost of upgrading liquid bio-oil for its effective handling and processing as a renewable fuel. The BIOCAT project focused on catalytic biomass flash pyrolysis (CBFP), an innovative technology which, using new porous catalysts and novel reactors, allows the conversion of various biomass feedstock and its catalytic upgrading into high quality bio-oil in the same reactor.

Although several other projects address fast pyrolysis of biomass to produce bio-oil, which can be either directly used for heat generation or refined and used as a transport fuel (biodiesel), the 30-month BIOTOX project is unique because it investigates the toxicity and eco-toxicity of a wide range of bio-oils from different processes and temperatures. Expected results include an assessment of the risk involved for human health and the environment and the definition of best practices for the production of bio-oil; the project also aims to contribute to reducing production costs and therefore making bio-oil from pyrolysis more competitive.

The Local and Innovative Biodiesel project aims to address the arising barrier of shortage of feedstock for biodiesel production and its competition with food uses. The project considers 25 different types of feedstock for biodiesel production besides rapeseed and soybean; considered feedstock also includes used vegetable oils. Biodiesel is produced on a laboratory scale from all these different types of feedstock, and the resulting biodiesel is analysed in order to assess whether or not it meets the necessary specifications. A selection of 6 different types of biodiesels out of the 25 is then tested for emissions and endurance in an internal combustion engine. The results of the project suggest that, although some of the biodiesels produced do not entirely meet current FAME specifications, their properties could be adjusted in order to meet the needs of the automotive industry. Based on these results, none of the feedstock type assessed can be excluded; this means that, using these types of feedstock, the current feedstock base for biodiesel production could be significantly broadened, both in the EU and worldwide.

Bioethanol production

Bioethanol for transport currently has a market share smaller than biodiesel; nevertheless it is growing fast in Europe and, in order for this trend to continue, conventional production pathways will have to be replaced by innovative technologies and more sustainable feedstock. In particular, producing bioethanol from lignocellulosic feedstock appears to be a promising route for the future; however, costs are still high and various parts of the process need to be optimised for it to

become competitive. Different ways of reducing bioethanol costs have been explored in the EC-funded projects here discussed.

The 40-month project TIME aims to improve the design and performance of key steps in the lignocellulose-to-ethanol process by focusing on pre-treatment, enzyme development and increased process integration. This will contribute to improving overall system efficiency and cost effectiveness and thus reduce the cost of producing ethanol by 10-20% in the medium to long term. The FERMATEC project developed a modular fermentation unit for continuous ethanol production. Compared with traditional units, it will decrease ethanol production costs to a minimum of 20% and increase bioethanol production yield to approximately 25 g EtOH/l.h.

The 48-month project NILE aims to propose the best process for a cost-effective production of bioethanol from lignocellulosic biomass to be used in combustion engines. The project is developing, investigating and evaluating new technologies for efficient conversion of lignocellulose to bioethanol. These technologies will be verified using a unique and fully integrated pilot plant providing reliable data for global socio-economic and environmental assessments and for the design of a future demonstration unit. The activities of NILE aim to overcome critical hurdles in process development. Key technology issues are:

- decreasing the cost of enzymatic hydrolysis of lignocellulose to fermentable sugars using new engineered enzyme systems;
- removing current intrinsic limitations in the conversion of fermentable sugars to ethanol;
- validating the engineered enzyme systems and yeast strains in a fully integrated pilot plant. Validation includes all process steps and recycling of process streams;

The project mobilises the critical mass of end-users and world-leading expertise necessary to improve the bioethanol production from the lignocellulosic biomass chain. By its integrated structure, NILE supports the development of research activities in close connection with industrial processes, their validation, their technical and socio-economic assessments, their dissemination as well as training activities.

Hydrogen production from biomass (bio-hydrogen)

While currently used biofuels for transport applications are biodiesel, bioethanol or biomethane, in the future the biomass feedstock that is used today to produce these fuels may also be utilised to produce hydrogen (BTH, or biomass-to-hydrogen). Moreover, processes for the production of innovative biofuels such as BTL (biomass-to-liquid fuels) often involve as an intermediate step the production of a hydrogen-rich gas. So there are significant overlaps and complementarities in technologies and processes for the production of innovative biofuels and of hydrogen. Various projects have been funded by the EC to advance these technologies; these are discussed here.

The 36-month AER-GAS project aimed to develop a new, efficient and low-cost single-step gasification process (Absorption Enhanced Reforming, AER) for clean biomass conversion into a hydrogen rich gas (H_2 conc. > 70 vol. %) with low tar content that is suitable for both direct use in fuel cells and fuel synthesis. Specific objectives of the project were: the development and selection of efficient catalytic CO_2 absorbent bed materials with improved mechanical and chemical stability for the AER process; and, the design of an AER biomass plant with investment costs less than 800 €/kW and energy efficiency for H_2 production higher than 75%. The project, now completed, obtained very encouraging results, to the extent that a second phase of the project has been funded, AER-GAS II, in order to further develop this technology towards market viability; AER-GAS II started in January 2006 and will last 3 years. The results achieved in the first phase of AER-GAS can be summarised as follows:

- The 8 MW pilot plant, operated continuously for the gasification of wood, generated a gas with ca. 75% H_2

- The raw gas produced showed low tar content, with a minimum achieved of 0.2 g(tar)/Nm^3
- The CO_2 absorbent material used as reactive bed material showed high mechanical and chemical stability; this was achieved by developing methods to improve stability based on coating and on mechanical and thermal pre-treatment
- The operation of the pilot plant also allowed full characterisation of the operating conditions of the process

Overall, the results obtained show that the gas produced is not only suitable for combined heat and power generation, but also for production of H_2 and of Substitute Natural Gas (SNG) for transport applications, hence the relevance of this project to MOBIDAYS. The composition of the gas produced can be controlled by both choice of process conditions and by downstream upgrading.

The 52-month project SUPERHYDROGEN addresses the production of pure hydrogen from biomass and waste using supercritical water (SCW). The main objective of this project is to develop the innovative SCW-gasification process for cost-effective (<12 €/GJH_2) conversion of wet biomass and waste into clean, renewable, compressed hydrogen with an energy efficiency to pure hydrogen exceeding 60%. Integrated parts of the SCW process development are: the development of a preparation method to convert wet feedstock of different origin into a high-solids content (up to 30% wt moisture), pumpable slurry; the development of a multi-functional, catalytic membrane reactor to convert CO and CH_4 (>70% conversion) to hydrogen, and simultaneously separate the hydrogen (purity > 98 vol%) from the gas. In the short term the technology may also be used with minor adaptations to produce Substitute Natural Gas (SNG) instead of hydrogen.

The 24-month project BIO-HYDROGEN aims at the development of a cost effective biogas reforming system (6 kW hydrogen) for decentralised application with biogas from agricultural biogas plants, municipal waste-water treatment plants and landfills. The main objective is the development of a reformer system which exhibits a better compatibility with biogas and hence an improved efficiency than conventional natural gas reformers.

CHRISGAS is a 60-month project which aims to demonstrate an energy-efficient and cost effective method to produce hydrogen-rich gases from biomass, which can be transformed into renewable automotive fuels such as FT-diesel, DME and hydrogen. This syngas-production process is based on steam/oxygen-blown gasification of biomass, followed by hot gas cleaning to remove particulates, and steam reforming of tar and light hydrocarbons to further enhance the hydrogen yield. The process was originally planned for demonstration at Värnamo, Sweden, after modification to the world's first complete IGCC demonstration plant for biomass; however, discontinued funding by the Swedish Energy Agency seriously delayed plans, to the extent that full-scale demonstration of the technology will not be possible before the end of the project. Nevertheless, parallel R&D activities covering the whole value chain from biomass to syngas have been carried out successfully so far. These include: feedstock biomass logistics; biomass drying integration; pressurised fuel feeding, gasification, hot synthesis gas characterisation; high temperature filtration/cleaning; catalytic steam reforming and shift gas catalyst characterisation. This will all lead onto the next phase: conversion of gas into motor fuels (Biomass to Liquids, BTL).

More recently the 60-month project HYVOLUTION is developing a 2-stage bioprocess for the cost-effective production of pure hydrogen from biomass by a non-thermal process which combines thermophilic and phototropic fermentation. The project deals with the whole chain from biomass to hydrogen, starting from the necessary pre-treatment technologies for optimal biodegradation of energy crops and bio-residues, to the fermentation reactors and ending with the cleaning of the gas generated by the process.

Hydrogen production by reforming of hydrocarbon feedstock

Reforming of natural gas is the most commonly used and economical technology for large-scale hydrogen production. Although conventional natural gas reforming is a well established technology, more advances alternatives are also being investigated. Here EC-funded projects investigating advanced reforming technologies are discussed.

The objective of the NEMESIS project is to develop a small-scale, fuel flexible hydrogen generator that is capable of working with liquid and gaseous hydrocarbon feedstock. An existing, state-of-the-art small-scale, on-site hydrogen generator for decentralised applications is extended to a wider range of fuels and significantly upgraded by introducing advanced separation technologies, new innovative materials and cost-effective and highly efficient sub-components. Operation is demonstrated with natural gas and low sulphur diesel.

The SOLREF project aims to develop an innovative 400 kW_{th} solar reformer for several applications, such as hydrogen production or electricity generation. Depending on the feed source for the reforming process, CO_2 emissions can be reduced significantly (up to 40% using NG), because the needed process heat for this highly endothermic reaction is provided by concentrated solar energy.

The SOLHYCARB project addresses the development of an unconventional route for potentially cost effective hydrogen production by concentrated solar energy. The novel process thermally decomposes natural gas (NG) in a high temperature solar chemical reactor. Two products are obtained: a H_2-rich gas and a high-value nanomaterial, carbon black (CB). Therefore H_2 and marketable CB are produced using renewable energy.

Hydrogen production by electrolysis

Electrolysis is a very flexible technology for hydrogen production; it can be used everywhere electricity is available and, due to its modularity, is very easy to scale up. However, producing hydrogen from electrolysis is currently very expensive and research efforts are being devoted to making electrolysers cheaper and more efficient.

HYSTRUC is a 42-month project developing an innovative 30 bar pressure electrolyser in the MW power range, based on a new concept for pressure electrolysers. Pressure electrolysers at present are complicated, require much operational energy, are expensive and susceptible to failure. The central innovation of the concept of this project is that all pressure-carrying components are placed within one single pressure vessel. The technical simplicity makes energy consuming auxiliary components obsolete, improves operational safety and reduces costs.

The GENHYPEM project is related to the electrolytic production of hydrogen from water, using proton exchange membrane (PEM)–based electrochemical generators. The specific objectives of the project are: to develop alternative, low-cost membrane-electrode assemblies and stack components with electrochemical performances similar to those of state-of-the-art systems; to develop an optimised stack structure for high current density (1 A cm^{-2}) and high pressure (50 bars) operation for direct pressurized storage; to develop an automated and integrated electrolysis unit allowing gas production from intermittent renewable sources of energy such as photovoltaic-solar and wind.

The project Hi2H2 is devoted to advancing the Solid Oxide Fuel Cell (SOFC) technology used in electrolysis mode, called “Solid Oxide Electrolyser Cell” or alternatively “Solid Oxide Electrochemical Converter” (SOEC). This technology has the potential to become an efficient and

cost-effective way to produce hydrogen from electrolysis. Because the water splitting process is endothermic, the electricity needed for electrolysis can be significantly reduced if the production of hydrogen takes place at high temperatures (700-1000°C). In addition, electrode kinetics are much faster at high temperature, which reduces electrode polarisation. Noble metal catalysts are not required and higher current densities can be obtained compared to existing low temperature electrolysers.

Hydrogen production from solar energy

There are essentially two routes to produce hydrogen from water using solar energy directly (i.e.: without converting it into electricity first): these are artificial or biological photosynthesis and thermochemical water decomposition. Both routes are researched by EC-funded projects.

The project SOLAR-H aims to develop two methods of producing hydrogen from water and solar energy; the first one consists in developing and testing man-made biomimetic systems; the other involves identifying and then, by molecular biology, improving the most suitable hydrogen producing photosynthetic micro-organisms (green algae and cyanobacteria). Research focuses on technologies in the very early phase of development or not yet existing; the uncertainty involved in this research is high but the long term potential impact that this may have is very significant.

The aim of the HYDROSOL-II project is to develop and build an optimised pilot plant (100 kW_{th}) for solar hydrogen production via an entirely novel, two-step thermochemical water-splitting process. The plant will be an advanced innovative solar thermal reactor consisting of monolithic ceramic honeycombs coated with active redox pair materials. The feasibility of this concept had already been demonstrated in the previous project HYDROSOL.

Hydrogen thermo-chemical cycles are processes where water is decomposed into hydrogen and oxygen via chemical reactions using intermediate elements which are recycled. These cycles have the potential of achieving a better overall efficiency than electrolysis and hence to reduce the cost of hydrogen production. The required energy for the process can be provided either by nuclear or by solar energy. Beyond that, hybrid solutions including solar and nuclear energy input are conceivable and desirable, if the production requires a continuous supply of heat. The objective of the HYTHEC project is to investigate the effective potential for massive hydrogen production using the Sulphur-Iodine (S_I) thermochemical cycle and to compare it with the Hybrid Sulphur cycle, also called the Westinghouse cycle. The project aims to improve the fundamental knowledge and efficiency of the S_I cycle H_2 production step, and to investigate a solar primary energy source for the H_2SO_4 decomposition step which is common to both cycles.

Hydrogen purification, storage and transport

Most hydrogen production processes discussed so far need to be followed by appropriate purification steps, to remove impurities and contaminants which may be present in the hydrogen stream. For use in fuel cell vehicles very pure hydrogen is needed, thus the importance of fuel purification. Moreover, particularly when hydrogen is produced centrally from fossil feedstock, efficient H_2/CO_2 separation technologies are needed in order for the CO_2 to be captured and sequestered. Apart from hydrogen purification, research is also needed in the area of hydrogen storage, compression and transport technologies, in order to enable effective hydrogen transmission and distribution.

Commonly used technologies for hydrogen purification are Pressure Swing Adsorption (PSA) and selective membranes. Using a PSA process is possible to recover high purity hydrogen (>99.99%) from e.g.: methane reforming; the amount of hydrogen recovered is usually in the range of 80 to 93% of total hydrogen produced. A typical PSA waste gas stream is at relatively low pressure

(~1.5atm) and temperature (~30 ºC) and has usual composition of 30-40% H_2, 50-60% CO_2, 10-25% CO and CH_4. Economic recycling of this stream is not an alternative since the entire stream must be compressed to the PSA feed pressure, and only a small amount of hydrogen can be recovered (40~50% of the recycled hydrogen). Furthermore, the CO_2 rich stream cannot be used for sequestration since it contains significant amounts of H_2 and CH_4. The main goal of project HY2SEPS is the development of a hybrid membrane/PSA H_2/CO_2 separation process which allows to enhance hydrogen recovery while also enabling the effective separation of CO_2 from the waste stream for subsequent sequestration.

Hydrogen storage is necessary not only on-board vehicles but also in various phases of the hydrogen transmission and distribution process. High-pressure compressed gas storage is energy intensive and liquid H_2 storage even more so. Storing H_2 in solid metal hydrides (MH) from which it can be readily recovered by heating is an alternative and safe, highly volume efficient storage method. Conventional MHs however suffer from low weight efficiencies and the challenge is to improve them to conform to specifications set by the practical applications. In response to these challenges, the 36-month HYSTORY aspires to advance the state-of-the-art in three MH classes and to develop hydrides based on lightweight, low cost elements with improved H_2 storage properties. The final aim is to provide a storage technology that is attractive both economically and environmentally.

Another project developing advanced hydrogen storage materials is the HYMOSSES. This project focuses on comparing various options for cost effective, compact, and safe storage solutions, namely metal hydrides, nanostructured carbon materials and composite materials. Other activities within the project involve prototyping of vessels and tanks, fuel handling and production, and conducting life-cycle analysis and techno-economic analysis of the materials developed.

Hydrogen can be transported by truck (both as a compressed gas and as a liquid) and by pipelines. Building dedicated hydrogen pipelines is not economical until demand becomes sufficiently high. The project NATURALHY however explores the potential of using the existing natural gas system to deliver hydrogen. In particular, the project aims to determine the conditions under which the existing natural gas system can safely be used to transport mixtures of hydrogen and natural gas, and to develop innovative technologies for the separation of hydrogen from hydrogen/natural gas mixtures.

Finally, the 5-year project ZERO REGIO is a demonstration project in the framework of which hydrogen production, storage, transmission, distribution and end-use technologies have been designed, approved, built and tested. Of particular interest to us are the innovative hydrogen compression and transmission technologies which were developed and tested as part of this project; these consists of an ionic fluid compressor which is capable of compressing hydrogen to very high pressures with high energy efficiency, and a high pressure (1,000 bar) hydrogen transmission pipeline. The infrastructure is being tested with favourable results so far. Comparisons between hydrogen and natural gas transport and refuelling have given positive indications, and the infrastructure overall has worked well despite some minor technical issues. It appears that by-product hydrogen such as that available at the Infraserv plant is a good intermediate step to the build-up of a hydrogen production infrastructure; the refuelling site connected to the Infraserv plant has been dispensing an average of 20 kg (H_2)/ month and the infrastructure is suitable to deliver significantly larger quantities of hydrogen as well. Assessment of technologies is still ongoing but results so far are encouraging.

<u>Transport demand and infrastructure management; other technologies related to transport sustainability</u>

As already mentioned above, in our analysis we have mostly focused on infrastructures related to the production, transmission and distribution of alternative transport fuels. However, we are aware of the importance of other technologies that address sustainability of road transport, such as those aimed at effectively managing travel and infrastructure demand.

Although, due to resource limitations and other constraints, we did not systematically review projects in this area, we have decided to review the 29-month project NICHES, which we considered particularly significant. This project did not focus on developing any specific technology for sustainable mobility. Instead it aimed at promoting a total of 12 particularly promising concepts for making urban transport of persons and goods more sustainable. These concepts have recently been developed and are currently being deployed in specific EU cities. The aim of the project is to support the large-scale deployment of these concepts in several EU cities, in order to move them from 'niche' to 'mainstream' concepts in urban transport policy. The 12 selected concepts are the following:

1) Urban lift-sharing services. Matching services that bring people travelling in the same direction together aiming to encourage individuals to share private vehicles for particular journeys (e.g.: liftshare in UK)
2) Public bicycles. Innovative schemes of rental or free bicycles in urban areas, which provide fast and easy access and can be used for daily mobility (e.g.: vélo à la Carte, Rennes, France)
3) Call-a-bus services. DRT schemes in public transport that adapt their itinerary and timetable to suit a particular transport demand (e.g.: Publicar, Switzerland)
4) Space management for urban delivery. Efficient use of infrastructure in urban areas taking into account the specific needs of urban goods delivery (e.g.: multiuse lane, Barcelona, Spain)
5) Inner-city night delivery. Delivery to retailers and shops in the inner city area during the night hours when the city is quiet and inactive (e.g.: night delivery, Dublin, Ireland)
6) Alternative solutions for home delivery. To organise the «last mile» processes efficiently; alternative delivery locations, time windows for the delivery and alternative redelivery strategies are considered if the consignee is not at home (e.g.: DHL packstation, Germany)
7) Policy strategy to deploy AFV in the private sector. Provide long term stability for the actors at the AFV market and involve new consumer groups (e.g.: clean vehicles in Stockholm, Sweden)
8) Biogas in captive fleets. The use of biogas from waste water or from solid biological material as fuel; contributes to reducing the waste problem and increasing the competitiveness of rural areas. This locally produced biogas is enough to feed city fleets, which allows to have a reduced number of fuelling stations and therefore introducing it steadily (e.g.: Swensk Biogas AB, Linköping, Sweden)
9) Joint procurement of AFVs. Gathering a substantial amount of buyers to overcome the uncertainty of the demand by the manufacturers and encourage the introduction of new models (e.g.: joint procurement of Ford Focus FFV, Sweden)
10) Transportation Management Associations (TMAs). Non-profit public-private associations forming partnership with business and local government that offer commuter information and mobility services (e.g.: ride On, USA)
11) Local taxes or charges ring-fenced for transport. Taxes or charges at local level that aim at benefiting the urban transport system as a whole by the reinvestment of the collected revenues into the local transport system (e.g.: congestion charging in London, UK)
12) City-wide campaigns using marketing and branding. Schemes presenting awareness raising events at a city level in close cooperation with public and private bodies and that are run on a permanent basis. The aim is to involve citizens and raise awareness on the various

mobility opportunities proposed within the city and its outskirts (e.g.: big wheel campaign, Nottingham, UK)

The project, now completed, has generated numerous policy and research recommendation aimed at promoting sustainable mobility in urban areas; due to its success, the project is currently being followed up by the FP7 NICHES+ project.

A tabular overview of all selected projects follows, where the potential for commercialisation of the technologies they have developed and their potential contribution to increasing sustainability of road transport are qualitatively assessed and ranked. In particular, the potential for commercialisation of the results of each project is ranked as "low", "medium" or "high", based on the available information on the project's objectives and achievements. The potential contribution that the project results can make to road transport sustainability is also ranked similarly: in the table "*" stands for low, "**" for medium and "***" for high; environmental, social and economic sustainability are assessed and ranked separately, based on the definition of sustainable mobility discussed in Section 2 above.

Table 11 Analysis: infrastructures projects

Project Acronym	Consortium composition	R&D focus	Potential for commercial exploitation of results	Potential contribution to road transport sustainability		
				Environmental	Social	Economic
AER-GAS	Mostly formed by research institutes and universities, from a total of 6 EU countries. Several representatives of Austria and Germany	Development of an efficient, low-cost, one-step adsorption enhanced reforming process (AER) for biomass which is capable to also produce hydrogen and SNG for transport uses	High Efficient, low-investment cost AER plant design Catalytic CO_2 absorbent bed materials with improved mechanical and chemical stability for AER process	*** Production of transport fuels from renewable, low-carbon energy sources	*** Production of transport fuels from local feedstock increases energy security	*** Development of technologies with wide commercialisation potential
BIOCAT	5 among research institutes and universities; 3 industrial organisations. 4 partners out of 8 from Greece	Catalyst Development for Catalytic Biomass Flash Pyrolysis Producing Promising Liquid Bio-Fuels	Medium Technology potentially promising but current state of development not known	*** Production of transport fuels from renewable, low-carbon energy sources	*** Production of transport fuels from local feedstock increases energy security	*** Development of technologies with wide commercialisation potential
BIOENERGY CHAINS	Almost entirely formed by research institutes and universities, from a total of 8 different EU countries	Technical, socio-economic and environmental assessment of the whole energy chain, from biomass production to thermochemical conversion, of a number of energy crops	Low No hardware developed by this project, however the assessment is potentially important to inform future developments of energy crops in Southern Europe	** Production of feedstock for renewable, low-carbon biofuel production	*** Production of transport fuels from local feedstock increases energy security	*** Development of valuable energy crops from marginal agricultural land
BIOGASMAX	31 partners from a total of 8 countries; half of the partners are from Sweden. Good balance between industry and other types of organisations	R&D activities within this project focus on improving technologies for biogas production, upgrading, distribution and end-use in road vehicles	Medium Although the project aims to promote the commercial uptake of biogas technologies and the R&D activities carried out as part of it are key to achieve this, it must be noted that overall these technologies are not far from being mature for commercialisation already	*** Production of low-carbon, renewable fuel from transport from waste, thus addressing two important environmental problems at the same time	*** Production of renewable fuels using local renewable resources contributes to increasing energy security.	*** Technologies with wide potential for commercialisation. Additionally, recovering energy from waste has positive economic impacts

BIO-HYDROGEN	7 industrial partners out of a total of 10. 4 partners from Germany and 3 from Austria.	Development and construction of a stable and cost-effective biogas reforming unit (6kW H2), with advanced and durable catalysts and a biogas upgrading unit for siloxanes removal	Medium Reformer unit was successfully tested with clean model biogas; whether it was also tested with real biogas is not known. The siloxane removal unit was successfully tested on a laboratory scale Research done in this project has generated promising results and is currently being followed up in the FP6 project HYVOLUTION	*** Production of renewable, low-carbon hydrogen for transport	*** Production of hydrogen from local feedstock increases energy security	*** Development of technologies with wide commercialisation potential
BIOTOX	Partners are research organisations from 3 EU countries	Assessment of toxicity of pyrolysis oil (bio-oil) and definition of best practices for production and handling Cost reduction of bio-oil production	Low The project did not involve major R&D activities, however the assessment is important to inform future developers of bio-oil production plants	** Development of best practices in liquid biofuel production	* Indirectly impacts on the production of transport fuels from local feedstock	* Indirectly impacts on the development of technologies with wide commercialisation potential
CATLIQ	3 partners for 3 different countries; 2 research and one consultancy organisations	Catalytic liquid biomass (e.g.: sewage sludge) conversion into fuels for CHP and other energy uses	Medium Technology is directly aimed at CHP and not specifically at transport fuels. Moreover the current state of development is not known	** Production of transport fuels from renewable, low-carbon energy sources	** Production of transport fuels from local feedstock increases energy security	** Development of technologies with wide commercialisation potential
CHRISGAS	More than half of the partners of this large consortium are from Sweden; several industrial organisations involved	Demonstrate an energy-efficient and cost-effective method of producing H2-rich gases from gasification of solid biomass. The H2-rich gas can then be upgraded and converted into renewable transport fuels (FT-diesel, DME and H2)	High Project R&D activities are severely delayed but have nevertheless generated very promising results with high potential for commercial exploitation after 2010	*** Production of transport fuels from renewable, low-carbon energy sources	*** Production of transport fuels from local feedstock increases energy security	*** Development of technologies with wide commercialisation potential
DIPROWASTE	3 partners from Germany and 3 from the UK. 4 partners are commercial organisations	Determine the best combination of pre-treatment methods to maximise the production of fuel gas and minimise post-treatment cost from anaerobic digestion	High Pre-treatment technology developed in the project is being commercially exploited by project partners	* Production of fuel mostly from stationary uses, but potential future use for transport as well	* Production of transport fuels from local feedstock increases energy security	* Development of technologies with commercialisation potential
ECHI-T	13 partners from a total of 6 countries: Italy, Germany, Belgium, Sweden, USA and China	Techno-economic and market assessment of energy crops for the production of bioethanol / ETBE in China and Italy	Low The project did not encompass major R&D activities, however the assessment carried out is important to inform future developers of energy crops in the EU	*** Production of transport fuels from renewable, low-carbon energy sources	*** Production of transport fuels from local feedstock increases energy security	*** Development of valuable energy crops from marginal agricultural land
FERMATEC	Half of the consortium is made of Portuguese partners, and 6 out of 10 are industrial organisations	Development of a modular fermentation unit for continuous ethanol production, in order to decrease cost and increase yields compared with traditional units.	Medium New fermentation unit shows ethanol production cost decrease of 20% and increase of bio-ethanol production yield to approximately 25 g EtOH/l.h. Current status of development of the technology and its possible commercial exploitation is unknown	** Production of renewable transport fuels at lower costs	** Production of transport fuels from local feedstock increases energy security	** Development of technologies with commercialisation potential
GASASH	Half of the consortium partners are from Finland, and the majority of the consortium consists of industrial organisations	Improvement of the economics of biomass/waste gasification by higher carbon conversion and advanced ash management	Medium Commercialisation of the technology development also depends on the commercial uptake of biomass/ waste gasification technologies	* Contributes to making the production of renewable fuels more	* Contributes to making the production of fuels from local	* Contributes to the development of technologies with

				economic and with lower environmental impact	feedstock viable	commercialisation potential
GENHYPEM	Consortium of 9 partners from a total of 6 countries, with a good balance between industry and academia/ research institutes	Development of low cost MEA and prototypes of proton-exchange membrane-based water electrolysers for hydrogen production	Low/ medium The project has generated several publications and 2 prototypes so far, but large-scale commercial exploitation of the system is not expected in the short term	** Contributes to the production of hydrogen from intermittent (renewable) sources on a small scale	** Contributes to making the production of fuels from local feedstock viable	** Contributes to the development of technologies with commercialisation potential
Hi2H2	Consortium made of research institutes from 4 different countries	Development of high-efficiency, low-cost planar solid-oxide based high temperature water electrolyser One of the objectives is to demonstrate degradation of less than 1% in 1,000 hours on a small stack	Low/ medium The project has generated several publications, but large-scale commercial exploitation of the system is not expected in the short term	*** High-efficiency, cost effective production of hydrogen from renewable energy sources	*** Production of renewable hydrogen from diversified, local energy sources	*** Development of technologies with high potential for commercialisation in the medium/long term
HYDROSOL-II	Consortium made of 5 partners, each one from a different country; good balance between industry and academia	Development and testing of an optimised 100kWth pilot plant; further scaling up of the technology and demonstration of the system coupled with a solar concentrator. Development of a stable support capable of at least 50 cycles in a row, and decrease of temperature of the regeneration step.	Medium/High New support materials have been developed and successfully tested. Development and optimisation of the reactor and its coupling with a solar concentrator are underway	*** Production of renewable hydrogen from solar heat	*** Production of vast amounts of hydrogen from solar energy, which can significantly contribute to energy security	*** Development of technologies with potentially very wide markets
HYMOSSES	Consortium of partners from 6 different countries, with good balance between industry and academia	Improve carbon and metal hydride materials for hydrogen storage in order to fulfill the needs of large scale use of hydrogen	Medium Detailed results of the project are not known	* Adequate storage materials are necessary to enable the large scale use of hydrogen	* Hydrogen has the potential to contribute to increasing energy security	** Hydrogen storage technologies have potentially wide markets
HYSTORY	9 partners from 5 countries, with a good balance between industrial and research organisations	Advancing the state of the art of metal hydrides for hydrogen storage and test these novel materials in a range of end-use applications	Medium Detailed results of the project are not known	* Adequate storage materials are necessary to enable the large scale use of hydrogen	* Hydrogen has the potential to contribute to increasing energy security	** Hydrogen storage technologies have potentially wide markets
HYSTRUC	Consortium of 3 industry partners from 3 different countries (Germany, Norway and Belgium)	Development and demonstration of an innovative 30 bar low-cost, small-size pressure electrolyser in the MW power range	Medium Detailed results of the project are not known	** Efficient, cost effective production of hydrogen from renewable energy sources	** Production of renewable hydrogen from diversified, local energy sources	** Development of technologies with good potential for commercialisation
HYTHEC	6 partners from a total of 6 countries. Research organisations are prevalent	Development of the S_I and hybrid sulphur thermochemical cycle for hydrogen production, by means of computer simulation and experimental work. Assessment of industrial scale-up aspects.	Medium First step of the analysis of the cycle and its scaling-up have been completed, but only initial results are publicly available so far	*** Potential for efficiently producing hydrogen from solar energy	*** Production of renewable hydrogen from diversified, local energy sources	*** Development of technologies with good potential for commerci

						alisation
HYVOLUTION	22 partners from 13 countries, evenly distributed between industry and research/academic entities	The main scientific objective is the development of a 2-stage bioprocess for the cost-effective production of pure hydrogen from biomass. The main technological objective is the construction of prototype modules of the plant which form the basis of a blue print for the whole chain of biomass to pure hydrogen.	High This technology has the potential to supply around 20% of hydrogen demand in Europe. The project builds on the results of the FP5 Biohydrogen project, and the technologies here developed are expected to be commercialised starting from 2015	*** Cost effective production of large quantities of renewable hydrogen	*** Small-scale production of renewable hydrogen from local energy sources	*** Technologies with potential for wide commercialisation
HY2SEPS	7 partners from 6 different countries; 4 research and academic institutions, 3 industrial organisations	The main goal is the development of a hybrid membrane/PSA H2/CO2 separation process which will be part of a fossil-fuel decarbonisation process coupled with hydrogen production.	Medium/ high Foreseen project achievements include the development of improved membranes and sorbent materials and the simplification of PSA operation in order to achieve more effective H2 recovery and CO2 separation	** Contributes to the production of carbon-free hydrogen from fossil sources	* Indirectly contributes to increase security of supply by enabling fossil-fuel based hydrogen production pathways	** Technologies with significant potential for wide commercialisation
Local and Innovative Biodiesel	12 partners from 7 countries; partners are mostly research institutes and local authorities	Research in this project focuses on testing a number of potential feedstock for biodiesel production, beyond the conventional ones. Work includes lab-scale production and testing in internal combustion engines	Medium/ high Biodiesel is already commercially viable and its uptake is growing fast. Research within this project may lead to the use of new feedstock and technologies for biodiesel production	** Contributes to increasing the production of renewable fuels for transport	*** Promotes the use of alternative and local feedstock for biodiesel production not based on food crops	*** Develops technologies for biodiesel production with wide potential for commercialisation
NATURALHY	Very large consortium of 40 organisations, the majority of which industrial. 12 countries are represented, of which the UK has the most partners	The main objective is to contribute to the preparation for the hydrogen economy by: i) using the existing natural gas system as a catalyst for change; ii) initiating the near-future practical transition towards the hydrogen economy	Medium The project should enable the introduction of H2 in the natural gas network in the short to medium term, and also aims to develop membranes for the separation of H2 from natural gas at the point of use which will be needed for the use of hydrogen in fuel cells	* Contributes to the development of a large-scale hydrogen economy	* Contributes to marginally increase security of supply in the short term; much higher potential contribution in the long term	* Technologies with potential for commercialisation by the companies involved in the project
NEMESIS	8 partners from 6 countries, equally divided between industry and research	The main goal is to develop innovative materials and efficient sub-components that can be integrated and used in a novel fuel-flexible, small-scale hydrogen generator	High The project starts from a commercial product by Hexion and aims to further develop it to make it fuel-flexible and more cost effective	* Hydrogen production mostly from fossil sources and small-scale so CCS is not an option	** Contributes to energy security by enabling flexible hydrogen production from various feedstock	*** Develops technologies with wide application and commercialisation potential
NICHES	The consortium consists of 7 partners from s total of 5 countries	The objective of the project is to promote a selection of 12 concepts for sustainable mobility , ranging from demand and infrastructure management to the promotion of AFVs.	Low The project in itself did not develop technologies; it instead aimed to promote existing sustainable transport technologies from niches to mainstream	*** Bringing the considered technologies to mainstream could have significant environmental benefits	** Overall the technologies considered are aimed to improve mobility and transport services without making these more expensive	** Economic benefits of these technologies are variable, as not all of offer significant opportunities to the EU industry
NILE	21 partners from 12 countries. Industry and academia/ research organisation are evenly represented	The objective of this project is to propose the best process for a cost effective production of clean bioethanol from lignocellulose to be used in combustion engines	High Although the large-scale commercial development of bioethanol from lingo-cellulosic biomass will not occur in the short term, in the medium to long term this route appears to be	*** Contributes to the development of viable routes to	*** Contributes to stimulate sustainable rural development	*** Contributes to extending EU leadership

			particularly promising and has potentially very wide application both in the EU and elsewhere	low-carbon, renewable transport fuels production	and has positive impacts in terms of European land use	in biofuels to bioethanol as well: it also improves competitiveness of fermentation and biotechnology industry
SOLHYCARB	11 partners from 7 countries; most partners are research institutes	Development of a process producing hydrogen and carbon black from thermal cracking of NG in a chemical reactor using solar energy	Medium Offers a potentially more economically promising route for hydrogen production from NG	** Makes hydrogen production from natural gas more efficient by using solar thermal energy	** Contributes to energy security by providing a more efficient way of producing hydrogen from NG	** Provides a technology for significant potential for commercialisation
SOLREF	8 partners from 7 countries, equally divided between industry and research organisations	Development of an innovative solar reformer for methane rich gases for the production of hydrogen and/or electricity	Medium/high The project develops a small-scale prototype and addresses scaling-up of the technology up to a 50MWth size	** Reduces CO_2 emissions associated with the reforming of methane	** Contributes to energy security by reducing demand for fossil fuels	** Technology with wide potential for commercialisation
SUPER-HYDROGEN	7 partners, the majority of which from the Netherlands. Industry and research partners evenly balanced	Development of an innovative supercritical water gasification process for cost-effective hydrogen production from biomass and waste	Medium Technology with good potential for commercialisation, but current status of development is unclear	*** Production of renewable fuels using renewable resources and waste	*** Uses diversified, low-value local resources, thereby increasing security of supply	*** Good potential for commercialisation of the technology
SOLAR-H	8 research institutes from a total of 6 countries	Development of novel routes for hydrogen production from water and solar energy involving both artificial photosynthesis and photo-biological processes	Low These technologies are still a very long way from their possible commercial use	*** Technologies with the potential to produce virtually unlimited renewable hydrogen	*** Technology with the potential to entirely solve the problem of energy security	*** Technologies with wide potential for application worldwide
TIME	7 partners from a total of 6 countries. Most partners are research entities	Development of novel technologies for pre-treatment and enzymatic hydrolysis steps of ligno-cellulosic biomass , which comprise up to 50% of the present production costs of bioethanol	Medium The potential for commercialisation of these technologies in general is high, particularly in the long term. However, it is not clear exactly what the outcomes of this project were	*** Contributes to the development of viable routes to low-carbon, renewable transport fuels production	*** Contributes to stimulate sustainable rural development and has positive impacts in terms of European land use	*** Contributes to extending EU leadership in biofuels to bioethanol as well: it also improves competitiveness of fermentation and biotechnology industry
ZERO REGIO	16 partners, the majority of which from industry and mostly from Germany and Italy	The project consists in constructing and testing hydrogen infrastructure for road vehicles in two European regions. R&D essentially focused on a ionic fluid compressor and a high pressure (1,000 bar) pipeline	High The technologies developed in the project particularly for hydrogen compression / liquefaction and transmission appear to offer a breakthrough with high potential for commercialisation	** Although the infrastructure developed in the project uses hydrogen produced	** Although hydrogen from natural gas only improves energy security to a	** Technologies developed within the project are aimed at improving

		system		from natural gas and as a by-product of industrial processes, it can also be used in the future for renewable hydrogen	limited extent, in the future hydrogen could be produced from a wide range of feedstock	the competitiveness of the EU hydrogen industry

1.6 Large-scale demonstration projects on sustainable mobility in Europe and worldwide

1.6.1 Overview of the considered projects

The selection process focused on the individualization of such projects developed a demonstration part, had a big public impact, contributed to make the transport more sustainable from different aspects, as specified in the definition. In this section most of the considered projects were carried out in Europe, with particular attention to the ones funded by the EC, but also some example regarding projects of other continents are considered to have a global view.
The projects were selected on the basis of the information available from internet, the Cordis Database and the EC brochures such as the "Projects Synopses: Sustainable Surface Transport Research Technological Development and Integration, 2002 – 2006", "Project Synopses: European Fuel Cell and Hydrogen Projects, 2002-2006". In addition, some projects information were collected by means of the filled in questionnaires.
Efforts were employed to find projects from the FP4 to the FP6, involving different kind of technologies and finally selecting only some of them and neglecting some others ones because of the time constrains. Making a choice, the selection of Asian, American, Oceania and African project focused mainly on hydrogen fleet demonstration projects, in order to carry out a comparison between a EC projects (Hyfleet: CUTE and HYCHAIN-MINITRAINS) with similar ones developed in other continents.
Among the received 11 questionnaires, two projects were picked out among them: Hyfleet:CUTE and CyberCars-2. Globally, from about European 250 projects database compiled during MOBIDAYS progressed, 29 were selected and included in the brochure, plus 2 are developed in the frame of national programmes. Among them, 23 are European, 9 from the other continents. Seven of those projects were presented during the conference, one of them was Japanese and one from U.S.A.
The selected project coordinators were then asked to provide more information about their projects by emails and some of them were contacted by phone.
Fairly problematic was the involvement of the speakers from the other continents. The available contacts on internet were poor and the email feedbacks were a few. For this reason, CIRPS contacted the embassy of different countries, trying to have a good balance among the continents. Actually, to contact the embassies was effective and they provided an important support to individualize, invite and involve the speakers from the other Continents.

The number of demonstration projects fostered in the world to solve the transport problems is huge and this report intends to propose and describe some example of them.

Table 12 Project summery demonstration projects

Acronym	Full name	FP (EC Framework Programme)	Coordinator	Partners (number of partners)	Website	Budget (M€)		Project timing
						Total	EC contribution	

FP4								
CITYBUS DORDRECHT	Advanced hybrid midibus fleet in the historic City Centre of Dordrecht	FP4	n.a	n.a	n.a	n.a	n.a	n.a
CONSTRUCTION AND DEMONSTRATION OF 10 LOW FLOOR BUSES EQUIPPED WITH A NEW ENERGY SAVING DRIVE SYSTEM.	Construction and demonstration of 10 low floor buses equipped with a new energy saving drive system	FP4	Magnet Motor GMBH- Weck W.	n.a.	n.a.	2.9	1.2	01.09.1991-31.12.1993
JUPITER	Joint Urban Project In Transport Energy Reduction	FP4 Energy Programmes	Merseyside Passenger Transport Authority - BLACKLEDGE DAVID	n.a.	n.a	0.02	0.1	19.07.1993-01.31.1997
MULI BUSLORRY WITH MULTIPLE USE GOODS AND PASSENGER TRANSPORT	Muli buslorry with multiple use goods and passenger transport	FP4-NNE-THERMIE C	BERLINER VERKEHRSBETRIEBE (BVG)-SCHMIDT HARTMUT	n.a.	n.a.	2.00	0.8	01.04.1996-31.03.1999
SAGITTAIRE		FP4	CITY OF LUXEMBOURG- Schiltz J.	n.a.	n.a.	4.9	1.5	01. 01.1997-30. 04.2000
FP5								
CIVITAS-TELLUS	Transport & Environment aLLiance for Urban Sustainability	FP5-GROWTH	MUNICIPALITY OF ROTTERDAM-Frank VAN VLIET	23	http://www.civitas-initiative.org/project_sheet?lan=en&id=7	n.a.	n.a.	01.02.2002-31.01.2006
CUTE	Clean Urban Transport for Europe	FP5	Tasis Industrial Applications Ltd- Kostas SEFERIS	4	www.fuel-cell-bus-club.com	1.5	0.8	01.08.1997-31.07.1999
CYBERMOVE	Cybernetic transportation systems for the cities of tomorrow	FP5-EESD	Institut National de Recherche en Informatique et en Automatique – INRIA- Bernard LARROUTUROU	14	www.cybermove.org	3.8	1.9	01.12.2001-30.11.2004
CYBERCARS	CYBERnetic CARS for a new transportation system in the cities	FP5 - IST	Institut national de Recherche en Informatique et en Automatique - INRIA - Michel PARENT	14	www.cybercars.org	5.0	2.5	01.08.2001-31.07.2004
ECTOS	Ecological city transport system	FP5-EESD	ICELAND NEW ENERGY LTD-Jon Bjorn SKULASON (Mr.)	11	http://www.ectos.is	6.9	2.9	01.03.2001-01.03.2001
FUEL CELL BUS	Fuel cell bus project	FP5	Berliner Senatsverwaltu	8		5.2	1.8	01.03.2000-29.02.2004

PROJECT			ng für Wirtschaft und Betriebe					
FP6								
ASK-IT	Ambient Intelligence System of Agents for Knowledge-based and Integrated Services for Mobility Impaired users	FP6-IST	SIEMENS S.A. Spain- Mr Angel Blanco	42	http://www.ask-it.org/	n.a.	n.a.	Not available
BEST	Bioethanol for Sustainable Transport	FP6	City of Stockholm, Environment and Health Administration . Gustaf Landahl	25	http://www.best-europe.org/	n.a.	n.a.	
CIVITAS-CARAVEL	Travelling towards a new mobility	FP6-SUSTDEV	Comune di Genova - Vito Maria Contursi	21	http://www.civitas-caravel.org	29,8	13,19	n.a.
CIVITAS-MOBILIS	Mobility Initiatives for Local Sustainability - aims to implement radical strategies for clean urban transport	FP6-SUSTDEV	SYNDICAT MIXTE DES TRANSPORTS EN COMMUN DE L'AGGLOMÉRATION TOULOUSAINE - Alexandre BLAQUIERE	30	http://www.civitas-initiative.org/project_sheet?lan=en&id=2	17.4	9.3	01.02.2005-01.02.2009
CIVITAS-SMILE		FP6-SUSTDEV	City of Malmö - Jesper König	27	http://www.civitas-initiative.org/project_sheet?lan=en&id=1	n.a.	n.a.	n.a.
CIVITAS-SUCCESS	Smaller Urban Communities in Civitas for Environmentally Sustainable Solutions	FP6-SUSTDEV	Communauté d'Agglomération de La Rochelle - Transport & Mobility Department- Jean-Marie Grellier	13	http://www.civitas-initiative.org/project_sheet?lan=en&id=4	18.8	7.5	February2005-February 2009
CYBERCARS 2	Close Communications for Cooperation between Cybercars	FP6-IST	Institut National de Recherche en Informatique et en Automatique – INRIA-	12	http://www-c.inria.fr/cybercars2	4.0	2.1	01.01.2006-31.12.2008
HYCHAIN-MINITRAINS	Deployment of innovative low power fuel cell vehicle fleets to initiate an early market for hydrogen as an alternative fuel in Europe	FP6-SUSTDEV	AIR LIQUIDE S.A.	24	www.hychain.org	37.6	17.0	15.01.2006-14.01.2011
HYFLEET: CUTE	Hydrogen for Clean Urban Transport in Europe	FP6-SUSTDEV	DAIMLERCHRYSLER AG-	31	http://www.global-hydrogen-bus-platform.com/	43.0	19.0	10.01.2006-09.09.2009
QCITY	Quiet city	FP6-SUSTDEV	ACOUSTIC CONTROL ACL AB- Nils - Ake NILSSON	27	http://www.acoustic.se	13.5	7.4	01.02.2005-31.01.2009
SILENCE	Quieter Surface Transport in Urban Areas	FP6-SUSTDEV	AVL LIST GMBH- Josef AFFENZELLER	43	www.silence-ip.org	15.8	8.9	01.02.2005-31.01.2008
ZERO REGIO GmbH	Lombardia & Rhein-Main towards Zero Emission: Development & Demonstration of Infrastructure Systems for Alternative Motor Fuels	FP6-SUSTDEV	Infraserv GmbH & Co. Höchst KG- Heinrich LIENKAMP	16	www.zeroregio.com	18.0	7.5	15.11.2004-15.11.2009

National European projects								
CEP	Clean Energy Partnership	German Governme nt		12	http://www.cep-berlin.de	n.a.	n.a.	November 2004-December 2007
SHHP	Scandinavian Hydrogen Highway Partnership		HyNor Hydrogen Sweden Hydrogen Link	5	http://www.scandinavianhydrogen.org	n.a.	n.a.	n.a.
NON-EU projects								
	Hydrogen Highway	Canada			www.hydrogenhighway.ca			
	UNDP-GEF-China fuel cell bus project	China						
	Domestic FCV development projects	China						
JHFC	Hydrogen & Fuel Cell Demonstration Project	Japan	Japan Ministry of Economy, Trade and Industry	Universities and research centres : n.a; automotive: 8; infrastructures builder: 16	http://www.jhfc.jp			JHFC1: 2002 – 2005 JHFC2: 2005 – 2010
CaFCP	California Fuel Cell Partnership	USA		21 full members 13 associate members	http://www.fuelcellpartnership.org/	2,000,000 $ each year		Start: 1999 1st phase: 2003 2nd phase: 2007 3rd phase: 2012
DOE Hydrogen Program	U.S. DOE's Technology Validation Program for Hydrogen Infrastructure and Fuel Cell Vehicles	USA			http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/doe_h2_tech_validation.pdf			

1.6.2 Conference objectives and outputs

The third and final Mobidays conference took place in Rome on 7 November, 2007. It dealt with large-scale demonstration projects on sustainable mobility in Europe and worldwide.
The conference aimed to provide the opportunity to disseminate and discuss the results achieved, the main goals reached and the problems still to be solved in large-scale European and non-European demonstration projects. It was also an opportunity to compare Europe with USA and Japan.

Playing the role of global project overview and therefore media wise more appealing, all the conferences –particularly on the final conference - engaged a significant media interest.

The conference started with a presentation of the European Investment Bank dealing with the Urban transport projects and the new financing instruments. Then, the conference was dedicated to European projects from the 4th to 6th Framework Programmes and gave some space to the industry. To compare the European experience with the Asian and the American one, a specific topic had been selected: the hydrogen fleets have been realizing in the world. Finally, the final reports from the previous conferences about 1) sustainable vehicles, 2) socio-economic barriers and 3) infrastructure have been presented.
In addition, during the conference four interviews to the speakers and other three ones to the MOBIDAYS partners were carried out in the press room and they were published on the H2roma website.

Speaker selection process
From about 30 among project coordinators, researchers, institution and industry represents, 10 were the selected speakers, from 7 countries and three continents, as reported in Table 13 (not considering the MOBIDAYS partners).

Table 13 Rome presentations

Name	Institution	Institution quarters	Projects presented	Title of presentation
Mario Aymerich	European Investment Bank	Belgium	NICHES	EIB urban transport projects
Adriano Alessandrini	Sapienza-University of Rome	Italy	CITYMOBIL	CITYMOBIL project
Michel Parent	INRIA	France	CYBER CARS 2	CYBER CARS 2 project
Giancarlo Crepaldi	Trentino Trasporti	Italy	Demonstration project for integrated energy saving urban transportation systems incorporating hybrid bus fleets	Demonstration project for integrated energy saving urban transportation systems incorporating hybrid bus fleets
Dr. Anton Reisinger	BMW AG	Germany	-H2Win (USA) -FreedomCAR/FreedomFUEL (USA) -Californian Fuel Cell Partnership(USA) -Californian Hyway (USA) -CEP-Clean Energy Partnership (Germany) -TES-Transport Energy Strategy (Germany) -HyWays (France) -JHFC Japan Hydrogen and Fuel Cell Demonstration Project (Japan) -Sinergy EDB Project (Singapore) -ECTOS-CUTE-STEP (Europe-China-Australia) -DoE Program USA	The BMW CleanEnergy programme
Dr. Udo Hartmann	Daimler AG	Germany	ECTOS-CUTE-STEP (Europe-China-Australia) CEP-Clean Energy Partnership (Germany) Bus Project Beijing China Californian Fuel Cell Partnership(USA) DoE Program USA JHFC Japan Hydrogen and Fuel Cell Demonstration Project (Japan)	The Road to the Future: The Daimler perspective on sustainable mobility

			Sinergy EDB Project (Singapore) Zero Regio (Italy, Germany)	
Tiago Farias	DTEA - Investigação em Transportes, Energia e Ambiente, Instituto Superior Técnico	Portugal	Hyfleet: CUTE project	Hyfleet: CUTE project
AmbrogioTagliabue	Air Liquide	Italy	HYCHAIN-MINITRAINS	HYCHAIN-MINITRAINS
Dr. Hiroschi Hasegawa	Polymer Electrolyte Fuel Cell Cutting-Edge Research Center (FC-Cubic), National Institute of Advanced Industrial Science and Technology (AIST), Japan	Japan	ASIA: JHFC - Japan Hydrogen & Fuel Cell Demonstration	ASIA: JHFC - Japan Hydrogen & Fuel Cell Demonstration
Ned T. Stetson	Office of Hydrogen, Fuel Cells and Infrastructure Technologies, U.S. Department of Energy	U.S.A.		U.S. Large Scale Demonstration Projects

Conference outcomes

In general, the demonstration projects evidenced:

- To have a significant role in communication. They constitutes a high impact interface between technicians and final users of the innovative products to enhance the general awareness on them. For example, considering the presentation of Mr. Crepaldi, he told the attendees that after the EC project, the technology of hybrid traction has been adopted by many private cars and a lot of taxis. During the past year, important winter resorts such as Moena, Cavalese, Predazzo and Pozza di Fassa tested hybrid buses for school transport and door-to-door freight. The heavy traffic in these resorts during winter months and the consequent emission concentration aroused the Authorities'interest in hybrid traction.
- To be fundamental in validating the real world performance of the technologies developed in the labs, in verification of the reliability in real life conditions, the robustness of the product in the hands of the users, the durability.
- To improve the expertise not only in technological and economical point of view, but also in social aspects, which is not negligible aspect. In fact, the products are chosen not only for performances, but also on the basis of costumer ecological sensitiveness, the safety perception, the costs and the everyday life habits modifications. In some cases the safety perception and responsibility issues are crucial aspects (e.g. driverless vehicles).
- For the innovative products application in transport sector, one of the barriers which affects all the projects is the lack of standardization, codes, regulation. Those obstacles often require long time and many human recourses to be overcome. For this reason, nobody wants to be the first to implement a new system.
- The Political support is important in such projects on the one hand to push (unpopular) accompanying measures and on the other hand to facilitate the long authorization procedure. About this aspect, it is worth to highlight that for example in Japan the Ministry of Economy, Trade and Industry directly coordinated the JHFC - Japan Hydrogen & Fuel Cell Demonstration Project.
- A preliminary study to select the site suitable for the specific application have to be carried out. It is very important in this kind of projects.
- Media coverage has to be ensured.

Two of the most representative vehicle manufacturers confirmed their interest in Hydrogen technology, one on ICE technology (BMW Group), and the other one more focused on FC propulsion system. Both of them are involved in a number of Hydrogen demonstration projects around the world and they showed their vision and the relative roadmaps to reach the objective of producing a large number of hydrogen powered vehicles and penetrate the market. They proved to believe in hydrogen as a promising substitute of the nowadays conventional fuels although they adopted different strategies to achieve the aim. In fact, while BMW chose liquid stored hydrogen and bivalent internal combustion engine (hydrogen/gasoline), at least in the bridging period, Daimler is focusing on compressed stored hydrogen and FC propulsion system.

In technology point of view, the crucial aspects and the individualised barriers are:

- The range has to be increased for the acceptance of the technology.
- Considering the hydrogen quality and purification: to develop cost-effective hydrogen purification technology and quality measuring devices; to increase understanding of the effect of impurities on fuel cell stack behavior.

Concerning the commercialization, it is necessary:

- Deploying a significant volume of vehicles based on similar technology platform to provide the conditions for a pre-industrial approach
- Lighthouse Regions as the next step to apply the hydrogen technologies.

The selected messages from the conference which are specific to the theme of standardization/code for the hydrogen fleets introduction are:

– Strong political commitment needed
– It is essential to synchronize the fleet operation of the Fuel Cell vehicles with corresponding hydrogen networks
– It is necessary to build-up customized networks of H_2 fuelling stations (publicly accessible, fast and complete refill, easy handling, …)
– It is required to determine methodology to reduce station access concerns and accelerate agreements
– Promotion of interim standards development and identification of Codes & Standards gaps related to storage and infrastructure have to be pursued
– Development of standards to ensure that fuel cell vehicles can be parked in public/home garages and service facilities nationwide
– About the vehicle use (US Specific), find methods to ensure that fuel cell vehicles can travel on bridges, tunnels and highways nationwide

With respect to the different approaches adopted by the different countries in the world to implement innovative solutions and realize demonstration projects, it is worth to highlight that in Japan the Ministry of Economy, Trade and Industry directly promoted and supported the project JHFC involving and coordinating the partnership which is comprised of research centers and companies (vehicles and infrastructures). In USA, the DoE establishes the objectives and the roadmap for innovative technology applications together with the industries, which are involved in the decision making processes by means of continuously organized meeting. In particular, to facilitate wide exploitation and dissemination of the research results, the NREL-National Renewable Energy Laboratory provides the direct access to all composite data products concerning the hydrogen and FC research on the web (http://www.nrel.gov/hydrogen/cdp_topic.html).

In technological perspective, Hyfleet Cute project raised a gap between the current and the next generation hydrogen buses, while Stetson of DoE told during his presentation that in USA the Roll-out of 2nd generation vehicles is beginning now.

Before analyzing some of the projects funded by the EC, the crucial role that the European Investment Bank (EIB) can play in the Urban Transport Projects realization will be briefly described. It is not part of the project analysis, but the presentation has been considered important for knowing the several instruments to undertake the demonstration projects in transport sector.
In fact, the EIB is enabling new instruments to support the Urban transport projects fall within main priorities of the Bank, which are:

- Environment
- Regional development

and possibly:

- Innovation
- Social cohesion

Being a bank, the projects to be supported by the EIB should have high technical quality and economic soundness, financial viability and adequate security, but in addition they should be consistent with EU priorities.
The dialog between the EIB and the EC gave the opportunity to agree some joint initiatives among which the most important are:

– JASPERS (Joint Assistance to Support Projects in European RegionS) is a major joint policy initiative of the EIB, the European Commission and EBRD to assist beneficiary countries (principally the new Member States and acceding countries of the EU) to absorb EU Structural and Cohesion Funds over the next budgetary planning period 2007-2013.
– JESSICA (Joint European Support for Sustainable Investment in City Areas) is a joint initiative of the Commission, the EIB and the Council of Europe Development Bank. The aim is to use Structural Funds to finance Urban Development Funds (UDFs) using revolving financial mechanisms to support revenue-generating projects within integrated urban plans supporting the sustainable development of urban areas. The EIB may act as holding fund of UDFs and is contributing to the initiative with its expertise and complementary financing of projects through loans.

Furthermore, the bank is currently preparing a new loan facility (namely using leasing financial principles) oriented to provide advantageous long-term financing to urban transport operators replacing or expanding their bus fleets with new vehicles outperforming existing environmental regulations.
New financial instruments, including higher assumption of risks (both during construction and operation), are being developed in order to support the realization of new projects in the urban area.
During the experience raised during the realization of the such projects, the most important lesson learnt is “The tariff adaption to actual demand needs and quality of service are the only ways for effectively attracting users” and this has to be absolutely taken into account to make a project economically and financially effective.

1.7 Projects analysis

An analytical description of the projects considered is proposed. Of the 31 EC projects, the 7 projects presented at the conference will be analyzed in depth, considering the research contents,

the consortium composition, the results and some comments about the possible exploitation and the market readiness has been proposed. Whist 21 European projects will be shortly reported.
All the considered projects include a demonstration application. Some are focusing mainly on one of the aspects of sustainable mobility, as defined in MOBIDAYS, but being the intents of this section to focus on large scale-demonstration project, most of them are developing the integration of several solutions. For this reason we could not propose a strict classification of them, but we are presenting an overview of them considering the Framework Programme they were funded from. The selection includes projects which worked on alternative fuels, as biofuel and hydrogen, hybrid vehicles, traffic management, safety, noise control, accessibility. Among those projects, both technological and socio-economic solutions have been developed.
Finally, an overview on projects carried out in other continents has been included, with particular attention to the ones were presented during the conference.

FP4

CITYBUS DORDRECHT was a demonstration project on an advanced hybrid minibus fleet in the historic city centre of Dordrecht, in Netherlands. It envisaged to use an advanced design full-length low floor midibuses in the city-centre, in association with integrated traffic management measures to improve the overall efficiency and appealing of public transport. This demonstration project in Dordrecht covered two routes which are sufficiently significant for the evaluation of the impact of this system.
During the commissioning phase the number of passengers increased from approximately 300 per weekday to approximately 1500 per weekday, but some the technical faults occurred regularly and they could not be resolved by the technical department of Stadsvervoer Dordrecht.
Based on technological and financial preconditions and preconditions concerning transport, Stadsvervoer proposes to decide against using hybrid or electric buses in a definitive plan of operation. As a next best alternative in terms of environmental aspects, it therefore proposes to include an LPG engine as a requirement in the public tender for the purchase of new buses.

CONSTRUCTION AND DEMONSTRATION OF 10 LOW FLOOR BUSES EQUIPPED WITH A NEW ENERGY SAVING DRIVE SYSTEM. Demonstration of a public transportation system of the future : low floor bus with a completely level floor and electric wheel motors. The project intended to realize an electric transmission which was completely new type at the moment of the project realization. Mechanical parts and functions (such as transmission, drive shaft, clutch, retarder) were replaced with electric components and electronic control elements. A generator was flanged directly to the internal combustion engine.
At the end of the project three buses have been in regular line operation for about 11 months. Final results concerning energy savings are not available.

JUPITER project had the objective to implement large scale projects in six European cities. They have implemented a variety of improvements to their public transport systems in combination with traffic restriction measures. The projects demonstrate combinations of measures designed encourage the use of public transport and discourage the use of private cars, thereby reducing energy consumption and emissions. The main measures implemented are :
(i) The introduction of new public transport vehicles providing a more user-friendly passenger environment (involving, in most cases, low-floor buses).
(ii) The introduction of state-of-the art passenger information systems.
(iii) The development of new or improved transport interchanges.
(iv) The introduction of bus priority measures combined with restrictions on private car traffic.
(v) The integration of urban traffic management control systems.

JUPITER 2. To improve energy efficiency, in both demand and supply sectors; to promote a wider utilization of renewable energy sources; to encourage a cleaner use of coal and other solid fuels; and to optimize the exploitation of the EU's oil and gas resources.

MULI BUSLORRY WITH MULTIPLE USE GOODS AND PASSENGER TRANSPORT is a demonstration project which was carried out by transport operators of Berlin and Trollhättan resp. Alvsborg region. The MULI buslorry is a medium sized vehicle for multiple use powered by natural gas - CNG. It can be used for passenger transport, for goods transport and for both passenger and goods transport at the same time. In urban areas the MULI buslorry can be used for passenger transport in the public transport system during periods of light traffic, when there is a need for smaller vehicles, or as an extra bus during rush hours. During the operation experience the following outputs raised:
- Several technical problems occurred with the gas driven MULI-Buslorry in Berlin. The vehicles unsatisfying availability created problems especially for the goods transport operator. This showed that a substitute vehicle is necessary and should provided in similar demonstrations.
- The vehicles is well accepted by the drivers of goods and passenger transport.
- The new public transport services provided by the MULI-Buslorries in Älvsborg line bus appreciate the vehicle comfort.
- Considerable difficulties were faced with the licensing of the vehicles in Sweden. Despite the MULI-Buslorries run by gas meet the common European safety standards the Swedish authorities denied the approval of the gas driven engine of the MULI-Buslorry. An exemption from the Swedish National Road Administration was applied for in March. The exemption decision was delayed until September 1998 and then denied. This shows that the technical requirements for gas vehicles in Europe should be harmonized.

SAGITTAIRE was a demonstration project using advanced hybrid-electric buses fitted with innovative batteries. It intended to improve the overall efficiency and attractiveness of public transport which demonstrated electric-hybrid bus in Luxembourg, Besançon, Alicante, Sintra, Stavanger, Savona, Trento, Athens and Brugge.
The main objectives may be summarized as follows:
- to demonstrate, on a sufficiently large scale and over a sufficiently long period, the viability of the hybrid electric bus technology in ordinary operating conditions and its positive effects on urban public transport in technical, economic, social, energy and environmental terms.
- to encourage the modal transfer away from private motorised traffic and towards public transport by installing an attractive service so as to overcome the problems caused by private motorised traffic in town centres (congestion of roadway system, energy consumption, polluting emissions, noise, etc.)
- to provide this service by means of hybrid electric buses combining energy efficiency and low zero emissions.
- to propose a high quality service so as to make urban public transport more efficient and more attractive (schedule, speed, frequentation, waiting times, security, timetables, intermodality, etc)
- to carry out a common procurement for purchase of the technology.
to demonstrate user acceptance of the hybrid-electric bus technology.
- to establish guidelines and formulate recommendations for a wide-scale penetration of the hybrid electric bus penetration.

FP5

CYBERCARS. It proposed a new approach in urban transportation. It developed prototype vehicles capable of moving autonomously without a driver, using an array of sensors, image

processing software and other communication technology. The prosecution of this project was CyberCars 2, but also other projects as Citymobil, MobiVIP (2004), CyberC3 (2005)

CYBERMOVE. The goals are to improve the attractiveness and quality of life in Anyville by reducing the use and the parking needs of traditional cars. This will be achieved by new transportation systems based on cybercars as a complement to public mass transportation. Cybercars offer a cleaner and safer transportation mode available to everyone including people who cannot (or should not) drive for a level of service better than with private cars (door to door, individual, on-demand transportation).
CyberMove's aim is to create a new transportation option for city authorities to move towards sustainability and increase the attractiveness of city centres.
It starts with an analysis of user needs, a definition of operating scenarios and a pre-design phase. The first planned milestone is the selection of sites in the 12 cities which have officially expressed their interests. The second milestone consists of guidelines for safety design in those selected cities. A design review is the last milestone before the Mid Term Assessment of the project, which will clarify demonstration plan and budget. Demonstrations are expected during the project in at least 3 European sites.

CUTE. It was a European Union project initiative to test three Citaro fuel cell buses each in nine cities in Europe. Therefore regional appropriate hydrogen (H2) production and refueling infrastructures were established. The outcome of the project was an improved public acceptance of the H2 fuel cell transport system, a more secure energy supply for the EU and the realistic application of renewable energy sources. It enhanced the competitiveness of EU industry. Its prosecution was HyFLEET:CUTE

ECTOS. A consortium of leading European corporations within the area of hydrogen production and fuel distribution, vehicle manufacturing join forces in Reykjavik, Iceland to perform a real scale comparative assessment of the effect of changing the transport energy base from fossil fuel to regenerative produced hydrogen. The ECTOS-project involves research, demonstration and evaluation of hydrogen infrastructure and fuel cell buses. The outputs of the project were exploited for the subsequent CUTE and Hyfleet:CUTE.

FUEL CELL BUS PROJEC. The project is aimed at completing the demonstration approach of the first European fuel cell bus using liquefied hydrogen in an inner city application. This project has been already evaluated in a former THERMIE evaluation as, excellent. Due to a lack of funding means the Commission was only in a position to finance the first phase of the project. This fuel cell bus project is aimed at demonstrating the innovative fuel cell propulsion system, different energy storage systems and a stationary hydrogen refilling infrastructure, clearly outlining not only the benefits to be obtained from a zero emission fuel, but also the advantages of this low bus design. Fuel cells are at the cutting edge of vehicle design and the project will show how its wider market introduction could have major environmental benefits. Fuel cell technology will show how European dependency on foreign energy sources.

FP6

ASK-IT deals with to make the means of transport, in particular the public service, accessible to everybody. The project develops ambient Intelligence System of Agents for Knowledge-based and Integrated Services for Mobility Impaired users. In Ask-it some demonstration projects are included as the **West-Brabant Initiative** and **The new London Taxi,** in which the designer adapted the classical London taxi so that it could be used by wheelchair users. The **West-Brabant Initiative** is a project implemented in Netherlands to improve the accessibility of public transport

to elderly and mobility impaired, for example by means of an on-demand service and bus equipped with automatic boards.

BEST-Bioethanol for Sustainable Transport is one of the biggest demonstration projects on biofuel. It has been demonstrated an extensive substitution of petrol and diesel to bioethanol. Furthermore, the project is initiating a lasting and accelerating development of bioethanol-fuel all over Europe through efficient ways of marketing and training and pave the way for a market breakthrough for ethanol- fuelled vehicles. The objective is to reduce dependency on oil and greenhouse gas emissions through a fine-tuned method of market introduction.
This has been done through a massive, but very strategic introduction of vehicles and distribution-lines at 10 strategically chosen sites in a maximum integrated public-private partnership of cities/regions, car manufacturers, fuel producers, fuelling stations and fleet owners combined with exactly targeted marketing campaigns. Almost 9.000 vehicles and more than 150 fuelling stations are expected as a result of the project making this the largest demonstration of alternative fuelled vehicles yet supported by the Commission

Qcity-Quite city incorporates issues such as traffic control, town planning, architectural features, noise perception issues, intermodal transport, change between transport modes, traffic restrictions, enforcement measures, economic incentive measures, introduction of hybrid vehicles and of new guided public transport vehicles. The solutions will be implemented in situ and validated.

SILENCE focuses more on noise pollution. It is developing a car with acoustic trim for demonstration purposes, is realizing and testing a prototype of a heavy duty vehicle powertrain, it is developing prototypes of improved power packs and optimized wheels and it is developing and testing novel road surfaces.

ZERO REGIO is aiming at developing low-emission transport systems, infrastructure systems for supplying fuel cell passenger cars, and automobile-fleet field tests in two regions in Italy and Germany. The aim is to test them in normal daily life use. The project is coordinated by Infraserv GmbH & Co Hochst KG and involves 16 partners from 4 European member states. In technological point of view, the realized fuel stations will supply liquid hydrogen at -253°C as well as compressed hydrogen at both 350 and 700 bar. After the construction of hydrogen infrastructure, FC vehicles (F-Cell, class-A from Daimler – Chrysler in Rhein-Main) will be driven in normal daily use in different applications. The demonstration phase of the project will be accompanied by an evaluation of the data acquired during the fleet tests with respect to energy efficiency, environmental impact and socio-economic aspects.

Among the sustainable mobility project, the **CIVITAS initiative** has an important role. It brings together cities from different countries to work jointly to improve the transportation in a sustainable way. CIVITAS I started in early 2002 (within the 5th Framework Research Programme); CIVITAS II started in early 2005 (within the 6th Framework Research Programme).
Within CIVITAS I (2002-2006) there are 19 cities clustered in 4 demonstration projects, whilst within CIVITAS II (2005-2009) 17 cities in 4 demonstration projects are taking part. These 36 cities all over Europe will be funded by the EU with 100 M € and the overall budget of the Initiative will be more than 300 M €.

CIVITAS CARAVEL: road and parking pricing, extension of access-restricted zones coupled with enforcement; High Clean Mobility Corridors; freight distribution schemes (use of alternative fuels and clean vehicles for public transport such as CNG and bio fuels), development of publicity and awareness raising schemes

CIVITAS MOBILIS. It aimed to the application of alternative fuels, implementation of ITS applications for improving traffic conditions and public transport services, management of the accessibility of sensitive areas through innovative zoning approaches, to clean urban logistics and implementing one new freight distribution centre operating with clean vehicles, to ensure social inclusion by enhancing the accessibility (physical, psychological, economic, informational) of mobility services, to enhancing public transport quality and integration with other transport modes substantially (private car, bicycle) through innovative planning and service development, to provide new targeted mobility services changing dominant concepts of vehicle ownership and use (car-pooling and car-sharing, mobility card schemes), to promote sustainable mobility, modal shift (walking, cycling, public transport) and behavioral change through targeted and personal marketing, service development, information dissemination, education and training; and finally Contributing to Europe-wide evaluation and dissemination of the results to be put forward through the CIVITAS initiative.

CIVITAS SMILE intends to cut the current trend of increased use and ownership of cars, promote sustainable alternatives and stimulate efficient and clean city distribution of goods. The project addresses these issues through promotion of bio fuels, clean vehicles and intelligent travels from door to door in order to provide better urban air quality, increased quality of life and better health, safety and security to all of city's inhabitants irrespective of social status, gender and other issues.

CIVITAS-SUCCESS will demonstrate:
- vehicles using clean and alternative fuels can be an efficient choice for urban transport: 12 hybrid buses, using biofuel and electricity will be implemented in the 3 cities; a process for recycling cooking oils for fuelling vehicles will be trialled in La Rochelle in cooperation with Ploiesti's university;
- an ambitious package of mobility and traffic management measures. Significant results can be seen regarding sustainable transport and energy policy: around 20 km² of car-free and pedestrian zones will be realised in the city centres; new concepts and policies for the local distribution of goods will be tested, involving new urban logistics organisation and management; telematics systems will be implemented to provide real time information for travellers (using advanced integrated databases or via GPS system) and allowing integrated pricing strategies for the local ticketing systems.

The accession countries, soon to be new member states, can learn from our previous mistakes and contribute to urban collective transport issues, while implementing at the same time actions promoting alternative transport modes: park-and-ride, dedicated bus lanes, accessibility improvements at interchanges, higher bus frequencies, improved infrastructures, cycling routes or walking streets; with all actions integrated within frameworks such as car or bike sharing plans, school or business travel plans.

Contribute deeply to many different related research and assessment activities such as new, all-inclusive training and communication initiatives supporting the project objectives.

CIVITAS TELLUS will focus on increasing the modal share in favour of public transport, increasing the use of bicycles, lowering congestion, reducing traffic related air and noise pollution below national and EC standards, decreasing inner city car usage, improving intra-organisational co-operation at city levels, increasing political and public awareness, reducing road casualties, improving public private co-operation.

In the following section, the projects presented at the Rome conference will be described and analyzed.

The projects analyzed below are reported in the order of the Rome conference programme. The summery tables will follow the projects description.

DEMONSTRATION PROJECT FOR INTEGRATED ENERGY SAVING URBAN TRANSPORTATION SYSTEMS INCORPORATING HYBRID BUS FLEETS, had the objectives to reduce the consumption of fossil fuels deriving from the new technologies (advanced hybrid and electric buses and innovative batteries), to compare the new technologies and to setting out of future policies, to improve the urban traffic and routes rationalisation, to increase the use of public transport in comparison with private one, to rationalise the costs of public transport system.
The chosen demonstration cities were Trento and Oxford.
The consortium included five private companies, two of which were transport companies, one had wide experience in alternative drive engineering and particularly in hybrid and electric vehicles, one was a Battery manufacturer and one was specialized in engineering test and judgement.
During the project, hybrid-series driven minibus equipped with sodium- nickel chloride type batteries was designed, built and tested in real life conditions.
From the technical point of view, the verified vehicles, excepts for problems caused by their 'youth', did not evidence particular problems with reference to their performances and reliability; since the thermal engine works at constant speed, the polluting emissions (including noise) were reduced in comparison with the traditional technology, without affecting the driving comfort. The bus was designed in order to travel "all electric" up to 15-20 km, which resulted more than enough to cross the historical centre.
Although sufficiently reliable for real life application, this technology is characterized by too high investments and maintenance costs to make this technology ready for the market.
The experience permitted also to field-test "Zebra" batteries equipped with sodium-nickel-chloride electrochemical system, thus highlighting further positive qualities of the accumulator, electric capacity, specific capacity for weight unit, absence of "memory" phenomena and constant power supply also at the final phase of exhaust (hysteresis). This type battery usage was experimental at the time and their tests enhanced the knowledge on real working conditions. They allowed further applications in a number of industrial technologies. The results were exploited to introduce second generation hybrid buses. The new vehicles, which were equipped with a direct injection diesel engine EURO 3, were introduced in 2001 and 2002.
In addition, the application of hybrid buses as public transport contributed to increase a relevant ecological culture side by side its technical evolution. If we only consider Trento, the technology of hybrid traction has been adopted by many private cars and a lot of taxis.
During the past winter season, important winter resorts such as Moena, Cavalese, Predazzo and Pozza di Fassa tested hybrid buses for school transport and door-to-door freight.

CITYMOBIL project has realized innovative automated transport systems. It aims to investigate the applicability of innovative systems such as Advanced City Cars, Personal Rapid Transit (PRT) and Cybercars in the real life considering not only the technological challenges, but also the human factor issue (e.g. the safety perception) and the regulation lakes about the certifications and homologation of those innovative means of transport, which is a key aspect to be solved. The overall work will bring through the realization of three large-scale demonstrators in three cities: Heathrow, Rome, Castellón. In addition, a Cybercars showcase was realized in Daventry where 3 permanent vehicles (plus 2 other vehicles) are already available for the project conference attendees, press, televisions, schools and other individual visitors. Another one will take place in Hyvinkää, while advanced city cars will be showed in Genova and La Rochelle. They will enhance general awareness about the characteristics, benefits and costs of such systems.
The first vehicle of the demonstration project in Castellon has been already available in March 2007 and after that, the tests phase started.
This huge project is organized in 5 horizontal sub-projects which involve 28 partners, compromising of city- and regional public authorities, manufacturers and suppliers of advanced

transport systems, universities, research institutes and public transport organizations from 10 European countries.
The project will contribute to promote innovation, to facilitate accessibility and co-modality, ensuring high level of safety.
Some of the prototypes and of the infrastructures are already realized and displayed as showcase during events for both technical and not technical persons: three electric vehicles (two Fiat Panda and one new Fiat "Cinquencento", (500) with advanced driving assistance, platooning and automated parking capabilities), one CyCab cybercar from INRIA equipped with an obstacle detection system based on a laser scanner.
With regard to the Personal Rapid Transit pilot scheme for Heathrow's new Terminal 5, the project has been confirmed and construction began in earnest in November last year. Most of the elevated guideways have now been built, and the network infrastructure are completed, two pre-production vehicles are being trialed very satisfactorily at ATS's Cardiff Test Track, and the sixteen vehicles which will operate on the network will be delivered throughout the rest of the year. Control equipment and the Control Centre are installed and the system will be tested exhaustively throughout the autumn and winter to ensure it is absolutely reliable. It will begin public operation, replacing the current shuttle bus service, in spring 2009.
Some possible applications of the technologies developed during the projects have already evaluated and proposed, for example the Advanced City Car technologies would help in the expansion of the car-sharing service in La Rochelle.

CYBER CARS 2 project - Close Communications for Cooperation between Cybercars.
The aim is to improve the management as well as the security by vehicle-vehicle and vehicle-infrastructure communications and vehicles coordination in order to avoid obstacles, to improve the interaction between two vehicles running at close range (platooning) and during the phases of merging and crossing. In addition it will support the management of dual-mode vehicles, which are vehicles can be used in two ways, of car-sharing, of various operation modes (including full automation) and of the goods transport (with a variant). In other words, it will upgrade the so-called Cybernetic Transport System concept in order to apply those new communication technologies and new control algorithms to eight cybercars in order to finally realise three demonstrations in Heathrow, Rome, Valencia.
As CyberCars 2 as Citymobil have a common history which started in 1990's with the first concepts in (Serpentine, RUF, Dedale,…) and went on with the following steps:

- First prototypes mid 1990's
- First operational system 1997
- CyberCars projet in 2001
- Floriades demo in 2002
- Antibes demonstrations in 2004
- MobiVIP (2004)
- CyberC3 (2005)

The acquired experience allowed to understand the importance of choosing a good site, of focusing on a real service, of facing safety and responsibilities issues, of carrying a follow-up. In addition, the dissemination activities during the conference and press meetings had great impact and allowed to enhance the general awareness about those innovative technologies.
The involved partners are 12 including research institutes, industries, universities.
The transition between cybercars and Advanced Driver Assistance Systems ADAS vehicles will be made easier with the forecasted arrival of "dual-mode" vehicles which will offer an automatic mode in specific situations such as platooning and in specific locations such as automated parking lots and manual-assisted mode in regular situations.

Hyfleet Cute involves a quite big and international partnership ensuring wide cooperation among transport companies, infrastructure companies, vehicle manufacturer and scientific organizations. In fact the partnership consists of: two governmental partners, three automotive partners, seven transport partners, nine energy companies and eight academic and consulting partners. It has proceeded from the Cute project which run from 2002 to 2006 and successfully demonstrated the viability of hydrogen powered fuel cell buses in public transport in 9 European Cities. 27. Furthermore, in the framework of the project decentralized hydrogen production in 7 European cities, centralized produced hydrogen for 2 European Cities and 9 new innovative high pressure hydrogen refueling stations were demonstrated.
Hyfleet Cute reached more international dimension than the CUTE one including also other continents: China and Australia. The fleet is composed by 47 hydrogen powered buses in regular public transport service in 10 cities on three continents.
The total driven mileage reached equal 2.036.668 km and the FC achieved 5000 working hours. The research implemented during the project should carry through the design and development of a new FC hybrid pre-prototype.
There are some aspects which have to be further developed to make the technologies ready for the market. In fact, there are still some problems to be solved. Some ones are connected to the vehicle technology in relation to the gap between present and next H2 bus generation, the availability of buses, the high cost and the maintenance of the innovative product. With concern to the H2 infrastructure, the problem are related to a lack of reliability, in technology point of view, but also to shortage of standardization, codes, regulation.
The hydrogen technologies will contribute to reduce the CO_2 and other GHGs emissions locally, but also globally depending on how the fuel is produced. In addition, the FC are quite, so they lower the noise pollution.
Hyfleet CUTE has been the prosecution of the **ECTOS** and the **CUTE** projects

Another big project is **HyCHAIN**, which has just started in 2006. It will put on the road 158 vans including mini 10 buses, 30 scooters, 34 wheelchairs, 40cargo-bikes, 44 utility vehicles all powered by hydrogen fuel cells. The demonstrations will be implemented in France, Germany, Spain and Italy. The consortium is composed by 25 partners of which 2 University, 3 Research organization, 1 spin-off, 1 no-profit organization and the other ones are private companies.
The following four step approach will be implemented during the project: the project will start from existing prototypes of five low power fuel cell applications that (1) are optimised in design and functionality. (2) Pre-commercial manufacturing lines will be set up to reduce costs as well as to improve quality and (3) the required hydrogen distribution logistics and services (transport, distribution, dispensing) will be established based on an exchange of innovative refillable storage solution. (4) A network of comparable subprojects using the common demonstration vehicles will be implemented in the four regions of Europe. The deployment will enable a large and wide variety of end users to be attained in a cost effective way, providing favourable conditions for achieving a significant reduction both in manufacturing and operating costs.
Technical deployment is complemented by socio-economic research targeted at increasing public awareness and overcoming the main current barriers, such as confined public acceptance, lack of certification, training, etc. Dissemination and exploitation activities provide the framework for maintaining the momentum and triggering a sustainable market growth in several lines of applications.

The **Japan Hydrogen & Fuel Cell Demonstration** (JHFC) started in 2002 and it kept on in 2005 by another project called (JHFC2) which will be funded until 2010. The project involves both the vehicle technology, and the hydrogen station demonstration study and also stationary FC demonstration study. In particular, this paper will focuse on the vehicles and infrastructures, neglecting the stationary applications. For developing the JHFC2 8 automotive partners and 16

infrastructures builder have been involved as partners (in 2006). The reached results were important to allow the realization of the fleet, which was enlarged in 2007 including also hydrogen ICVs and FC Mini-Cars. With concern to the reforming type station, the goal was to increase the energy efficiency from 54% to 65%. In addition, the researchers are working to increase the hydrogen pressure storage up to 70MPa and third parties are involved to test operation under actual usage conditions. Some of the JHFC objectives are:

- To verify energy saving and environmental impacts
- To collect data for codes & standards development
- To conduct activities on public relations & educations
- To clarify issues for commercialization

To make the FC technology ready for the transport market some issues have to be reached by the researchers. The JHFC individualized some of those issues:

- Increasing durability by three times ;
- Havening the Fuel Cell Stack size;
- To guaranty the FC start in extremely cold conditions (-30°C);
- Lowering the FC cost to 1/100 the current one;
- Doubling the range.

The hydrogen fuelled vehicles and infrastructure will contribute to lower the environmental impacts, in particular in CO_2 and other GHGs emissions point of views.

Ned T. Stetson of the US Dept. of Energy, showed the first-generation vehicle results and factors affecting fuel cell degradation. The **demonstration projects** carried out in the **US** have being provided important outcomes in validating H2 FC vehicles and infrastructure. It directly involved both car manufacturers and fuel distribution companies. Important results were reached:

- 77 vehicles and 14 stations deployed;
- 800,000 miles traveled, 30,000 kg H_2 produced or dispensed;
- 149,000 individual vehicle trips analyzed;
- 41 composite data products published;
- First public 700 bar station opened in U.S.

Although the vehicles and delivery stations are not ready for the market yet, because they are still in a development phase to improve the reliability and the costs, the project contributed to

- Systems Integration & Analysis
- Basic Research & Applied R&D for the technology validation:
- Manufacturing R&D
- Safety, Codes & Standards
- Education

The whole of those contributions will probably bring through a market transformation in transport sector and fuel delivery. Considering the intent to make the transport more sustainable, the project focused in particular to develop such a technology to decrease the CO_2 and other GHGs emissions, to reduce the resources utilization, thus including fossil fuels, to limit the transport noise and some efforts were performed to ensure a high level of safety and reliability in mobility of people and goods.

Some of the analyzed aspects of the projects are schematically reported in Table 14

Table 14 Analysis: Large-scale demonstration projects

Acronym	Research content	Consortium balance	Achieved results	Exploitation of the results	Potential exploitation of results	market readiness
EU projects						

DEMONSTRATION PROJECT FOR INTEGRATED ENERGY SAVING URBAN TRANSPORTATION SYSTEMS INCORPORATING HYBRID BUS FLEETS	To reduce the consumption of fossil fuels deriving from the new technologies (advanced hybrid and electric buses and innovative batteries), to compare the new technologies and to setting out of future policies, to improve the urban traffic and routes rationalization, to increase the use of public transport in comparison with private one, to rationalize the costs of public transport system	5 private companies	Hybrid-series driven minibus equipped with sodium- nickel chloride type batteries was designed, built and tested in real life conditions. From the technical point of view, the verified vehicles, excepts for problems caused by their 'youth', did not evidence particular problems with reference to their performances and reliability. The bus was designed in order to travel "all electric" up to 15-20 km, which resulted more than enough to cross the historical centre.	The experience permitted also to field-test "Zebra" batteries equipped with sodium-nickel-chloride electrochemical system, thus highlighting further positive qualities of the accumulator, electric capacity, specific capacity for weight unit, absence of "memory" phenomena and constant power supply also at the final phase of exhaust (hysteresis). This type battery usage was experimental at the time and their tests enhanced the knowledge on real working conditions. They allowed further applications in a number of industrial technologies.	The results are exploited to introduce second generation hybrid buses.	Although sufficiently reliable for real life application, this technology is characterized by too high investments and maintenance costs to make this technology ready for the market.
CITYMOBIL	It aims to investigate the applicability of innovative systems such as Advanced City Cars, Personal Rapid Transit (PRT) and Cybercars in the real life considering not only the technological challenges, but also the human factor issue (e.g. the safety perception) and the regulation lakes about the certifications and homologation of those innovative means of transport, which is a key aspect to be solved.	28 partners, compromising of city- and regional public authorities, manufacturers and suppliers of advanced transport systems, universities, research institutes and public transport organizations from 10 European countries	Some of the prototypes and of the infrastructures are already realized and displayed as showcase during events for both technical and not technical persons: three electric vehicles (two Fiat Panda and one new Fiat "Cinquencento", (500) with advanced driving assistance, platooning and automated parking capabilities, one CyCab cybercar from INRIA equipped with an obstacle detection system based on a laser scanner	Some possible applications of the technologies developed during the projects have already evaluated and proposed, for example the Advanced City Car technologies would help in the expansion of the car-sharing service in La Rochelle	Contribution to promote innovation, to facilitate accessibility and co-modality, ensuring high level of safety	Not available for the market yet. Regulation lakes about the certifications and homologation of those innovative means of transport, are still key aspect to be solved.
CYBER CARS 2	The aim is to improve the management as well as the security by vehicle-vehicle and vehicle-infrastructure communications and vehicles coordination in order to avoid obstacles, to improve the interaction between two vehicles running at close range (platooning) and during the phases of merging and crossing. In addition it will support the management of dual-mode vehicles, which are vehicles can be used in two ways, of car-sharing, of various operation modes (including full automation) and of the goods transport (with a variant). In other words, it will upgrade the so-called Cybernetic Transport System concept in order to apply those new communication technologies and new control algorithms to eight cybercars in order to finally realize three demonstrations in Heathrow,	12 partners: 4 national research institutes, 4 industries, 4 universities	The acquired experience allowed to understand the importance of choosing a good site, of focusing on a real service, of facing safety and responsibilities issues, of carrying a follow-up	n.a. yet	The transition between cybercars and Advanced Driver Assistance Systems ADAS vehicles will be made easier with the forecasted arrival of "dual-mode" vehicles which will offer an automatic mode in specific situations such as platooning and in specific locations such as automated parking lots and manual-assisted mode in regular situations.	Not available for the market. Regulation lacks

	Rome, Valencia					
Hyfleet CUTE	Demonstration of the viability of hydrogen powered fuel cell buses in public transport in 9 European Cities	29 partners: 2 governmental, 3 automotive, 7 transport companies, 9 energy companies, 8 belonging to academic and consulting	Decentralized hydrogen production in 7 European cities, centralized produced hydrogen for 2 European Cities and 9 new innovative high pressure hydrogen refuelling stations were demonstrated. The fleet is composed by 47 hydrogen powered buses in regular public transport service in 10 cities on 3 continents. The total driven mileage reached equal 2.036.668 km and the FC achieved 5000 working hours.	The project is enhancing the awareness about hydrogen technologies reaching also non technical public (The bus users). In technical point of view, the results and the analysis leaded to improve FC and the other hydrogen technologies applied during the project.	The research implemented during the project should carry through the design and development of a new FC hybrid pre-prototype	Not ready for the market: gap between present and next H2 bus generation; low availability of buses, high initial and the maintenance cost. With concern to the H2 infrastructure, the problem are related to a lack of reliability, in technology point of view, but also to shortage of standardization, codes, regulation.
HyCHAIN	It will put on the road 158 vans including mini 10 buses, 30 scooters, 34 wheelchairs, 40cargo-bikes, 44 utility vehicles all powered by hydrogen fuel cells. The demonstrations will be implemented in France, Germany, Spain and Italy	25 partners: 2 University, 3 Research organization, 1 spin-off, 1 no-profit organization and the other ones are private companies	n.a.	n.a.	n.a.	Big lack for the market application
Non EU projects						
JHFC	It involves both the vehicle technology, the hydrogen station demonstration study and also stationary FC demonstration study. The objectives are: –To verify energy saving and environmental impacts –To collect data for codes & standards development –To conduct activities on public relations & educations –To clarify issues for commercialization	8 automotive, 16 infrastructures builder	Realization of the fleet (enlarged in 2007) including also hydrogen ICVs and FC Mini-Cars. With concern to the reforming type station, the goal was to increase the energy efficiency from 54% to 65%.Tto increase the hydrogen pressure storage up to 70MPa	The real life working conditions will bridge to the market availability of the hydrogen technology	The test operation under actual usage conditions will allow an improvement of the hydrogen technologies	To make the FC technology ready for the transport market some issues have to be reached: –Increasing durability by 3 times ; –Havening the FC stack size; –To guaranty the FC start in extremely cold conditions (-30°C);

						–Lowering the FC cost to 1/100 the current one; –Doubling the range.
U.S. Large Scale Demonstration Projects	Realization of the first-generation vehicle results and factors affecting fuel cell degradation. To provid important outcomes in validating H2 FC vehicles and infrastructure.	It directly involved both car manufacturers and fuel distribution companies	–77 vehicles and 14 stations deployed; –800,000 miles traveled, 30,000 kg H2 produced or dispensed; –149,000 individual vehicle trips analyzed; –41 composite data products published; –First public 700 bar station opened in U.S.	It contributed to –Systems Integration & Analysis –Basic Research & Applied R&D for the technology validation: –Manufacturing R&D –Safety, Codes & Standards –Education	For further exploitation, the NREL-National Renewable Energy Laboratory provides the direct access to all composite data products concerning the hydrogen and FC research on the webpage: http://www.nrel.gov/hydrogen/cdp_topic.html.	The vehicles and delivery stations are not ready for the market yet, because they are still in a development phase to improve the reliability and the costs

Using the sustainability definition, in Table 15 a project mapping is proposed, considering the objectives of the projects presented at the conference.

Table 15 Projects linkages to sustainable mobility objectives. Large-scale demonstration projects

Acronym	equity & accessibility	safety & reliability	co-modality	energy & land use	renewable energy	emissions & noise	CO2 emissions	technology & development	economic return	regional development
DEMONSTRATION PROJECT FOR INTEGRATED ENERGY SAVING URBAN TRANSPORTATION SYSTEMS INCORPORATING HYBRID BUS FLEETS		*		** (ENERGY)		*	**	*		
CITYMOBIL	**	**	**	*				**		
CYBER CARS 2	**	**	**	*				**		
Hyfleet CUTE		*		* (ENERGY)	*	*	**	**		
HyCHAIN	*	*		*	*	*	**	**		
JHFC	*	*		*	*	*	**	**		
U.S. Large Scale Demonstration Projects		*		*	*	*	**	**		

Notes: ** – key objective of the project, * – one of the objectives of the project

A look out overseas

The transport problems have to be considered globally, because they involve more or less all the countries and all of them are implementing a strategy to improve the transport but in a sustainable way.

Figure 1. Traffic jam

Look at the Figure 1. Could you get which street is in the picture? Probably not. The reason is that the traffic problems are spread out in every continent. For this reason several demonstration projects are implemented more or less in all the globe.
For example, a number of demonstration projects are making hydrogen fleets run. As mentioned before, the CUTE Hyfleet project involves Europe, China and Australia. In California, in the USA, there is one of the biggest projects in the world on it: the **Fuel Cell Partnership**. Another significant project is the **California's Hydrogen Highway Network**, which should be achievable by 2010, and the **HyRoad,** the AC transit's hydrogen fuel cells programme, and on 4/10/2007 the CT Transit used the New England's First Fuel Cell-powered Hybrid Bus in its bus service in Hartford.
In Canada the **Hydrogen Highway** will be realized (Canada). It is one of the world's most integrated and advanced hydrogen and fuel cell technology demonstration programs, showcasing growing the British Colombia's network of hydrogen fuelling stations and end-use driven applications. It will connect the National Research Council (NRC) on the University of British Columbia campus, the North Vancouver, Surrey, Vancouver, Vancouver International Airport, Victoria, Whistler. It will largely used during the Vancouver 2010 Winter Games.
Another very big project is implemented in Japan, the **JHFC** - Hydrogen & Fuel Cell Demonstration Project (**Japan**). In the frame of this project a number of vehicles are hydrogen powered: buses, cars, carts, wheelchair.
In **China** the **UNDP-GEF-China fuel cell bus project** approved five countries who carry out total 46 FC Buses demonstration projects in six cities. Another Chinese projects is **Domestic FCV development projects,** including the realization of total five FC buses and ten cars with hybrid configuration. The construction of Beijing Hydrogen Park is promoted and funded by China MoST and Beijing Municipal Government and it was initiated in 2004. Beijing SinoHytec Limited, BP and Beijing Tongfang Co.Ltd as the project stakeholders cooperate to construct the first hydrogen fuelling station in China. Some demonstrations will be available during the Beijing Olimpic Games. In Singapore, BMW, Daimler and other companies have worked together to the SINERGY project, which aims to realize another hydrogen fleet.

In **Australia** the STEP project prosecuted and merged into the intercontinental Hyfleet: CUTE.
About the biofuel applications, the leader is **Brazil**, thanks to a long tradition in this technology. In fact, the ethanol cars sold pick was realized in 1985, after the 70s oil crisis. After that date, the

ethanol cars market decreased, but in the last years it is increasing again. In 2005 the number of sold flexi vehicles, which can use alcohol, was around 900 000 against about 600 000 which can use only gasoline and about 140 000 which can use only diesel. With its 15 x 10^9l/year of ethanol and 176 x 10^6 l/year of biodiesel produced, Brazil is the first biofuel maker in the world.
Concerning South **Africa**, a demonstration of a sustainable transport plan will be implemented for World Cup 2010 in the framework of **SOUTH AFRICA MOBILITY** project, in order to make the public transport more safe and accessible during the World cup and beyond. Some other improvements of the transport in the City of Johannesburg are envisaged:

- a 122 km BRT- **Bus Rapid Transit** network will be completed by 2009 as a first phase. This is the largest investment by any South African city in respect of public transport. The project is linked to other development initiatives such as urban design, land use restructuring, service improvements for longer distance customers and inner city node strengthening.
- The National Department of Transport in partnerships with Provincial departments of transport have been experimenting with a Bicycle roll-out project, namely Shova Kalula targeted at scholars, women and farm-workers, all in the rural areas. Some of the successes and failures of the initiative have been reported at the annual Southern African Transport Conference. In short, the project has attempted to put together in one project such things as job creation in the form of repair workshops, spare parts, affordable mobility (subsidised bicycles) and improved livelihoods (improved access to schools).
- In terms of Mobility Management/TDM: there has been a number of demonstration projects across the country, with limited successes. Also a system has experimented with the use of cell phones to profile the mobility patterns of people to supplement travel diaries. The City of Johannesburg is running an internet base ride sharing scheme.

South Africa is also supporting very innovative solutions and for this reason it will be hosting a Solar Powered Car race in this year (2008) between Johannesburg, Cape Town and Durban. The University of Kwazulu Natal has been encouraging their students to participate in the event.
The report intended to conclude providing some spot examples of what is happening in the other continents about transport technology applications to make mobility more sustainable.

1.8 Lessons learnt and conclusions

Some of the most important lessons learnt during the implementation of the project MOBIDAYS are reported and some suggestions on how to overcome the problems we encountered are provided. In particular, the main difficulty in MOBIDAYS was the limited availability of information on results obtained and problems faced during the implementation of EC-funded projects on sustainable mobility.
The most important **problems** met by all the partners of MOBIDAYS are:

1. Finding detailed information on the outcomes of some projects, in particular on FP5 projects and before (the Cordis database does not include all the projects). The EC has recently put in place useful dissemination tools, such as the DG TREN Transport Research Knowledge Centre and ManagEnergy websites, as well as the publication of FP project synopses, but those instruments are still not well linked to each other. As a result, it is often the case that detailed information on some projects is only available on one of these tools but not on others. As an example, only basic information on the Scientific Support for Policies project HEATCO can be found on the CORDIS database, whereas slightly more information can be found on the DG Research website under: http://ec.europa.eu/research/fp6/ssp/heatco_en.htm and detailed information including some of the downloadable deliverables is available on the Transport Research Knowledge Centre website (http://www.transport-

research.info/web/projects/project_details.cfm?id=11056&page=outline). Unfortunately, neither of these sources provides a link to the others.

2. In some cases, even if some information of a project is available on the Cordis Database, it was difficult to find out about specific outputs and deliverables produced by the project and the potential recipients of its results.
3. Understanding specific roles of the partners involved in projects examined; in particular, it was not always possible to find out what partner worked on a specific deliverable, carried out an analysis or developed a specific component as part of the project.
4. Finding out if the results of the EC funded projects considered found any practical application after the end of the projects. It is very hard to trace what happened to the technologies developed as part of EC-funded projects once the project is completed.
5. In order to gather information on the results of EC-funded projects on sustainable mobility, we initially developed a short questionnaire, which was distributed to the coordinators of the relevant projects. However, the rate of completion of these questionnaires was rather low and this suggested limited interest by project coordinators to supply detailed information, particularly in the case of project that have already been completed since some time.
6. Engaging in participants of the completed projects: most of the contacts are not available anymore, the websites of the completed projects have been discontinued and in some cases even finding out the name of the EC scientific officer in charge of the project is not easy.
7. It proved difficult to involve representatives of national and local governments in all countries where conferences were organized (Czech Republic, United Kingdom and Italy).
8. Project representatives who presented their projects at the conferences generally did not go into much detail of specific problems encountered and outcomes, despite having been explicitly asked to do so. With some exceptions, the speakers generally avoided to talk about the problems met during the implementation of the projects.

The consortium tried to develop some **solutions** for the mentioned problems:

1. The MOBIDAYS consortium has been proposing some solutions the EC could implement. In particular, the Cordis database could be improved and systematically linked to the other relevant tools developed by the EC. In addition, a new database could be built which for all relevant projects collects data, models, tools developed, deliverable reports and, the 'Plan for using and disseminating the knowledge'. Building the new database would not require much additional effort from the Commission provided a clause was added to EC funding contracts that makes it compulsory for the project consortium do deliver all the necessary material in a format that is compatible with the needs of the database before the project ends. In any case, most of this material is already encompassed by current EC contracts and therefore compiling this information in a database should be relatively straightforward.
2. The selection of the projects focused mainly on the basis of the information in the Cordis database. In some cases people were directly contacted by phone, and were asked for information about the project carried out. In addition, information on EC brochures and conferences proceedings was considered when selecting projects. Storing project websites on an EC system once the projects are completed could be very useful in order to be able to access information on past projects.
3. In order to address the problem of keeping track of the commercial exploitation of technologies originally developed as part of EC-funded projects, the introduction of a labeling scheme could be considered.
4. MOBIDAYS tried to contact the persons involved in completed projects, looking for the contacts on the EC website. In addition, even if the speakers disseminated projects of FP6 during the conference, during the meeting they had the opportunity to bring their experiences of the previous projects if they were involved in other projects FP5 and before.

5. Even if directly contacted, participation of representatives from local and national governments was very low in all the conferences.
6. Realizing that the speakers rejected to disseminate the problems met during the implementation of the projects to a big audience (as the public of a conference), and considering that a conference is not the proper place to discuss because of the time management which characterize a conference itself, after the conference in Prague, the MOBIDAYS consortium decided to organize and realized two meetings in concomitance of the conferences in London and Rome. Only the MOBIDAYS consortium and the speakers of each conference were invited to take part. In those round tables the participants had the possibility to informally discuss general as well as specific problems encountered about the problems met, mainly about the non technical ones (e.g. consortium management, legislation lakes, relationship with the EC, etc) and some solutions were proposed. The meetings appeared to be more effective instrument to discuss the problems and to propose solutions. For dissemination and further exploitation of the projects results, maybe, a well targeted meeting between the suppliers (the people or the companies who developed a product during a project) and the clients (the potential costumers of the developed technology) could be organized, like the industry does to promote the new products.

2 Dissemination and use

Section 1 - Exploitable knowledge and its Use

MOBIDAYS carried out an analysis of the projects on sustainable transport, in particular focusing on the EC funded projects, so the knowledge developed as part of the project consists in information on the relevant projects and their outcomes.
At the start of the project MOBIDAYS a working **definition of sustainable transport** was elaborated by the consortium. This definition is reported in all the brochures written inside MOBIDAYS and was used when assessing EC-funded projects and their impact on sustainability of road transport.
All the collected information about the analysed projects and the outputs of the project is included in the **final report**. It contains a database of the selected projects, for each of which the following information is provided :

- project Acronym
- project full name
- EC Framework Programme
- Coordinator
- Partners
- Project website
- budget
- project timing

In addition, each project is evaluated considering the research contents, the consortium balance, the achieved results their current and potential exploitation of results, the market readiness of developed technology/know-how.
The report also contains the comments, the problems met and some solutions proposed by the speakers and the consortium of MOBIDAYS, particularly based on discussion held during the meetings and the conferences. The intention is for this report to be a useful information source for the Commission and for people working on EC project on sustainable mobility.
The intended result is to provide feedback to the EC and to create a window of communication between the EC and the projects partners to improve future EC-funded projects in the area of sustainable mobility.
Some of the proposed solutions contained in the report can be implemented in future projects or implemented by the EC.

Overview table

Exploitable Knowledge (description)	**Exploitable product(s) or measure(s)**	**Sector(s)** of application	Timetable for commercial use	Patents or other IPR protection	**Owner** & Other Partner(s) involved
1. Sustainable transport definition		*Transport projects*	*2008*		***MOBIDAYS consortium***
2. Final report		*Transport projects*	*2008*		***MOBIDAYS consortium***

Section 2 – Dissemination of knowledge

Further information about the Dissemination of knowledge regarding the final event will be included in the 'Media Impact analysis', which is a deliverable will be provided in the second reporting period.

Overview table

Actual Dates	Type	Type of audience	Countries addressed	Size of audience	Partner responsible /involved
June 7, 2007	*Press release, press*	*General public and press*	*Eurpe*		*UK*
June 7, 2007	*Press release, press*	*General public and press*	*Czech Republic*	*-*	*UK*
June 20, 2007	*Press release, press*	*General public and press*	*Czech Republic*	*-*	*UK*
06/11/07	*Press release, press*	*General public and press*	*Italy*	*-*	*CIRPS*
06/11/07	*Press release, press*	*General public and press*	*Italy*	*-*	*CIRPS*
07/11/07	*Press release, press*	*General public and press*	*Italy*	*-*	*CIRPS*
07/11/07	*Press release, press*	*General public and press*	*Italy*	*-*	*CIRPS*
09/11/07	*Press release, press*	*General public and press*	*Italy*	*-*	*CIRPS*
12/11/07	*Press release, press*	*General public and press*	*Italy*	*-*	*CIRPS*
December07	*Press release, press*	*General public and press*	*Italy*		*CIRPS*
28/12/07	*TV*	*General public*	*Italy*	*-*	*CIRPS*
28/12/07	*TV*	*General public*	*Italy*	*-*	*CIRPS*
29/12/07	*TV*	*General public*	*Italy*	*-*	*CIRPS*
30/12/07	*TV*	*General public*	*Italy*	*-*	*CIRPS*
04/06/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
september-07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
october-07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
16/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
16/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
16/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
16/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
16/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
16/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
16/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
16/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
17/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
17/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
17/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
18/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
30/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
31/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
01/11/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
02/11/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
02/11/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
04/11/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
04/11/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
05/11/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
05/11/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
06/11/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
04/06/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
september-07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
october-07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
16/10/07	*Teaser*	*General public and press*	*Italy*	*-*	*CIRPS*
18/06/07	*Conference Prague*	*Research General public*	*Europe*	*90*	*UK*
21/06/07	*Conference London*	*Research General public*	*Europe*	*70*	*ICL-IST*
07/11/07	*Conference Rome*	*Research General public*	*Europe*	*100*	*CIRPS*
06/11/07 07/11/07	*Exhibition*	*Industry, press, general public*	*Europe*	*1000*	*CIRPS*
18/06/07	*Brochure: European research on socio-economic barriers to sustainable mobility*	*Research General public*	*Europe*	*1000*	*UK*
21/06/07	*Brochure: European research on vehicles for sustainable mobility*	*Research General public*	*Europe*	*100*	*IST*
06/11/07	*Brochure: European research on infrastructures*	*Research General public*	*Europe*	*100*	*ICL*

Actual Dates	Type	Type of audience	Countries addressed	Size of audience	Partner responsible /involved
	for sustainable mobility				
06/11/07	*Brochure: Large-scale demonstration projects on sustainable mobility in Europe and worldwide*	*Research General public*	*Intercontinental*	*500*	*CIRPS*
February 2007	*Project web-site*	*Research General public*	*Intercontinental*	*-*	*CIRPS with contributions of ICL, UK, IST*
November 2007	*Posters*	*Research General public*	*Italy*	*-*	*CIRPS*
June 2007	*Electronic Flyers*	*Research General public*	*Europe*	*-*	*UK*
September 2007	*Electronic Flyers*	*Research General public*	*Europe*	*-*	*ICL-IST*
From 01/06/07 to 09/06/2007	*Direct e-mailing*	*EC Project coordinators*	*Europe*	*150*	*CIRPS*
01/06/2007	*Direct e-mailing*	*Research Press General public*	*Europe*	*500*	*CIRPS*
06/06/2007	*Direct e-mailing*	*Research Press General public*	*Europe*	*More than 7000 contacts*	*CIRPS*
02/07/2007	*Direct e-mailing*	*Research Press General public*	*Europe*	*500*	*CIRPS*
12/09/2007	*Direct e-mailing*	*Research Press General public*	*Europe*	*More than 7000 contacts*	*CIRPS, ICL*
16/10/2007	*Direct e-mailing*	*Research Press General public*	*Europe*	*More than 7000 contacts*	*CIRPS*
02/11/2007	*Direct e-mailing*	*Research Press General public*	*Europe*	*More than 7000 contacts*	*CIRPS*
	Direct e-mailing	*Research General public*	*Europe*	*More than 7000 contacts*	

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