



**ICT for Clean & Efficient Mobility  
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## 1. Executive Summary

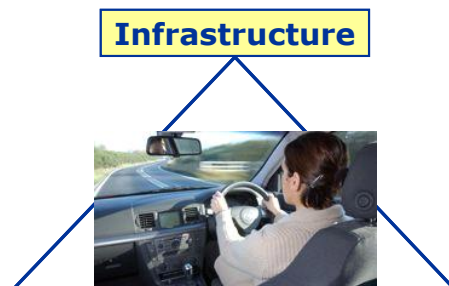
Global warming is now an accepted fact by the world's scientific community. By far the greatest influence appears to be the growth in emissions of CO<sub>2</sub>, a powerful "greenhouse gas", that enters the atmosphere as a result of heating, industrial processes, electricity generation – and transport. In simple terms, CO<sub>2</sub> emissions due to road transport are a factor of four key elements<sup>1</sup>:

- Vehicle technology
- How the fuel is produced and used
- What customers drive and how they drive it
- How efficient the roadway environment is and what alternatives such as bikes and public transport are available

In Summer 2006 the *eSafety* Forum Steering Group approved a proposal to set up a new Working Group focusing on the **application of *eSafety* technologies for the environment**. The Working Group was to "identify and promote the potential benefits *eSafety*/ICT applications and services can bring towards cleaner and more energy-efficient mobility for people and goods."

In the course of its first three meetings, the Working Group has first brainstormed about the scope of the activity, reviewed the state-of-the art in the application of ITS ("Intelligent Transport Systems & Services") towards environmental ends, taking account of the recent and current European research and development. The Group has identified the priority areas of ICT applications with potential to yield environmental benefits, and those measures most likely to reinforce the environmental sustainability of mobility.

The Working Group has pursued a balanced approach, considering the vehicle, the driver and the infrastructure in an integrated way. ITS applications and services that did not affect the vehicle or road transport in general, or non-ITS applications, with the exception of eco-driving measures, were not considered, as these are already dealt with elsewhere. Similarly, technologies for the clean and efficient vehicle, such as advanced powertrain engineering or alternative fuels are adequately addressed and were not considered by this Working Group. [Not noise as primary objective]



The goal of the Working Group has been to concentrate on those aspects either not treated adequately until now, or where there is a significant potential for *eSafety*

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<sup>1</sup> Carl-Peter Forster, President GME, Fuel for Thought Event, Brussels, Nov. 21, 2007

technologies (ITS/ICT applications) to yield environmental benefits and productivity gains (traffic flow management, fleet management).

### **Environmental objectives – what are we trying to achieve?**

The Working Group's goal is to see how far it could be possible to reduce energy consumption and production of CO<sub>2</sub> and other pollutants not only by conventional measures but also with the help of “alternative therapies”. Notably, these include bio fuels, infrastructure eco-management and eco-driving, of which the latter two are part of this analysis as far as they are based on the use of information and communication technologies.

Elements that can contribute to such CO<sub>2</sub> savings include:

- Increasing fuel efficiency by making traffic flow more smoothly
- Help drivers find the most eco-friendly route & mode choice
- Giving travellers information about different journey alternatives
- Collecting real-time information about traffic and environment conditions, incidents
- Reduce congestion by improved traffic flow management and by responding quickly to any discontinuation
- Support drivers to acquire and adopt eco-driving techniques

### **Technologies and measures**

The principal types of *e*Safety technology considered in this WG include cooperative systems based on vehicle-to-infrastructure and vehicle-to-vehicle communication, and mobile – and internet-based – online services for travellers. Advanced vehicle safety technologies like ACC, ADAS, etc. have been the subject of numerous international research projects to prove their feasibility, quantify their safety potential and, more recently, also to explore their potential positive secondary impacts on the environment (see also 5.7). This is guided by the principle that safety technologies help to avoid accidents, reduce congestion, save energy and therefore help to reduce emissions.

Today the technology has already advanced in a way that some advanced vehicle safety technologies are offered as optional features for the safety conscious customer, or are fitted as standard in top-of-the-line models. Most of these systems are autonomous vehicle systems and, therefore, do not fall under the scope of this study. To try to calculate an overall environmental benefit for a potentially higher future penetration rate of such autonomous systems or try to estimate an emission reduction potential in case such systems could become connected have little value, as the efficacy of such systems would be pure speculation. When justified the Working Group might select the one or other technology for further impact analysis. The *e*Safety technology areas thought by the Working Group to hold greatest potential for environmental impact can be grouped as follows:

## **Infrastructure & traffic management related technologies and applications**

This comprises a group of current technologies & best practice for ICT systems not involving in-vehicle systems. These can have substantial impact on fuel use and emissions, and are subject only to policy / availability of funding

- Environmental monitoring & modelling
- Coordinated dynamic urban traffic control
- Traffic signal synchronisation (“green wave”) and signal phase information
- Variable speed limits
- Parking availability and guidance by variable message sign
- Environmental zone access management
- Digital map for navigation
- Real-time traffic information and guidance (TMC)

These applications could be improved through simply adding positioning, infrastructure-vehicle communication & enhanced driver displays, and then the following applications become feasible:

- Digital map databases enhanced with 3-D geometry, black spots, speed limit and safe speed information, traffic regulation & advisory signs, commercial vehicle restrictions
- Online map update service for map data changes, temporary roadworks, real-time info on incidents, congestion, speeds, road & environment conditions
- Enhanced navigation algorithm for dynamic route guidance, e.g. with historic data, least-fuel routing,
- Mobile data collection, e.g. probe vehicle or mobile phone data
- Area traffic management strategies optimised for environmental criteria
- Pre-trip and on-trip road traffic, transport and environment information (RTTI)
- Parking availability, booking and guidance
- Access management taking account of emission criteria
- Commercial vehicle management & logistics, e.g. minimise empty loads (“deadhead” journeys), groupage,
- Fuel-consumption related telematics services, e.g. remote diagnostics
- Cooperative tactical traffic control –vehicles to communicate with traffic signal control systems in order to optimise the speed and spacing of vehicle clusters, minimising overall fuel consumption and emissions.

## **Driver support**

There is no dispute that a major area of potential gains is driving technique – a behavioural rather than strictly technical issue. Called “eco-driving”, shorthand for a number of techniques to reduce fuel consumption through influencing human behaviour, this appears to offer potential for a major contribution towards CO2 reduction targets.

The aim to change behaviour can be achieved through training, awareness, real-time information, incentives & penalties, for example. However, in this report we look at those eco-driving measures that make use of information and communication technologies, including:

- Eco-journey support – on-line and mobile information services to the traveller with advice on environmental conditions and on multi-modal choices, provided before and during the journey;
- Enhanced navigation using adapted algorithm for dynamic route guidance, e.g. with historic data, least-fuel routing etc.
- Cooperative eco-driving – providing the driver with support, feedback and guidance on a more fuel-efficient driving behaviour (e.g. CO<sub>2</sub> production or cost/saving in Euros)
- Online & real-time incentives – “bonus / save as you drive / green points”
- On-board and online coaching of “golden rules of eco-driving” for drivers

Note that driver support systems must ensure that environmental gains are not at the expense of safety, e.g. these systems should not overload drivers with information or actions, deflecting attention from the driving task or prolonging reaction times.

### **Vehicle safety (active/eSafety) technologies and related applications**

Driver support technologies with a primary objective of safety – even if they provide a secondary impact on less fuel consumption and related emissions will only be discussed in this report when an environmental benefit becomes significant based on scientific evidence. A good example in this respect is adaptive cruise control e.g. including “stop & go assistant”, which could help to reduce fuel consumption.

The earliest advanced safety systems now entering the marketplace include functions such as:

- ESC (electronic stability control)
- Emergency braking systems
- Lane departure warning, lane keeping assist, blind spot monitoring, obstacle warning systems
- Night vision systems (infrared, radar)
- Intersection warning
- Speed alert
- Alcohol, drug and tiredness detection, etc.

The direct impact of these systems on the environment is limited and difficult to assess. Furthermore, most systems are vehicle-based and autonomous, and therefore not ICT related.

## Recommendations

This draft report suggests a number of recommendations that could be issued by the Working Group, directed at different actors:

### • Priority ECO-ITS measures

monitoring	<ul style="list-style-type: none"> <li>• probe vehicle data collection</li> <li>• environmental sensors</li> <li>• integration &amp; modelling</li> </ul>
eco-traffic management	<ul style="list-style-type: none"> <li>• optimise to environmental criteria (e.g. minimum fuel consumption or emissions)</li> <li>•</li> </ul>
eco-driving	<ul style="list-style-type: none"> <li>•</li> </ul>
eco-mobility	<ul style="list-style-type: none"> <li>• ride sharing, car pooling</li> <li>• car sharing</li> <li>•</li> </ul>
eco-navigation	<ul style="list-style-type: none"> <li>• using statistics on revealed driver behaviour, optimises route for fuel consumption, number of brakings and stops</li> <li>• link to engine management</li> <li>• enhanced maps, with gradients etc.</li> </ul>
eco-Info services (SOA)	<ul style="list-style-type: none"> <li>•</li> </ul>

### • For the European Commission

<p>“green ITS” measures (e.g. infrastructure-based with impact on efficiency and environment) should be taken into account in policy initiatives such as the forthcoming ITS Roadmap and Action Plan, and the synergy with eSafety measures should be highlighted;</p>
<p>Development of “green ITS” technologies and applications should be given higher priority in future R&amp;D programmes such as the next FP7 calls for proposals and large scale field operational tests (FOTs).</p>
<p>In particular, work is urgently needed on the reliable appraisal and quantification of potential environmental impact and benefits of eSafety technologies and applications;</p>
<p>EC to evaluate and favour the use of incentives to encourage eco friendly driver behaviour.</p>

- **For industry**

Traffic management industry should develop products and promote standards for eco traffic management systems;
Public transport and traffic management system suppliers should cooperate to offer integrated & compatible mobility systems
Automotive industry should explore approaches to promote more eco friendly driving and driver behaviour as a complement to current efforts to improve fuel efficiency and reduce emissions through vehicle engineering
Need for data exchange standard for transfer of engine parameters to (“engine map”) navigation system for eco-navigation support
Digital map makers to enhance database with attributes/features to support “eco-navigation”
Both traffic management and automotive industries should collaborate with each other in developing cooperative vehicle infrastructure systems for lower emissions and fuel consumption.

- **For operators and service providers**

Road operators (both public and private) should add environmental aspects to road management schemes & systems;
Traffic and travel information providers should consider including broadcast messages and guidance to promote eco-driving and eco-ITS;
Consumer organisations such as automobile clubs should offer their members advice on the benefits of and support for eco-driving;
Driver education and training organisations should increase their offer of courses in eco-driving.

- **For national, regional and local governments**

Public authorities should promote advances in eco-friendly technologies for mobility and more efficient driver behaviour through targeted measures
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such as fiscal or other incentives, as well as the adoption of “clean mobility” objectives within transport, energy and environment policy;
Governments should include eco-driving within the scope of driver licensing and licence examination, and within the curriculum of required driver training;
Transport aspects of energy efficiency should feature strongly in the work programme of EU Presidencies;
National and local governments in Europe should cooperate and harmonise the approach to environment-friendly mobility, in order to ensure interoperability, lower costs and greater impact.
Public authorities/road operators should invest in SoA intelligent infrastructure, e.g. VMS, traffic control, speed management

• **Other**

Standardisation bodies should identify the need for European and global standards for certain ITS-technologies, and promote a corresponding standardisation road-map and action plan;
Universities & research institutes should prioritise work on: <ul style="list-style-type: none"> <li>- environmental monitoring and modelling techniques – high resolution as input to new eco-mobility services</li> <li>- extended methods of impact assessment</li> <li>- include health impacts as a dimension of eco-ITS assessment</li> <li>- expand EDUNET training programmes and curriculum to include eco-ITS</li> </ul>
The impact of ITS on “Efficient and sustainable mobility” should be a major theme in future ITS events such as European and World Congresses;
Lastly, the key stakeholder interests should establish a forum (“Mobility Forum”?) to link and focus the many activities in the domain of ICT for clean

and efficient mobility, and set priorities for action.
Make link to other relevant forums e.g. ERTRAC, ...[to be completed]
Develop information material for ICT for Clean & Efficient Mobility
Measures for shared access to traffic & environmental monitoring data – problem of access to diverse and incompatible sources

### **For the WG**

Ensure that environment-related data are collected together with traditional traffic, road network and meteo data collection
Develop scenarios “eco-ITS for the future” – best case, worst case

### **Monitorability & Measurability**

While the environmental benefits of many of the measures mentioned are broadly accepted, it is important to ensure that measures can be monitored and measured. The European Commission has stated that only then can measures play a role in formal EU strategies. Working Group recommendations should, therefore, also concern how to ensure that benefits of the measures proposed are monitorable & measurable.

### **Link between ITS Benefits and Environmental Strategies**

To ensure a consistent policy approach, a link should be created between ITS benefits and existing and/or planned EU strategies, for example in the area of CO2 limits for cars. Given the high costs of some of the measures discussed in this paper, mandatory fitment across 100% of cars is unlikely to be possible or advisable for a number of measures.

Therefore, intelligent incentive systems, e.g. credit systems, should be considered that would reward companies for the installation of systems whose CO2 benefit can be demonstrated.

## 2. Backgrounds and Mandate

The eSafety initiative driven by the European Commission, ACEA and ERTICO pursues an integrated approach, recognizing that vehicles, infrastructure and drivers each have a contribution to make towards safer road transport in the future. Its general objective is to support the development, deployment and use of preventive and active safety systems, so-called eSafety systems. The eSafety Steering Group facilitates the deployment of ICT for safe and intelligent transport through a framework of working groups and plenary events of the eSafety Forum.

The eSafety Forum members and the eSafety Steering Group welcome the high-level political commitment shown by the European Commission in launching the “i2010” initiative to stimulate the “digital” economy, and specifically to promote the take-up of information and communication technologies (ICT) within the transport sector. i2010 is intended to create growth and employment in the information society and the media industry, with a main focus on an increase of EU investment in ICT research and development.

Within i2010, DG Information Society and Media is promoting the “Intelligent Car” flagship initiative, to establish a new approach to smarter, safer and cleaner transport and mobility by developing a comprehensive agenda comprising RTD, demonstration, large-scale field testing, deployment and user awareness actions. Furthermore, co-ordination with national activities, exchange of best practice and monitoring and reporting of progress should be established. “Intelligent CAR” also includes intelligent infrastructure and other elements of an integrated approach and is not just focussing on the vehicle as the name might suggest.

With this initiative the Commission wants to accelerate the take-up and use of advanced ICT-based in-vehicle and co-operative systems that make road transport safer and cleaner, by raising user awareness of such systems and their benefits, and by facilitating their deployment. On 17 September 2007 the Commission published its first Communication on the Intelligent Car Initiative “Towards Europe-wide Safer, Cleaner and Efficient Mobility: The First Intelligent Car Report” and gave more details on the **environmental challenge** related to transport:

- Congestion costs amount to € 50 bn per year or 0.5% of Community GDP
- By 2010 this rate could go up to 1,0% of EU GDP
- Number of cars per 1000 persons has increased from 232 in 1975 to 460 in 2002
- Overall distance travelled by road vehicles has tripled in the last 30 years
- Volume of road freight transport grew by 35% contributing to serious daily congestion of about 10% of the road network

Concerning **energy efficiency and emissions**:

- Investigations show that up to 50% of fuel consumption is caused by the traffic situation and driving behaviour [need to quote the source]

While Information and Communication Technologies (ICT) help to create more intelligent vehicles, they can also provide new intelligent integrated solutions

including infrastructure measures that contribute to solving the key societal challenges described above.

### **Relationship between safety and environment**

While the EC eSafety program was initially set up to support the Commission's objective to halve the number of fatal road accidents in the ten years to 2010, using an integrated approach (vehicles, infrastructure, driver), many of the measures to help reduce accidents and create a smooth traffic environment also have an indirect positive impact on the environment by reducing congestion and traffic jams.

Improved traffic flow can lead to shorter driving times, lower fuel consumption and fewer emissions. Consequently, the idea was born to **exploit the possibilities of emerging and future eSafety technologies** to produce environmental benefits such as:

- Improved traffic flow through infrastructure measures like e.g. traffic light synchronization, variable message signs, demand management, access control;
- More efficient journeys through real-time traffic information and dynamic route guidance (RTTI);
- Smoother driving using safety systems such as adaptive cruise control (ACC) or stop-and-go assistance, vehicle-to-X communication (e.g. interactive traffic control, local danger warning);
- Lower fuel consumption and emissions through measures to support eco-driving and
- Enforcement of traffic regulations, and safe speed and speed limit advice.

In May 2006 the formation of a new eSafety Working Group jointly chaired by ACEA and ERTICO was proposed to the eSafety Forum and approved at the eSafety Steering group of 4 July 2006.

The new work group started its work with a kick-off meeting on 6 December 2006

### 3. Objectives and Terms of Reference

The first ideas were to investigate “Potential contributions of information and communication technology for the reduction of CO<sub>2</sub> and other emissions in a combined effort of industry, users, public authorities and infrastructure operators”.

The **aim of the new workgroup** was defined as:

“Identify and promote the potential benefits eSafety/ICT applications & services can bring towards cleaner and more energy-efficient mobility for people and goods”.

Since only few ITS systems and services especially address environmental objectives the various sectors need to be mobilized to cooperate in identifying and promoting deployment of new solutions and prepare the business environment

In order to do so, the work group should

- Identify & assess the ICT applications with strongest potential to yield environmental benefits
- Examine measures to reinforce the environmental compatibility & sustainability of mobility
- Examine potential for education & support tools to promote environment-friendly driver behaviour
- Cost benefit assessment of measures to reduce environmental impact of mobility
- Identify measures to promote & support deployment.

The following work areas were proposed:

- Environmental traffic management strategies and operations, e.g. environment-optimised traffic light synchronisation, automatic traffic incident detection and management, urban goods delivery management, air pollution crisis management, etc.
- Integrated traffic/mobility management systems, traveller information and guidance services
- Infrastructural measures to reduce negative environmental impact of mobility
- Cooperative vehicle-infrastructure systems, e.g. optimisation of vehicle-traffic management in order to avoid congestion, with accompanying environmental benefits
- On-line environmental information services for drivers, travellers and operators
- Systems, tools and incentives to support & educate drivers in environmentally-friendly driving
- Innovative business and organisational models to deliver environmental ITS
- Cost-Benefit analysis of environmental ITS policies and options
- Measures to promote and support deployment of ITS for clean & efficient mobility

It is important to underline that vehicle powertrain and exhaust gas after treatment related improvements (less consumption, reduced emission, etc.) would not be subject

to this work group as those issues are dealt with in other more specialized expert work groups.

As the overall objective is to reduce the negative environmental impact of transport and of road traffic in particular, it is, however, difficult to understand why traffic and accident management related reductions are not becoming part of the overall measurement system, same as alternative fuels and tyres.

For the ToR document see Annex 1.

## 4. Scope

With regard to the Intelligent Car Initiative this report will **concentrate on road transport, intelligent road infrastructure and road users** but it is important that contributions from other transport areas should be exploited through other projects as well.

The report will only **concentrate on ITS/ICT measures** and not on pure road construction matters (elimination of accident critical spots, safety barriers, park & ride facilities, network of pedestrian and bicycle paths, noise walls, etc.).

The exclusion of emission (CO<sub>2</sub>) reductions from vehicle engine/powertrain improvements or other vehicle technologies was already mentioned before. The same is valid for **weight, size and shape** of vehicles as well as horsepower, etc.

Furthermore, this report will not comment on potential impacts of setting lower legal speed limits or using alternative fuels (fuel cells, liquid gas vs. petrol or diesel, etc.).

Last but not least the **high average age of the European vehicle park** leaves much room for improvements, the same is valid for the potential **unfavorable individual fleet composition of single fleet operators**. This, however, will not be subject of this study either.

To comply with service and maintenance intervals and regularly emissions tests (in most countries mandatory by law) is only subject to this study when ICT is used for remote diagnostic applications.

## 5. Research overview

There are numerous studies available highlighting the potential impact of ITS/ICT applications on fuel consumption and emissions. However, summing up all impacts, road traffic would be in a position to regenerate fuel and save more emissions than actually emitted. Consequently the studies need to be carefully evaluated, the assumptions need to be transparent and comprehensible and the interrelationship between different applications must be clearly worked out. In most cases there is rather a levelling impact than the possibility to accumulate numbers.

It is important to identify the so-called “real world indicators” to know and understand potential impacts resulting from the implementation of ICT for clean mobility.

In the following, key studies in the three different areas, mode of transport, intelligent infrastructure, driver and legal environment will be presented and critically described.

[Needs to be detailed by sub-workgroups over the following months]

## **5.1 Transport Means**

Multi modal traffic planner  
Online diagnostic services

## **5.2 Intelligent Infrastructure**

TM: Traffic (flow) Management  
TCS: Traffic Control Systems/  
Congestion Management Centres – online air quality measurements -> temporary speed limits displayed on variable message signs, smog alerts  
RDS/TMC: Data Radio System/Traffic Message Channel, optimized route planning and route guidance  
TLS: Traffic Light Synchronisation  
JPS: Journey Planner Support (pre-trip and on-trip information services)  
PM: Parking Management  
GDM: (Urban) good delivery management/heavy good priority

## **5.3 Driver**

Driver support/assistance systems  
Eco-driving, driver training  
Driver education  
Driver information

## **5.4 Interactions – Interdependence of in-vehicle technology and systems with infrastructure and information**

V2V: vehicle to vehicle communication  
V2I: vehicle to infrastructure and infrastructure to vehicle communication

## **5.5 Legal environment**

Systems for incentives, penalties, charges

## 6. ICT for Clean & Efficient Mobility – Current activities

	ICT for People	ICT for Goods
<b>Education/instruction based systems</b>	Eco-Driving behavior instructions, simulation, training	iManage (GE fleet) includes the ability to look at drivers performance in terms of spend, maintenance costs and CO2 profiles
	85,2% of accidents are caused by pure human error [source?]	Economical driving training for truck, bus and coach drivers
<b>Internet/ Telecommunication/Sensor based systems</b>	Online environmental information/ eco-information for journey planning	Online environmental information (e.g. temperature, smog alarm)
	Personalized information systems	ITSWAP (transport services via wireless applications)
	AMBIESENSE (information system for mobile users)	ROLLING STOCK (internet monitoring of cargo for time of arrival)
	DIAMOND (ITS application through Multimedia DAB)	TROP (virtual enterprise for forwarders)
	APNEE/APNEE-TU (Combine environmental data with travel information)	GIFT (Global freight information system)
	MESSAGE (use busses and pedestrians to act as mobile sensors, collecting vital real time air quality data)	MOSCA (DSS for door to door delivery)
	PEPTRAN (Pedestrian + public transport navigator)	Ad-hoc journey & load sharing management
<b>Vehicle based systems</b>	Driver information feedback systems	Driver information feedback systems
	Vehicle crash prevention systems	Vehicle crash prevention systems
	Navigation systems	Navigation systems
	Energy efficiency of safety related applications like ADAS/ACC systems	Energy efficiency of safety related applications like ADAS/ACC systems
	Enhanced engine & drive train management/control and feedback	Enhanced engine & drive train management/control and feedback
<b>Infrastructure based systems</b>	5,1% of accidents are related to infrastructure issues	Adaptive network management & control using real data
		Online quality control
	Inter-modal support (TRASCOM, TRANS-3)	Tracking and Tracing (PARCEL CALL, MOCONT-II)
	Synchronization of traffic lights	Route & Load optimization
	Incident detection and management	Delivery optimization
	Network supported route & parking guidance	
	Map related projects: NextMap, ACTMAP, MAPS&ADAS, FEEDMAP	
<b>Cooperative systems</b>	Congestion detection and management	

## 7. Impact Matrix (based on research results)

Below are compiled a number of results of the impact of vehicle and/or infrastructure measures to reduce environmental impact. Note that some are expressed as a reduction of fuel consumption, others as reduction of emissions; these are of course closely associated.

	<b>Impact indicator</b>	<b>Emission reduction</b>
<b>Eco-Driving</b>	20-25% decrease after driver training and 10% less fuel consumption as sustainable training effect on driving behavior	A 10% decrease in consumption would translate into 40 billion liters of fuel and 100 megatonnes carbon dioxide (CO <sub>2</sub> ) emissions
<b>Gearshift Indicator/GSI</b>	GSI as driver assistance measure will reduce fuel consumption by some 3%	Related reducing effects on CO <sub>2</sub> and other emissions
	GERICO on-board system design (driver to adopt best driving behavior, smooth speed and good gear management by visual and vocal messages (optimization algorithm) leading to up to 15% consumption reduction (80 tests)	ECODRIVEN project (European-wide eco-driving campaign) with 500.000 car drivers to reach 0.5 Mton of CO <sub>2</sub> emission reduction until 2010
<b>ACC/Intelligent vehicle</b>	0.4-3.6% in normal traffic (field data)	
	Simulation: 10% ACC vehicles 28%	Up to 60% less pollution in specific situations
	Intelligent vehicles with ACC/LDW cut accidents by 8% (Dutch Field test) and saved 3% of fuel	Emissions decreased by up to 10% when driving with ACC and LDW (Dutch Field test)
<b>Traffic Management</b>	Smart NETS: new software + real-time traffic data in urban traffic control centers: considerable energy savings	Up to 40% in traffic standstill and congestion
	Free flowing traffic along the motorways consume on average 60% less fuel than when traveling on the local urban network (Greece)	By penalizing left-hand turns in route planning (trucks) the ROADNET software generates savings on fuel and emissions
<b>Floating Vehicle Data for Traffic Management and incident data to vehicle systems</b>		Congestion information from highways and interurban and urban roads
<b>Traffic Light Synchronization</b>	Utopia (Italy) dynamic urban traffic control system increased intersection throughput for private traffic by 15%	
<b>Transport Demand Management Strategies (TDMS)</b>		HEAVEN DSS (2003): Decision Support System to evaluate the environmental effect (air/noise quality) of

		TDMS. Driven by 6 European cities
		CITEAIR (based on HEAVEN experience 11-18 European cities are developing efficient means to collect, present and compare air quality data across a multitude of sites and provide input to the air quality reporting and action planning.
<b>Predictive cruise control</b>	CC linked to intelligent map information + GNSS position + maps: up to 2% of fuel economy	
<b>Navigation systems</b>	Linked to real-time traffic information: reduced driving time and fuel consumption	
<b>Cooperative systems</b>	PREVENT: equipment rate of only 20% of vehicles could avoid traffic jams on selected highway sections with subsequent energy savings	