CIECA
internal project on
‘Eco-driving’ in category B
driver training
& the driving test
(2007)

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1. Background and aims of project

Awareness of the environment and the need for sustainable development is growing in developed countries all around the world. One area which has a considerable effect on the environment is the transport sector. Over the last decade, a growing number of private companies have taken steps to ensure that their 'driving personnel' (sales staff, deliveries, etc) follow eco-driving training or follow eco-driving good practice. A major incentive behind this move is the potential cost-savings that can be accrued as a result of lower fuel consumption, fewer accidents and better vehicle maintenance as well as reducing the impact of motorised transport on the environment. Research has also shown that drivers using eco-driving techniques have less accidents and cause less wear-and-tear on the vehicles they drive (see page 9).

However, most countries have tended to react more slowly when it comes to introducing eco-driving awareness and techniques in statutory driver training and testing. The potential impact of such measures are considerable: it is easier to train eco-driving to youngsters who have no driving experience than it is to 'un-train' experienced drivers who are used to driving in a different way. Furthermore, the earlier 'the seed' is planted in the minds and experience of road users, the greater the potential benefit for reducing the impact of transport on the environment. Some countries, such as Germany, Finland, Switzerland, Netherlands and Sweden, have been quicker than others in recognising this.

So, how is eco-driving addressed in initial training and how is it being assessed in the driving test? And does eco-driving really constitute safe driving? These are the three main questions that this project intended to answer. On the basis of these results, some conclusions and recommendations were made on how best to introduce such measures in countries where eco-driving is not yet a focus of initial training and testing. The project only looked at learner and novice drivers of category B vehicles.

The techniques and principles revolving around eco-driving and awareness of the influence of transport on the environment are not described in great detail in this report. This is because they are already explained in some depth in technical documentation produced, for example, by national energy efficiency agencies and EU research projects (e.g. "Eco-driving Europe"[1] and "Treatise"[2]). What really concerns us in this report is how such techniques can be effectively trained and tested and what problems there are in reaching this goal.

For further information on this topic, readers are urged to consult the individual reports made by CIECA following project visits to countries with experience in this field (Finland, Netherlands, Germany and Switzerland), available on CIECA's members only webpages.

2. Participants in project

CIECA's Eco-driving project was an internal project which brought together CIECA members from countries that are interested in introducing eco-driving in training and testing with other members from 'expert countries' who have already had a number of years experience with eco-driving.

The main participants in the project, i.e. those countries interested in introducing eco-driving in training and testing were:

1. Driving Standards Agency (DSA), Great Britain[3]
2. Driver & Vehicle Agency (DVA), Northern Ireland
3. Ministry of Transport, France

[1] Now www.ecodrive.org
[2] http://www.treatise.eu.com/
[3] Financial contributor

4. Ministry of Transport, Luxembourg

Naturally, the project could not have gone ahead without the support of the following CIECA members from the 'expert countries':

1. Finnish Vehicle Administration (AKE)
2. VdTÜV and TÜV SÜD (technical inspection association), Germany
3. CBR (national driving test organisation), Netherlands
4. Asa (Association of Automobile Services), Switzerland
5. Swedish Road Administration (SRA)

A number of other national organisations assisted in the preparation of the visits to 'expert countries' and our thanks are extended to them too.

3. Methodology of project

Data on research and experience was collected over a series of visits to the 'expert' countries (Finland, Netherlands, Germany and Switzerland) between April and June 2007, following a kick-off meeting in January 2007. Reports were made of each visit and relevant documentation was collated. These visit reports were submitted to the host country for their comments and edited if necessary. A draft final report was put together by CIECA on the basis of these visits. This report was finalised following consultation with a range of CIECA member organisations at a meeting in Stockholm in October 2007.

It is important to note that other European countries also have a focus on eco-driving in training and testing, e.g. Norway and Austria. However, due to the limited timeframe of the project these countries were not visited. Sweden was also not officially visited due to the timing of the introduction of its own eco-driving plans (December 2007+), but the final meeting to discuss the project report was ultimately held there and the Swedes had an opportunity to present their plans there.

4. Basic principles of eco-driving

To fully appreciate the content of training in the eco-driving field, a distinction should be made between:

- Eco-driving as part of a broader attitude and respect for society and the environment, including re-cycling and prudent use of household energy and water.
- general principles on how to minimise the effects of transport on the environment, and
- specific techniques for driving a car in an environmentally-conscious and energy-saving manner.

As CIECA members are primarily driver testing organisations, a major focus of this project was to determine how best to assess specific eco-driving techniques in the practical driving test. However, countries with obligatory theory classes for learner drivers – and those with developed theory tests - have an opportunity to address the broader principles of transport and the environment, such as alternative, more environmentally-friendly modes of transport, selection of appropriate vehicle (according to energy efficiency) and trip-planning to avoid traffic congestion and thereby shorten the trip. The extent to which eco-driving can be considered in driver training as part of a broader culture for environmental protection depends on the individual country and the level of awareness and motivation of (young) citizens on this subject.

The main focus on this section will be on the basic techniques for driving a passenger car in an environmentally-conscious way. These techniques may differ slightly from place to place, and from organisation to organisation. Much depends on the target audience, namely whether the drivers themselves are experienced drivers, professional drivers, learner drivers and what category and type of vehicle they are driving.

The basic point to bear in mind is that modern car engines (from about 1990 onwards) are more efficient, so driving at excessive rpms only wastes fuel and increases engine wear. Modern engines have a completely different torque to engines 20 years ago. The maximum torque is now a lot higher and is already reached between 1500 and 3500rpms. The torque in old petrol-powered cars only began at around 3500rpms. Non-turbo charged diesel engines had a lot higher torque than comparable petrol-fuelled cars but not to the extent that engines have today. Both the torque and power of engines with similar cubic capacity (cc) have almost doubled in this 20 year time period.

In the context of the **EU Ecodriven project**[4] (ongoing), the golden rules of eco-driving are as follows:

1. Shift up as soon as possible
   Shift up between 2.000 and 2.500 revolutions.
2. Maintain a steady speed
   Use the highest gear possible and drive with low engine RPM
3. Anticipate traffic flow
   Look ahead as far as possible and anticipate surrounding traffic
4. Decelerate Smoothly
   When you have to slow down or stop, decelerate smoothly by releasing the accelerator in time, leaving the car in gear
5. Check the tyre pressure frequently
   25% too low tyre pressure increases rolling resistance by 10% and your fuel consumption by 2%.

The tips promoted in the mass media campaigns for the **'New Driving Style' in the Netherlands**[5] are:

1. Shifting through the gears at low (2000-2500) rpms
2. Coasting[6] (no pressure on the accelerator = zero fuel consumption)
3. Maintaining the right tyre pressure
4. Driving in the highest gear possible.

The **Eco-driving Quality Alliance in Switzerland**[7] promotes similar techniques but in a different way:[8]

1. Drive in the highest possible gear with low rpms
2. Move off and accelerate swiftly, changing quickly into 2nd gear and beyond
3. Change early into a higher gear and late into a lower one
4. Drive smoothly by anticipating traffic, avoid unnecessary braking and gear changing.

[4] www.ecodrive.org
[5] http://www.hetnieuwerijden.nl/
[6] The term 'coasting' is used on several occasions in this report. It refers to the use of 'built-up momentum' or the 'kinetic energy' of the vehicle, where no pressure is applied on the accelerator, the clutch is not engaged and the car is still in gear. The clutch should be engaged if the rpms go below about 1000 rpms (depending on the car), and according to the traffic situation the driver should either bring the car to a stop or move away again in a lower more appropriate gear than the one previously used at cruising speed. The term 'coasting in neutral' means that the rolling momentum is being used but the car is not in gear.
[7] http://www.eco-drive.ch/
[8] Research from TNO in the Netherlands has calculated and compared the relative energy and fuel consumption of such "fuel-consuming accessories". It also showed that driving with the windows open can add 10% to total fuel consumption (compared to 18% for A/C). TNO report 05.OR.VM.066.1/RvM (2005)

Germany's "Drive and Save safely" (Fahr und Spar[9]) programme developed by the DVR (German Road Safety Council) lists the following techniques:

1. Swift acceleration to cruising speed
2. Quick changing up through the gears (changing at low revs, e.g. 2000rpm)
3. Smooth, consistent driving in the highest possible gear
4. Maintaining longer safety margins (e.g. 3 seconds)
5. Removing foot from the accelerator as early as possible when needing to slow down / come to a halt
6. Using built-up momentum (rolling / coasting) with foot off accelerator where appropriate
7. Turning off the engine at stops longer than 40 seconds
8. Right tyre pressure

Other tips include: not applying the accelerator when starting the car (old habits), removing unnecessary extra weight and un-aerodynamic features of the car (e.g. roof racks) when unneeded, avoiding over-use of A/C or window heaters.

The car manufacturer **Ford** has boiled down the essence of Eco-driving to just 3 techniques:
1. Change gear – and drive – at low rpms
2. Make optimal use of momentum and built-up energy
3. Drive in a relaxed and anticipatory manner

The **EU TREATISE Project**[10] adds some more detailed tips to the above ones, such as:
- Driving uphill: The most efficient way to drive up a hill is to use the highest gear possible with a deep accelerator position.
- Negotiating Bends: Drive round bends in a high gear, when safe & practical
- Fuel Saving In-car Devices: various in-car devices encourage eco-driving, such as the rev counter, cruise control, on-board computers and satellite navigation systems.
- Get your engine regularly tuned.

The core techniques of this new driving style boil down to:

1. Smooth, consistent driving, looking far ahead and avoiding unnecessary braking and stops.
2. Changing gears at relatively low rpms and driving in the highest gear possible.

…in a well-tuned vehicle with appropriate tyre pressure.

In essence, the various descriptions of the eco-driving techniques described in this chapter appear to largely repeat themselves. However, the precise wording and structure of these descriptions may have an impact on how well they are implemented on the ground and so it was considered useful to include all relevant descriptions in this report. Individual countries and CIECA members can decide for themselves which techniques to promote and how to promote them.

[9] http://www.fahrspartraining.de/
[10] http://treatise.eu.com/

5. The benefits of eco-driving

Eco-driving is said to entail a number of benefits for the driver, (the driver's employer), his/her passengers and for the environment. These benefits are presented in no particular order below, and each benefit may appeal to a different target group of road user:

- **The driving experience is more comfortable** for driver and passengers, due to smoother, more anticipatory driving
- **Lower fuel consumption – and therefore cost-savings** result due to driving in a higher gear, less stopping, less erratic use of the accelerator as a result of a smoother driving style, appropriate tyre pressure and less ballast
- **There is less pollution due to lower emissions**, namely in terms of CO2 which has a direct impact on global warming
- **There is less noise**, as a result of driving at lower rpms
- **Driving is safer**, due to greater anticipation and less erratic and unpredictable behaviour[11]

6. Marketing and communications

Although the various eco-driving techniques promoted by individual countries and companies essentially boil down to the same thing, this driving style has been marketed in different ways according to the country and to the target group.

Branding of eco-driving

The following is a non-exhaustive list of some of the terms used to describe eco-driving which have been encountered during this project:

✶ EcoDriving® (a Finnish trademark patented in the 1990s)	✶ Ecological driving
✶ Environmentally-aware driving	✶ Cool driving
✶ Eco-driving	✶ Smart[13] driving
✶ Eco-friendly driving[12]	✶ Eco-safe driving
✶ Economical driving	✶ The new driving style*
✶ Energy-aware driving	

The term 'the new driving style'* is significant in that it highlights the fact that, over the last few decades, engine technology and performance of passenger cars, lorries and buses have improved rapidly, such that these vehicles are now designed to be driven in a different way than cars more than 20 years ago. It should be pointed out, however, that the term 'new driving style' will only be appropriate for branding purposes for a limited timeframe – because it can only remain 'new' for so long!

[11] This has not yet been proven in the case of eco-driving for learner / novice drivers.
[12] The term 'Eco-friendly' driving is not recommended as a means of promoting eco-driving. It implies that this driving style and behaviour is beneficial to the environment, whereas in reality it is of course damaging the environment, although perhaps less than an old-fashioned driving style.
[13] In the American sense of the word: smart = clever.

Marketing to youngsters

In Finland, eco-driving is known as 'economical driving' to learner drivers; therefore the potential cost-savings of a more efficient driving style are thought to influence youngsters and the way they perceive eco-driving. More recently, in Germany, the concept is being marketed as 'cool driving' and 'smart' driving to youngsters there. Novice drivers adopting eco-driving techniques are marketed as cool and smart in providing their passengers with a smooth, comfortable ride. The modern aspect of eco-driving is also used as a way of encouraging more technically-oriented individuals to adopt eco-driving because it is the modern, 'hi-tech' thing to do. In both the Netherlands and Germany, eco-driving is also known as the 'new driving style'; this is the way that modern cars are designed to be driven. Depending on the current perception of the environmental cause amongst youngsters, the 'saving the planet' argument should also be considered. This argument is becoming progressively more legitimate, although there is still a risk that youngsters and other segments of the population may become desensitised by the environmental message, or even consider it to be exaggerated.

Marketing to youngsters' parents

Today's parents were taught to drive in what is now considered to be an 'old-fashioned way', e.g. pressing the accelerator when starting the engine, stretching the engine between gears and shifting down through the gears when coming to a stop. A small proportion of them will follow – or have already undergone – eco-driving training, or will have seen advertising on this issue so they are at least aware of the new techniques. However, in general, parents can legitimately be considered as an impediment to encouraging youngsters to adopt the new driving style. In more than half of the EU's member states, learner drivers are allowed to undergo private practice (learning to drive via accompanied driving with a parent or other licence holder). Their driving will also be scrutinised by parents, especially in the first few months after licensing. In order to prevent parents from actively discouraging their children from adopting eco-driving techniques, various measures can be considered:

- Campaigns for the general driving population on the benefits of the new driving style (e.g. Netherlands)
- Training for accompanying persons on economical driving (e.g. Sweden[14])
- Training for learner drivers (in theory classes) on how to stand up to criticism from parents and to convince them of the benefits of eco-driving (e.g. Germany)

Driver testing organisations also have the means of reinforcing the environmental message in the context of the practical driving test. In addition to the emphasis on the use of eco-driving techniques by candidates during the test, the testing organisation could also introduce environmental guidelines for the cars being driven during the test. These guidelines would apply to driving instructors' vehicles, parents' vehicles and those supplied by the testing organisation (depending on the country) and would ensure that they meet minimum environmental standards. If a candidate can fail the practical driving test due to poor eco-driving, it would send a mixed message if he/she were able to drive a car with high emissions during the test itself.

Communication to the broader population of road users

Active campaigns targeting the general population on sustainable development and environmentally-conscious thinking, particularly with regard to transport and eco-driving, can be a useful means for creating general awareness of the issue, thereby facilitating the integration of eco-driving into initial training and driver testing. This is the process being undertaken in the Netherlands for example.

[14] Not so much emphasis is currently put on economical driving in this accompanying persons' seminar in Sweden; but the point is that such a forum could be used for this purpose.

7. Research on effectiveness of eco-driving training for experienced drivers

A number of evaluations, with a focus on the effects of eco-driving amongst professional/company drivers, have been carried out in Switzerland and Germany. Other evaluations, for example in the Netherlands, have looked at the effects of communication measures and eco-driving in a simulated environment. The evaluations on professional/company drivers, mostly carried out the Quality Alliance Eco-drive (CH) and the DVR (DE) – but also by Ford, Mercedes and BMW, have consistently concluded that eco-driving training has led to lower fuel consumption (and related cost-savings) and fewer accidents amongst the drivers concerned. As one might expect, however, the long-term effects are less significant than the short-term ones and thus ongoing training in this area is recommended.

The main conclusions made on the basis of these evaluation results by SenterNovem (NL) in the context of the EU Ecodriven project are:

- There is sufficient information about the short-term effects (< 1 year) of training measures. Fuel consumption can be reduced on average between 15 and 25%.
- There are some studies which indicate a long-term effect (> 1 year) of training measures between 4,7% and 8% (in terms of reduced fuel consumption). The long-term effects are less than the short-term ones as the old driving habits of these experienced drivers tend to re-emerge.
- Eco-Driving also reduces accident risk. Maintenance costs and accident costs are reduced.
- The effect of combined measures is greater than the effect of single measures.
- Communication measures have proved their worth.

A full table of the research carried out so far has been provided by SenterNovem can be found on the Eco-driving project homepage of the CIECA website.

The above results refer to eco-driving training for company employees and professional drivers. There is, however, no knowledge as yet regarding the long-term effects of eco-driving training on learner and novice drivers. Arguably, learners are likely to be less motivated to adopt and maintain eco-driving techniques than professional drivers who work within a strict context of cost-savings and who are constantly under pressure from their superiors to perform in a fuel-efficient and economical manner.

What does exist with regard to eco-driving and learner drivers is a 2004 report from Turku University (Finland) entitled: “Eco-safe is coming – does it improve driving safety?” This report was a process evaluation of the situation regarding eco-driving in training and testing. Importantly, the report highlights some possible conflicts between pure economical driving techniques and safe driving. These conflicts are presented and discussed on page 18 of this report.

8. Summary of experiences with regard to initial training and testing of eco-driving in the 'expert' countries

The following section consists of summaries of the experiences of the individual 'expert' countries (Finland, Netherlands, Germany and Switzerland) with regard to eco-driving and learner/novice drivers.[15] It also includes a brief overview of the plans for introducing eco-driving into the category B practical driving test in Sweden.

The summaries cover information on the following themes:

- A brief explanation of the category B driver training and testing system in the country in question
- How eco-driving fits into initial driver training (theory and practice) and the theoretical and practical driving test, including obligatory 2nd phase training (Finland, Switzerland…).
- How the concept of eco-driving is marketed to learner and novice drivers
- Training on eco-driving for examiners and instructors
- Experiences to date, including how well eco-driving is being taught, learned and assessed.

FINLAND: "Economical driving" in training and testing

Since 1989, Finland has had a 2-phase driver training system: the first 'phase' of training is before the driving test and the second 'phase' of training is after the driving test. In the initial phase, learner drivers have the choice of either following a training programme in a driving school or to train with lay instructors (e.g. parents). About 90% of learner drivers choose the 'driving school' option. The first phase driving school training is composed of 20 hours of theory (class-based) training and a minimum of 15 hours of practical (on-road) training[16]. The driving test itself is the traditional format of a PC-based theory test and a practical on-road test. The pass rate at the practical test is around 73% (2006). The 2nd phase of training is obligatory for all novice drivers and should take place between 6 months and 2 years after the driving test. The main components of the 2nd phase are: a 90 minute on-road 'feedback drive', a series of risk-based vehicle manoeuvring exercises on a track and a group discussion (all led by a driving instructor). The whole 2nd phase package lasts a total of about 1.5 days. The main goals of the overall category B driver training curriculum are: 'safety', 'economical driving'[17] and 'social skills'.

'Economical driving' was introduced as a concept in category B training in Finland in 1995 and in the driving test from 1998[18]. An important message in driver training is thus that the use of economical driving techniques can lead to significant cost savings as a result of lower fuel consumption. It is included in initial driver training, the driving test and obligatory 2nd phase training. The main focus regarding economical driving in the first phase of practical training, depending on how quickly the learner is progressing, is on reaching cruising speed swiftly by changing up quickly through the gears, and looking far enough ahead in traffic (so as not to have to brake unnecessarily). However, as the 1st phase of practical training only lasts about 15 hours, there is little time to develop any skills beyond swift changing of gears. At least 1 hour of the first phase (class-based) theory training is devoted to environmental awareness in the broader sense: the effects of transport on the environment, choosing a car from an environmental perspective, transport planning (use of alternative transport modes) and trip planning, as well as basic techniques for eco-driving.

The theory test typically contains at least 1 (out of 60) environment-related question. Economical driving plays a role in the practical driving test although candidates cannot fail the test as a result of poor economical driving. 'Economical driving' is one of 7 criteria on which the test candidate must evaluate him/herself in a self-assessment (on the driving test assessment form) which should be filled out before the candidate starts the test (rating 1-5, with 1= poor and 5= excellent) and discussed with the examiner after the test.

[15] Readers are strongly recommended to read the full visit reports (English only) for a more detailed analysis.
[16] In practice, too, the actual amount of pre-test on-road training is around 15 hours per learner.
[17] 'Economical driving' is the term used by the Finns to describe environmentally-friendly driving.
[18] The Eco-driving© trademark originated in Finland but was sold to a Swedish company.

2nd phase training provides an opportunity to focus intensively on economical driving – especially in the on-road feedback drive where most instructors emphasise economical driving techniques in 'before-and-after drives'. The months of solo driving between the driving test and 2nd phase gives many novice drivers the added experience necessary to more easily adopt such techniques. Written feedback is given to the novice driver after the drive. This includes tips for economical driving, an overall appraisal of the driver's driving style and a recording of the exact fuel consumption (litres per 100km) in the first and second drives.

All instructors have received a 1-day training on economical driving and 'most examiners' have received similar training, although it is recognised that "such training should be continuous".

A 2004 report by Turku University (see page 18) highlighted possible conflicts between pure economical driving techniques and safe driving. It also concluded that 2nd phase training seems to be a good time to train economical driving, and that novice drivers often obtain a 10% reduction in fuel consumption between the first and second trip in the on-road feedback drives. However, there is no knowledge about the long-term effects of such training.

Finally, in an ongoing large-scale survey of novice driver opinions in Finland, drivers rate economical driving the least useful part of their training (apart from 'driving in difficult conditions'). This may, however, be due to the fact that the novice drivers lack a clear understanding of what actually constitutes 'economical' driving, because this is simply the way they are taught to drive.

NETHERLANDS: The "New Driving Style" / "Environmentally-aware driving" in training and testing

Category B driver training can only take place with a certified driving instructor, i.e. accompanied driving is not allowed. The average learner takes around 40 hours of practical driving lessons before taking the test. Learners generally prepare for the theory test through home-study. The pass rate in the practical driving test is around 50%.

The 'new driving style' is being introduced as part of the practical driving test from 2008 onwards. The Netherlands has prepared for this by providing free ½ day training for over 90% of instructors and examiners in the last few years. Some driving instructors have already started training learners on basic new driving style techniques, such as early gear shifting, letting the car roll (coasting) and early anticipation. The extent of this focus in training largely depends on the progress of each individual learner.

2008+ will constitute an experimental phase with regard to the new driving style in the test. Symbolically, energy-conscious driving has only been added in an appendix to the official category B training and testing curriculum ('Rijprocedure') rather than being integrated immediately into the main body of the text.

Energy-conscious driving is one of 13 criteria which can be used in reaching a pass-fail decision in the practical driving test. The current stance with regard to the relative weight of energy-conscious driving in reaching such a decision is that candidates will not fail on the basis of poor eco-driving as long as his/her safe driving behaviour is otherwise excellent. However, poor eco-driving can contribute to failure if other (safe driving) aspects of the candidate's performance are found to be lacking. Eco-driving has thus become an important assessment criteria because in practice very few people drive otherwise excellently.

In order to illustrate the kinds of environmentally-aware driving that the examiner will be looking for in each different part of the test, the following examples were spontaneously given during the project visit to the Netherlands (note: driving at low rpms applies to all items):

- Driving away	Changing quickly into 2nd gear when moving off
- Driving straight and around bends	Quickly changing up through the gears Staying in a high gear around bends Using built-up energy when having to stop on a straight road (coasting) Use of cruise control, if present and appropriate
- Intersections	Possibility of not stopping when having priority and if no traffic coming Rolling up to the junction, taking into account traffic from the rear Not changing down through the gears on deceleration (and engaging the clutch at the latest possible moment)
- Entering and exiting traffic	Skipping some gears (e.g. 2 or 3 to 5). Explosion of speed (motorway) Exiting: release gas pedal at early stage (looking behind at same time for safety reasons)
- Overtaking and lane changing	Overtaking – skipping gears (extra explosion of speed)
- Behaviour next to specific traffic features, e.g. bus stops	Turning off the engine, e.g. at railroad crossings. Driving on roundabouts – in higher gear. Driving past public transport in higher gear for noise reduction purposes…
- Special manoeuvres	Avoiding excessive revs (noise and emission pollution). Waiting so long for appropriate moment may require turning off engine.

Finally, it is important to note that the Netherlands has spent considerable time and resources over the last few years on developing an awareness of the new driving style amongst the broader population (namely experienced drivers). This broader awareness may facilitate the integration of the new driving style in initial training and testing.

GERMANY: "Drive and Save in Safety" / "Cool driving" in training and testing

Initial driver training can only take place in driving schools, i.e. pre-test accompanied driving is not allowed. However, most of the federal states of Germany have recently introduced a model which allows learners to train and take the test one year earlier than normal, followed by an obligatory post-test accompanied driving period until the person's 18th birthday. Driving school-based training involves a mandatory amount of 12 hours practical training and 14 hours theory lessons (in groups). The average amount of driving practice per cat. B driver before the test is estimated to be between 20-25 hours. The pass rate in the practical driving test is 70-75%.

Eco-driving became part of the practical and theory test in 1999. Since then, all driving instructors and examiners have followed an eco-driving training course. However, experience shows that some driving schools are still not systematically applying eco-driving practices into the category B driver training. A federal initiative has recently led to a further wave of eco-driving training for driving instructors and examiners in an attempt to consolidate on eco-driving as a whole. In 2007 a new set of detailed guidelines in the form of a 30-page magazine has been made for driving instructors on how to integrate eco-driving techniques into initial driver training. A new campaign "Cool Fahren – Sprit sparen" (Cool driving – save fuel), including TV advertisements, has also been launched to make eco-driving more attractive to youngsters.

The content of practical driving school training in Germany is guided by a series of 'Leitfaden' or scripts which instructors are expected to follow for each stage of the learning-to-drive process. Eco-driving principles and techniques have been integrated into some of these scripts. For instance, swift 'changing of gears' and 'coasting' have been integrated into the initial learning stage. Eco-driving issues dealt with in compulsory theory lessons are split into technical, social and discussion-based components. The technical components look at eco-driving techniques. The social aspects bear the leitmotif "My passengers should always feel comfortable" and include ways of dealing with older drivers who are unfamiliar with eco-driving techniques. Discussions revolve around questions such as:

- what do I have to do to make my passengers feel at ease?
- how is the driver driving when you, as a passenger, are not feeling comfortable?
- what can you do when the person driving you is making you uncomfortable?

A new round of eco-driving training for instructors and examiners is now being launched. The 1-day course involves a mixture of theory and practice and addresses themes such as legal aspects, the driving techniques themselves, experiencing the techniques in practice and developing a common basis for driver training.

The category B test candidate in Germany can fail the practical test if he/she makes significant errors with regard to eco-driving. The overall category B practical test pass rate lies between 70-75%. Of the candidates that fail, most fail as a result of frequent errors of varying types. Eco-driving errors are likely to be included here. The number of candidates who fail purely on the basis of Eco-driving errors is very low and is estimated to be around 1%. Note: specific fault categories apply in the driving test in Germany, but it is up to the individual examiner to reach a pass-fail decision based on his own global assessment of the candidate, rather than a specific number of driving faults).

Quick gear changes and use of the appropriate gear in relation to speed are essentially the main features of eco-driving seen by candidates during the practical category B test. Anticipatory driving (smooth driving at consistent speed, coasting, etc) requires additional skills and is rarely seen by test candidates, according to the examiners spoken to during the project visit.

SWITZERLAND: "Environmentally-conscious driving" in training and testing

In Switzerland, a PC-based multiple choice theory test has to be passed before learners can begin to practise on the road (from 18 years old). At this point, learners can drive accompanied (private practice) and/or with a driving school. In practice, mostly all learners do both, and learners tend to take between 20 and 30 hours of practical lessons in driving schools. The only obligatory element in initial driver training is an 8-hour series of *Road Sense* classes, spread out over 4 days. Following the practical driving test (pass rate = 55-60%), the novice driver enters a 3-year probationary period which includes an obligatory 2-day 2nd phase training programme (since Dec 2005).

The Road Sense classes in initial driver training include at least 45 minutes of presentation / discussion on 10 eco-driving principles:

1. Selection of appropriate vehicle	6. Avoiding unnecessary wind resistance, e.g. roof rack
2. Using first gear only to move off (changing quickly into second gear)	7. Turning off engine at stops and traffic jams
3. Always driving in the highest gear possible	8. Pre-drive route planning, including use of GPS
4. Looking far ahead when driving	9. Driving smoothly (avoiding aggressive or erratic driving styles)
5. Using rolling mass (built-up momentum) of vehicle	10. Regularly engine maintenance (tuning)

Learning eco-driving in practical training can be difficult if the learner has already practised privately. In such cases, it is likely that they have been taught to drive, for instance by parents, according to an old driving style which is not eco-driving friendly. 'Un-learning' such a driving style is difficult and time-consuming.

Ideally, the driving instructor begins practical training with learning how to move off and how to brake. The next stage is 'use of gears'. At this point eco-driving principles are immediately introduced, i.e. changing into 2nd gear after the length of one car. Thereafter follows practice changing the gears at around 2500rpms, and even missing gears (e.g. 2-4) where appropriate[19]. The next stage is encouraging the learner to come to a halt in the same high

[19] Other instructors prefer to teach novice drivers to go through each individual gear so that they can get into the habit of changing up every 2000-2500rpms.

gear that he/she was cruising in, i.e. they should not change down through the gears when slowing down. The appropriate gear should then be chosen according to the speed of the car at the time of moving off again. During the training, the learners are taught to accept that there are certain situations where eco-driving principles are not appropriate, e.g. when entering a motorway or overtaking. The last stage in the training process, and the skill that takes the most time to develop, is looking far ahead in traffic and coasting, i.e. taking your foot off the accelerator as early as possible when recognising the need to slow down.

'Most' driving instructors have followed special training on eco-driving and, in the knowledge that Swiss driving instructors must follow at least 60 hours of ongoing training every 5 years, some of this training is inevitably spent on eco-driving.

In terms of the practical driving test, faults are categorised according to light, moderate or serious errors but ultimately the examiner makes a global assessment of the candidate's performance to make the pass-fail decision. Errors relating to eco-driving can be light or moderate errors and include:

1. Use of inappropriate gear (if you drive constantly in the wrong gear you can fail the test, despite otherwise driving safely)
2. Driving at too high rpms
3. Not turning off the engine at traffic lights (this rule is taken very seriously in Switzerland. For traffic lights at large junctions or any other longer stops, the accepted rule is that cars behind the first 3 cars in the line MUST turn off the engine during the wait).
4. Erratic (uncomfortable, unsmooth) driving (on and off the accelerator).

At least one of the two days of second phase training for novice drivers in Switzerland, as in Finland, has a major focus on eco-driving. This day includes two on-road feedback drives, where 2-3 novice drivers evaluate each other's performance in the presence of a trainer. The first feedback drive focuses on the novice driver's normal driving style. Thereafter follows a group class-based session where the novice drivers should work out for themselves what constitutes good environmentally-conscious driving, recalling what they have learned in the initial training phase. Then the second feedback drive takes place in which the novice drivers are supposed to apply eco-driving techniques. As in Finland, fuel consumption is recorded in a before-and-after comparison to visually illustrate the benefits of such techniques. Second phase trainers (in practice these trainers are mostly all driving instructors) are required to follow a 10-day further training course which includes these eco-driving elements.

A recent unofficial idea from Switzerland was to increase awareness of the environment and of eco-driving by measuring the fuel consumption of each candidate during the practical test and comparing consumption after the test with a benchmark for the test route.

SWEDEN: Economical driving in the driving test

The Swedish Road Administration will introduce economical driving in the category B driving test from December 2007 onwards.

The five basic actions below are focused upon when assessing the fulfilment of the sub-goal in the curriculum "using a driving technique leading to low fuel consumption".

1. Idling
2. Starting/accelerating
3. Choice of gear at steady speed
4. Braking/slowing down using the engine
5. Planning/thinking ahead

The application of knowledge and driving skills that will be assessed can be seen from the bulletpoints below, presented for each basic action.

1. *Idling*
   Demonstrate the skill
   - to avoid unnecessary idling

2. *Starting/accelerating*
   Demonstrate the skill
   - of how starting and edging forward should be carried out
   - of how to use the gears
   - of how to accelerate

3. *Choice of gear at steady speed*
   Demonstrate the skill
   - of choosing the most appropriate gear for fuel-saving, whilst still providing a comfortable ride.

4. *Braking/ slowing down using the engine*
   Demonstrate the skill
   - of using the engine to slow down and the correct way to do this

5. *Planning/ thinking ahead*
   Demonstrate the skill
   - of avoiding great changes in speed, unnecessary braking or stops (at traffic lights, pedestrian crossings, intersections, etc) by good scanning routines and proper speed adjustment
   - of maintaining a proper distance to vehicles in front.

From 3 December 2007 onwards, "economical driving" will be assessed in the Swedish practical driving test. All examiners will then have completed the necessary special education. Environmentally friendly driving will be included in the test as a natural part and shall not take precedence over other things in the assessment of the candidate's driving. It shall be valued like other objectives in the curriculum, in an overall judgement of the test[20]. Moreover, traffic safety will always take priority.

A total compliance to "economical driving" principles will not be required, but if no sign of economical driving techniques is demonstrated this will be seen as a constant fault and will lead to failure of the candidate. The examiner must see some evidence that the candidate is in the process of practising economical driving before passing him/her. There should obviously be some action of that kind in the candidate's driving; some evidence that the candidate has started to think in the right direction and has also started to adopt those techniques.

All driving instructors and examiners in Sweden have both received theory and practical training on eco-driving. The training costs were covered by the Swedish Road Administration.

[20] The pass-fail decision in Sweden is made based on a global assessment by the examiner. Fault categories do not exist.

9. Differences in eco-driving techniques advocated from one country to another

There are some differences, although mostly small, in the techniques advocated in the various countries included in the project. Whilst these differences may be considered so small to be insignificant, it may be useful to clarify why these rules differ. After all, small differences in the message developed at policy level can have larger consequences at application level. A further issue is the balance that should be struck between what is environmentally and technically correct, and what is best for the training process of learner and novice drivers.

Note that this section focuses, like the other parts of this report, to category B vehicles.

The main differences found from one country to another in terms of eco-driving techniques and rules for learner drivers relate to:

- The ideal gear-changing moment
- The amount of pressure to apply on the accelerator
- When - and if - to switch off the engine at stops
- Coasting in gear or in neutral

The ideal gear-changing moment:

The ideal moment to change gears depends on the individual car and whether the car is petrol or diesel-powered. The gear-changing moment in the most modern diesel and petrol-powered cars is about the same but in 'older' diesel cars the moment is lower. For communication purposes, as presented in section 4 of this report, a range of rpms is given in which gears should normally be changed when applying eco-driving techniques. In practice, there are some differences between one country and another in this regard, ranging from 1500-2500 rpms in Germany to up to 3000 rpms in Sweden (albeit in combination with skipping gears[21]). The ideal rpm range in the Netherlands is 2000-2500. It is not the task of this report to determine which one is more technically accurate or more appropriate for learner-novice drivers, but simply to point out these differences.

The amount of pressure to apply on the accelerator:

From an environmental and emissions perspective, how much pressure should be applied on the accelerator in between gear changes? Research from TNO (Netherlands) suggests that halfway is better in terms of emissions than full gas[22] and this is what will be taught in Dutch driving schools. Based on experience and knowledge in Germany, the approach there is that the gas pedal should be pressed to about 2/3 to get the best mixture of quick acceleration and fuel savings. The type of vehicle (engine, equipment, diesel/petrol) definitely plays a role here: you would tend to press the accelerator further in a car with a weak engine than in one with a strong engine.

Then comes the question: which approach is most appropriate for learner and novice drivers? It has been suggested that sending a message of using 'full gas' to young adults may lead to inappropriate acceleration for the circumstances. Moreover, full gas implies quicker acceleration and therefore the need for the learner driver to act more quickly when changing gears and finding the balance between clutch and accelerator. This may be more difficult to learn than a 'halfway' approach, in terms of vehicle handling.

[21] For example, shifting up from 3rd to 5th gear, missing out 4th gear altogether.

[22] TNO (2006): The effects of a range of measures to reduce the tail pipe emissions and/or the fuel consumption of modern passenger cars on petrol and diesel. R.J. Vermeulen

When - and if - to switch off the engine at stops

Generally there are extreme differences between individual cars with respect to when to switch of the engine from an environmental perspective (energy-efficiency, air quality, CO2). For some cars, it makes environmental sense to turn off the engine at stops of only 10 seconds; for others the emissions are greater if you switch off the engine before 8 minutes have elapsed! From a communication (easy, unequivocal) and social point of view (e.g. noise) the Dutch national eco-driving programme 'Het Nieuwe Rijden' communicates 1 minute. 1 minute will also be the rule for switching off the engine at stops during the practical driving test in the Netherlands (from January 2008). In Germany, the guidelines recommend 40 seconds and the rules in the Swiss practical driving test are particularly strict. In Switzerland, as in Holland, candidates are – or will soon be - expected to turn off their engine at red traffic lights, provided they are a few cars back from the front of the queue. In addition, the candidate should not apply the accelerator when switching the engine back on. Current rules in Sweden and GB are that the engine should be switched off at stops over 2 minutes (e.g. at railway crossings).

However, during the project a number of queries have emerged regarding the practice of switching off the engine:

1. Learning to switch off the engine regularly at traffic lights can be rather stressful for a learner driver, particularly in terms of having to switch the engine back on and move away quickly once the lights go green.
2. Learner drivers may have difficulty estimating the waiting time during a stop, and therefore whether or not to switch off the engine.
3. In traffic jams at junctions, applying this rule could mean switching on and off the engine a number of times before passing through the traffic lights.
4. In cold temperatures where hot air is needed in the car, and in hot temperatures where A/C is required, turning off the engine in most cars will also switch off the air flow (at least in terms of the temperature regulation). This could lead to the car getting steamed up or the temperature becoming uncomfortably warm or at least irregular.
5. Examiners will require training and monitoring to ensure that they are not over-zealous in assessing the candidate's application of this rule.
6. If the engine is completely switched off, rather than left in the recommended 'contact mode', there is a risk with some cars of the steering wheel locking.
7. The significant variation between individual car brands and models in terms of when it is best to switch off the engine means that it is difficult to establish a simple yet accurate rule for communication purposes.

Coasting in gear or in neutral

Coasting, i.e. using the built-up momentum of the vehicle when slowing down or coming to a stop, with no pressure on the accelerator and therefore zero fuel consumption, can be carried out in gear or in neutral. Both are possible, depending on the situation. If the car needs to roll over a long distance, for example when gradually decelerating on a motorway before reaching your exit, coasting in neutral allows the car to role further than when the gear is in gear and the braking action of the engine is used. If the car should stop earlier, and this is the most likely case in traffic, then coasting in gear is the best option. It is important to note that coasting downhill should always be with the car in gear, because driving in neutral disactivates engine braking and puts a lot of pressure on the brakes (risking over-heating). From a teaching and learning perspective, most countries would appear to prefer stipulating that the car should remain in gear.

It is worth re-emphasising here that environmentally-aware deceleration should <u>not</u> involve changing down through the gears, despite this still being generally expected in the practical driving test in countries such as France.

10. Possible conflict areas between eco-driving and safe driving for learner / novice drivers

Is eco-driving the same thing as safe driving, especially where learner and novice drivers are concerned? The 2004 Eco-safe report from Turku University (Finland) first addressed this issue and, in fact, highlighted a number of potential conflict areas between economical driving techniques and safe driving. On the basis of this knowledge, the project team made a point of asking each country's representatives (especially driving instructors) if their experiences were similar.

The Finnish Eco-safe report concluded the following:

- A principle of rapid acceleration to target speed could be taken too literally[23], and could cause shorter safety distances in traffic if not combined with proper anticipation.
- Coming too close to the vehicle in front in an effort to maximise your evenness of speed. Maintaining a constant speed, if misunderstood, can lead to insufficient safety margins because of delayed slowing down.
- Applying engine braking too early may result in a different pattern to that of 'normal traffic' and increase the risk of rear-end collision.
- The principle of 'avoiding stopping' could cause problems: if it is applied near pedestrian crossings or intersections without a clear view, 'it is possible that the learner driver's observation skills may be inadequate'.

Informal discussions with driving instructors in the Netherlands revealed the following possible conflicts:

1. Drifting in and around junctions (with a view not to stop in order to reduce fuel consumption) but thereby compromising safety (getting too close to other road users, for instance)
2. Early release of the gas pedal (coasting) on, for example, the approach to traffic lights can upset drivers behind them (and cause these drivers to act rashly, such as overtaking without proper planning)
3. Consciously trying to stay in a high (fuel-efficient) gear, but therefore manoeuvring at too high a speed (e.g. cornering)
4. Turning off the engine at long stops (more than 1 minute) can sometimes lead to the steering wheel locking which makes it difficult to move away quickly[24]. It can also be stressful for learner drivers and irritate drivers to the rear.

One Dutch instructor suggested that the rule of thumb "use eco-driving techniques unless it is unsafe to do so" is too complicated a message for some learner drivers who lack experience and therefore need a simpler message (i.e. just drive safely). The project team have suggested that turning this around and stating "drive safely and use eco-driving techniques where possible" would be a more appropriate maxim.

Examiners during the visit to Germany considered the only possible conflict to be "disrupting of the traffic pattern to the rear of the car when coasting towards a stop (especially if this process is initiated too early by the learner driver)".

DSA observers during the same visit expressed concern about "coasting in neutral having an adverse effect on control of the vehicle (especially for a novice driver and especially downhill on bends)". This view is shared by the CBR (Netherlands).

An additional possible conflict, which relates more to training and testing rather than safety, was identified by the project team. Many countries insist that the candidate drives in the practical driving test at the maximum speed allowed in any given area if the traffic allows it (this is known as 'making progress'). This is to test the ability to drive at 'higher' speeds. However, for eco-reasons, a candidate may choose to drive at a lower speed.

[23] Rapid acceleration has been marketed as part of economical driving in Finland so it would not be perceived as 'slow'.
[24] See previous section for other side-effects of switching off the engine at stops.

The ideal speed economically and environmentally speaking is around 90kmh or 55mph, depending on the car. This may make it difficult for the examiner to distinguish between candidates who lack skills and therefore drive slowly and those who choose to drive more slowly than allowed for environmental reasons.

These conflict areas, although to a large extent more potential than actual, merit further analysis and consideration into what exact techniques are being trained, how and when in the learning process they are being trained, and how the messages suit the needs of inexperienced drivers who can easily be overloaded.

11. Conclusions

At least some of the techniques advocated within eco-driving simply constitute the 'new way of driving', regardless of the environmental benefits. Modern engines are more efficient and the 'old way of driving' no longer corresponds to the opportunities provided by such technology. In addition to this technical argument, eco-driving carries a number of other benefits, such as lower fuel consumption, lower emissions, less noise pollution, cost-savings and a more comfortable ride for the driver and his/her passengers. Moreover, the fact that eco-driving encourages a smooth, consistent driving style and early anticipation can also benefit other road users and safety in general, because the eco-driver is more defensive, predictable and less erratic in his driving behaviour. Seen from this perspective, eco-driving is more 'the' way of driving than just a temporary fad. In fact, some eco-driving messages (such as not revving the engine when starting up, changing gear at lower revs) may already be given in driver training without being officially acknowledged as such.

The eco-driving argument can be presented to youngsters in many different ways: 'comfortable is cool', 'drive this way and save money', 'be modern and technically astute', 'save the planet' and 'take responsibility for yourself and others' are some of the messages that are currently being used.

Whilst the techniques under the heading 'eco-driving' are presented in slightly different ways according to the country and the target group, the essential principles are as follows:

1. Smooth, consistent driving, looking far ahead and avoiding unnecessary braking and stops.
2. Changing gears at relatively low rpms and driving in the highest gear possible.

…in a well-tuned vehicle with appropriate tyre pressure.

However, seen from the perspective of learner drivers, eco-driving does not necessarily constitute safe driving. Arguably, learner drivers who lack experience and wisdom when driving need a single, clear message ('be safe') rather than a slightly more complicated one ('drive in an environmentally-aware way unless it is not safe to do so). The project team felt that "drive safely and use eco-driving techniques where possible" was perhaps a more appropriate rule of conduct, although it may not emphasise eco-driving as much as some countries would wish.

Some potential conflicts have been identified in the previous section and include:

- Drifting around junctions and pedestrian crossings in an attempt not to stop
- Coming too close to the vehicle in front in an effort to maximise your evenness of speed.
- Coasting too early and disrupting the pattern of traffic to the rear, thereby increasing the risk of a rear-end collision
- Rapid acceleration to cruising speed could cause shorter safety margins to vehicles in front
- Trying to stay in a high (fuel-efficient) gear, but therefore manoeuvring at too high a speed (e.g. cornering)
- Switching off the engine at short stops can lead to the steering wheel locking.

The risk of these conflicts actually occurring presumably depends largely on which eco-driving techniques are emphasised to learner drivers and how they are taught.

The broader aspects of the environment and transport should also not be forgotten: use of alternative transport modes, choosing a fuel-efficient car, trip-planning, checking tyre pressure regularly, removing unnecessary ballast from in or outside the car, etc, can be considered in theory lessons in the initial training process (such as in Switzerland, Germany and Finland) and in publications, especially where theory lessons are not obligatory. Knowledge of these issues can also make a significant contribution to reducing the impact of transport on the environment, if combined with a positive attitude towards this societal theme.

The general assumption is that it is easier to train learner drivers to drive in an environmentally-aware way than it is to 'un-train' experienced drivers who have learned to drive differently and who have driven that way ever since. Instructors in Germany and Switzerland, for instance, start to integrate eco-driving principles from the beginning of the driving school training process, beginning with quick gear changes to reach cruising speed. However, the time allocated to initial driver training in some countries is so short (e.g. Finland = 15 hours practical training) that it is difficult to expect learners to have mastered any techniques other than basic vehicle control and basic interaction in traffic. It will no doubt be more difficult for countries where accompanied driving (private practice) is allowed to convey a systematic eco-driving message to learner drivers. Although the vast majority of learners also take practical driving lessons in driving schools in most countries where accompanied driving is the norm, these driving school lessons may come later in the learning process. This makes it likely that they have learned to drive in a different (e.g. outmoded) way and therefore provides a challenge for driving instructors who have to 'un-train' them. Nevertheless, experience from Switzerland shows that this is not an insurmountable task.

Based on the experience of Finland and Switzerland, countries with obligatory (2nd phase) post-test training for novice drivers will find that this provides a good opportunity to further develop the eco-driving 'seed' which was planted in pre-test training. Once novice drivers have accumulated more driving experience, they are likely to be in a better position to anticipate traffic, self-evaluate and to learn and apply more eco-driving techniques.

The use of electronic support can reinforce the learning process as far as eco-driving is concerned, and can facilitate eco-driving in general. In-car fuel consumption monitors such as the Econen[25] and the MD/eco[26] make it clear to the learner driver when fuel consumption is highest and before-after comparisons can be made to highlight the benefits of an eco-driving style. Cruise control reduces fuel consumption and SatNav systems reduce on-road time and therefore fuel consumption too. The use of driving simulators in the training process may also be considered[27].

In terms of the category B practical driving test, there are different approaches used in each country that has been visited/discussed:

- In Finland, the examiner is looking to see if the candidate reaches cruising speed swiftly by changing up quickly through the gears, and that he/she looks far enough ahead in traffic. But the candidate cannot fail purely because of poor economical driving.
- In Germany, quick gear changes and use of the appropriate gear in relation to speed are essentially the main features of eco-driving seen by candidates during the practical category B test. Failure to employ eco-driving techniques in the practical driving test can lead to failure. Only about 1% of candidates fail due to eco-driving errors alone, but eco-driving errors often make up part of a range of errors leading to failure.
- In Switzerland, errors related to eco-driving are categorised as 'light' or 'moderate' (but not 'serious') and include use of inappropriate gear, driving at too high rpms, not turning off the engine at traffic lights (if you are in the 3rd car or more from the front of a queue) or driving erratically (on and off the accelerator). Such errors can contribute to the failure of the candidate.
- In Sweden, a total compliance to "economical driving" principles will not be required, but if no sign of economical driving techniques is demonstrated this will be seen as a constant fault and will lead to failure of

[25] http://www.paetronics.fi/tuoteframe_eng.html
[26] http://www.moderndrive.de/produkte/produkte.html
[27] http://www.drivingcenter.ch/eng/mobil/mb_simu.html

the candidate. The examiner must see some evidence that the candidate has started to think in the right direction and has also started to adopt these techniques.

- In the Netherlands, where environmentally-aware driving will be introduced into the practical test from January 1 2008, the current stance with regard to the relative weight of environmentally-conscious driving in reaching such a decision is that candidates will not fail on the basis of poor eco-driving if his/her safe driving behaviour is otherwise excellent. However, poor eco-driving can contribute to failure if other (safe driving) aspects of the candidate's performance are found to be lacking (which in practice is quite common). Page 11 includes a useful table where the ideal eco-driving behaviour is presented according to the situation.
- From September 2008, eco-driving will be included in the practical driving test in Great Britain, but it will not constitute a formal assessment criterion. A weakness in the candidate's eco-driving performance will be noted and referred to in the post-test feedback from the examiner. A brochure on eco-driving will also be given out after the test.

Arguably, there is little point in introducing a new element into the driving test if poor performance in this area cannot contribute towards failure of the test. However, such a stance may be considered for a transitional period in the knowledge that all the different actors involved (learners, instructors, accompanying persons and examiners) may need time to adjust to the new requirements.

In terms of the theory test, this can be a useful means of encouraging a greater awareness of the impact of transport on the environment, other than simply being able to employ eco-driving techniques when driving (e.g. maintaining correct tyre pressure, removing unnecessary ballast, planning trips in advance…).

Overall, the introduction of eco-driving requirements in training and the test requires a comprehensive package of training and communication measures involving all eco-driving partners: examiners, instructors, candidates and accompanying persons. Training for instructors, for example, can include the theory of eco-driving and the broader impact of transport on the environment, practice of eco-driving[28], the legal framework and how best to teach it to learner drivers. Based on experience, some resistance from instructors towards the new driving style is to be expected, but such resistance can be countered during training. Insufficient training and/or communication, lack of clarity of the basic goals and poor coordination with regard to the timing of the actions can undermine the success of the measure. For instance, some countries are concerned that driving examiners will either be under-enthusiastic about eco-driving (due to their traditional focus on safety aspects alone) or over-enthusiastic in applying the new criteria, thereby possibly leading to a higher failure rate than would otherwise be the case.

Finally, it is important to point out that there is no information available as yet on the long-term effectiveness and sustainability of eco-driving training on learner and novice drivers. It is questionable, for instance, whether eco-driving training will stop the 'hard-core' of young, male drivers from driving in an aggressive, risky manner unless these attitudes are addressed during training too. This underlines the importance of marketing eco-driving for individual target groups. However, the countries visited during the project feel strongly that the eco-message is important and that initial training and testing is the appropriate time to convey it.

Some countries may shy away from a full attempt to integrate eco-driving into the driving test because:

- there is not yet any evidence that novice drivers maintain eco-driving attitudes and techniques once they are driving solo.
- it is more difficult to introduce eco-driving into a liberal training and testing regime (where there is no obligatory theory training and accompanied driving is allowed in initial training, thus leading to learners picking up the wrong techniques from parents driving in an old-fashioned way)
- there may be a wish to focus more on improving other areas of the practical driving test, such as reflecting typical accident scenarios of novice drivers.

[28] A before-after approach seems to be the most common, whereby instructors first drive (with 2-3 of them in the car with a trainer) in their normal style and then, following theory training, drive a second time applying eco-driving techniques. Fuel consumption can be measured on both occasions and then compared.

- Fuel is cheaper in some countries than others, and in cheap-fuel countries there is less of an incentive to cut costs through eco-driving.
- Advances in vehicle technology in the near future are expected to contribute more towards emission reductions than changes in driver behaviour.

12. Recommendations

1. Some eco-driving facts and techniques should feature in the training and testing of learner and novice drivers – it is not only less damaging to the environment but is also the way to drive modern cars.
2. Eco-driving should be marketed to youngsters in an attractive way; cool driving, hi-tech driving, economical driving, etc.
3. The techniques which are taught should be specially designed for learner drivers (providing the best possible return in terms of environmental benefits but avoiding techniques and messages which could increase accident risk). Trip planning is an important driving skill which is related to eco-driving and thus should also be taught.
4. Safe driving should take precedence over eco-driving, should any conflict arise between the two
5. In-car devices should be used in training in order to reinforce the eco-message (e.g. fuel consumption monitors such as the Econen or MD/eco)
6. The broader issues of transport and the environment could also be included in training, such as choice of alternative transport modes
7. Countries must decide for themselves whether or not a safe driving performance in the driving test can lead to failure solely because of poor eco-driving techniques
8. Ensure a clear, well-timed and comprehensive information, training and communications package for all eco-partners: learners, instructors, accompanying persons and examiners, ideally in parallel with a public discussion. Bear in mind that both initial and ongoing training in this area is likely to be needed.
9. Consider offering the same eco-driving training programme to both instructors and examiners
10. Provide excellent learning materials on eco-driving.

Useful websites

Subject	**Website address**	**Language(s)**
EU Ecodriven project	www.ecodrive.org	English
EU Treatise project	http://treatise.eu.com	English, with links to 8 countries with national language (+ downloads)
Quality Alliance Eco-drive (Switzerland)	www.eco-drive.ch	German, French, Italian
The New Driving Style (Netherlands)	www.hetnieuwerijden.nl	Dutch, and parts in English
'Drive and Save' training (Germany)	www.fahrspartraining.de	German
Econen fuel consumption monitor (Finland)	www.paetronics.fi/tuoteframe_eng.html	English
MD/eco fuel consumption monitor (Germany)	www.moderndrive.de/produkte/produkte.html and click on *Eco-driving*	German
Eco-driving simulator (Switzerland)	www.drivingcenter.ch/eng/mobil/mb_simu.html	English

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- DVR, Germany
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- Veltheim Driving Center, Switzerland
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Additional documents pertaining to this project can found on the 'members pages' section of the CIECA website at: http://www.cieca.be