

# Ecodriving

The smart driving style



Produced by SenterNovem, Utrecht for the EC TREATISE project, September 2005.



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## Table of contents

	<i>Page</i>
<b>1. Introduction .....</b>	<b>5</b>
<b>2. What is ecodriving? .....</b>	<b>6</b>
<b>3. The ‘why’ of ecodriving.....</b>	<b>9</b>
<b>3.1 Technical background.....</b>	<b>9</b>
<b>3.2 Environmental, economical and personal benefits .....</b>	<b>10</b>
<b>4. The ‘how’ of ecodriving.....</b>	<b>12</b>
<b>5. Facts and figures: Best practices .....</b>	<b>20</b>
<b>6. How to implement ecodriving.....</b>	<b>21</b>
<b>6.1 Activities on ecodriving .....</b>	<b>21</b>
<b>6.2 Collaboration and participation .....</b>	<b>25</b>
<b>6.3 Setting up national or regional programmes on ecodriving .....</b>	<b>25</b>
<b>7. Monitoring and evaluation of CO<sub>2</sub> emissions.....</b>	<b>28</b>
<b>7.1 Project level.....</b>	<b>28</b>
<b>7.2 Programme level .....</b>	<b>29</b>
<b>8. Further information .....</b>	<b>31</b>

# 1. Introduction

## **Ecodriving manual**

This manual covers ecodriving, a smart new driving style that improves energy efficiency and traffic safety. It concerns one manual out of a series of three that have been developed within the framework of the international project TREATISE\* that was carried out in the period 2005-2008 on behalf of the European Commission. The three manuals concern the following topics:

- Mobility Management
- Cleaner fuels & vehicles
- Ecodriving

## **The TREATISE project**

In the TREATISE project a consortium of 7 European national energy agencies have developed transport and sustainable energy training programmes for target audiences in local energy agencies and other local transport actors in each country. The training programmes are designed and structured to meet the expressed needs of staff in these audiences as identified in a series of initial workshops in each country. Besides the three manual also a web-based training tool was designed and built using the manuals and a series of training workshops for the target audiences. Within TREATISE a continuous programme of marketing and dissemination of information was undertaken across 11 countries. The aim was to encourage the target audiences to design and implement new transport initiatives and projects based on the learning that they gained in the TREATISE project.

## **The COMPETENCE project**

TREATISE, besides e-atomium and COMPETENCE, is one of the 3 projects co-financed by the EC within STEER in the framework of the Intelligent Energy – Europe Programme EIE which serves a similar target group. All 3 projects co-operate in the design of training material and in the implementation of training units. COMPETENCE – “Strengthening the knowledge of local management agencies in the transport field” is a 30-months project (2005 – 2007). The main activities in COMPETENCE are the design and implementation of international and national training and know how transfer activities, the design of training materials and the implementation of case studies as part of a training-on-the-job-program. The beneficiaries of the project are mainly local and regional energy agencies but also other organisations like environmental agencies, health bureaus etc. interested in enhancing their knowledge and skill base in the topic of urban transport. The COMPETENCE project consortium involves the active participation of 15 countries in Europe.

\* Training programme for local energy agencies and actors in transport and sustainable energy actions

## 2. What is ecodriving?

### A smart way of driving

Ecodriving is a smart way of driving, which contributes to reduce fuel consumption, the emission of green house gases and accident rates. Ecodriving is an adapted driving style, which best fits modern engine technology. Ecodriving means smart, smooth and safe driving at lower engine speeds (1,200 – 2,500 revolutions per minute), which saves 5-10% fuel on average. Without an increase of travel time.

### Developments in engine technology

New developments in engine technology have made possible a new, more efficient and more attractive way of operating passenger cars, lorries and busses. This way of optimised vehicle operation is called ecodriving. Most of the driving techniques of ecodriving are also applicable to older vehicles. Ecodriving offers benefits for drivers of private cars, company cars, lorries and busses and for fleet owners as well: cost savings, increased safety, more comfort and fuel savings. Several European countries have implemented a more or less successful programme on ecodriving.

### Elements of ecodriving

Ecodriving comprises the following five elements:

- Educating novice drivers;
- Re-educating licensed drivers;
- Fuel saving in-car devices;
- Tyre pressures;
- Purchasing behaviour (e.g. car labelling).

All five are integral elements of conscious and responsible vehicle handling. Energy-efficient purchasing behaviour and energy-efficient driving behaviour two ends of the same awareness proces. Ecodriving means optimising energy-efficiency through driving behaviour and the purchase of a fuel-efficient car, lorry or bus. Ecodriving also means optimising trip efficiency through frequent checks of tyre pressures and the use of fuel-efficiency improving in-car devices.

### Driving schools and driver exams

#### Educating novice drivers

The most (cost-)efficient way of spreading ecodriving is to get it incorporated in driving school curricula and exams. When novice drivers are taught ecodriving from the very first beginning, for most of them it will become a normal way of driving. To make ecodriving an integral part of driving school curricula it is however inevitable to have ecodriving judged in driver exams.



Figure 2.1: Novice drivers can be taught ecodriving very well

**Common driving style does not fit modern engine technology**

**Re-educating licensed drivers**

Although it is important to start at the very beginning to teach drivers a desirable driving style, it is also important to train current licensed drivers. They have been taught a driving style, which does not fit today's engine technology. For example drivers change gear at far too high revs. Over the last decades engines of passenger cars, lorries and busses have changed significantly, while driving style of most drivers has not moved with the times. Driving in a slightly different way that complements new engines will give benefits in cost savings, safety and comfort. With the right driving style training programme, drivers can save an average of 5-10% on fuel. Some drivers even reach savings of over 20%.



Figure 2.2: Re-education of licensed drivers: On the road and virtually on the simulator and PC

**Checking tyre pressure at least once a month**

**Tyre pressure**

Checking tyre pressures is not usually a priority when inspecting the vehicle, although common pressure losses of around 0.1 bar per month mean that over 12 months about 1.2 bar pressure will be lost. If the pressure is too low, the tyre resistance and fuel consumption increase. Driving with low tyre pressures is also unsafe because of the negative effect on road holding and braking. Results of surveys in several European countries show that about 50% of all passenger cars are driven with too low tyre pressures.

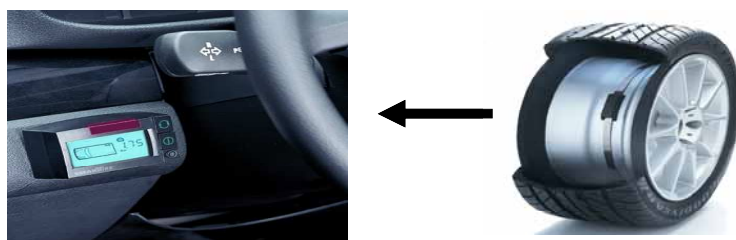


Figure 2.3: Tyre pressure monitoring system

**Purchasing behaviour and energy labelling**

**Purchasing behaviour (e.g. car labelling)**

Fuel saving starts with buying energy-efficient vehicles. Therefore many countries introduced an energy label for new passenger cars, which indicates the (relative) fuel consumption and the amount of CO<sub>2</sub> emission of a car. The labels are displayed on all new passengers' cars in dealer showrooms and at official events.

In case of relative fuel consumption the fuel consumption of a particular vehicle is being compared to the average consumption of cars of a similar size. In some EU-countries, the energy label for cars is similar to the label that is being used for washing machines and refrigerators. The label shows the relative fuel consumption in a particular colour, which immediately shows whether the vehicle uses more or less fuel than other comparable vehicles. Yellow means that the fuel consumption is average, red means it consumes more fuel, and green means it consumes less than average.

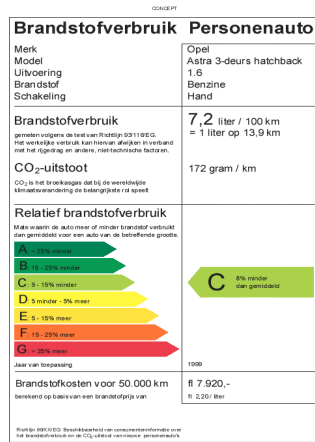


Figure 2.4: Energy label for passenger cars

Other label “models” just fulfil the minimum criteria given by a European Directive (stating fuel consumption and CO<sub>2</sub> emission figures). Hence, there is the aim to harmonise the car labelling EU-wide.

### Fuel saving in-car devices

During and after a trip, drivers, fleet owners, instructors and novice drivers can use various systems to check and optimise the driving behaviour and fuel consumption. In several field tests devices such as econometers, on-board computers, cruise controls and speed and revolution limiters have proved to save fuel and sometimes even to increase traffic safety resulting in a drop of accident rates. These devices itself already have positive effects on driving style. In field tests with commonly available in-car devices drivers were able to save 5% fuel on average. Individual savings sometimes exceeded 10%. Field tests with more sophisticated experimental feedback instruments resulted in fuel-efficiency improvements of even up to 20%. The use of fuel saving in-car devices supports a fuel-efficient driving style and substantiates and optimises an ecodriving driving style after having taken training courses.

**Fuel saving in-car devices contribute to fuel efficiency and traffic safety**



Figure 2.5: Some fuel saving in-car devices: On-board computer and cruise control



### 3. The 'why' of ecodriving

#### 3.1 Technical background

**Improved engine technology and performances**

In the last decades, engine technology and performances of passenger cars, delivery vans, trucks and buses have improved significantly. Petrol and diesel vehicles have become far cleaner in terms of their 'air quality' emissions i.e. emissions that affect human health. This is the result of e.g. the introduction of catalytic converters, which reduce emissions of CO, HC and NO<sub>x</sub> and of selective catalytic reduction systems, which reduce diesel NO<sub>x</sub> emissions. There have also been some improvements with conventional fuelled vehicles' fuel consumption and CO<sub>2</sub> emissions.

**Engine calibration to test cycle performance**

Unfortunately these improvements are only partly realised in 'real life' traffic. This is due to the fact that most people do not drive their car the way its engine was designed and calibrated. Passenger cars have to pass an obligatory test cycle to determine several exhaust emissions (regulated emissions). This test cycle has been designed according to a directed fixed format of the European Commission. The European Commission has also determined maximum levels for regulated emissions. Car manufacturers calibrate the engines of their cars within the boundaries of a delicate equilibrium of optimal driveability and optimal exhaust emission levels. Engine calibration optimally fits test cycle conditions. However, the calibration does not fit common driving styles well. Through ecodriving however it is possible to approach the optimal conditions.

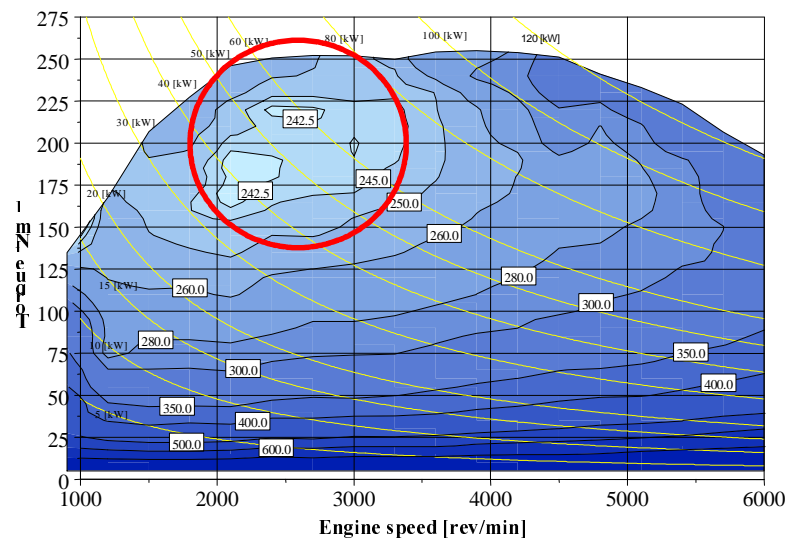


Figure 3.1: Engine map of an average modern petrol car

On the x-axis the engine speed is indicated. Engine speed is equivalent to the number of revolutions (revs) of the engine per minute. The driver may read off the actual engine speed on the revolution meter in the dashboard, when applicable.



Figure 3.2: Revolution meter indicating the actual engine speed

**Fuel-efficient part of the engine map**

On the y-axis the amount of torque of the engine is indicated. The amount of torque is equivalent to the amount of 'labour' an engine has to provide. For fuel injected cars (both diesel and petrol) a deep position of the accelerator at low revs means high torque.

The red circled area indicates the most fuel-efficient part of the engine map. To drive energy-efficiently one should try to keep the engine running as much as possible in the red circled area. This is what many of the ecodriving driving style tips are about, to make use of this energy-efficient area of the engine map, in compliance with traffic safety issues: energy efficiency should never prevail over traffic safety. Other tips make use of new technologies like fuel injection shut-off when the driver releases the accelerator pedal while leaving the car in gear (see tips in chapter 4).

**Fuel savings and greenhouse gas avoidance**

**3.2 Environmental, economical and personal benefits**

Ecodriving has the potential for considerable fuel savings and consequently reduced CO<sub>2</sub> emissions from traffic. Governmental policies so far give little attention to such measures though the EU and other prominent organisations have repeatedly concluded that they are potentially effective. The European Climate Change Programme (ECCP) calculated in 2001 a potential for driver education and ecodriving of at least 50 Mton CO<sub>2</sub> emission avoidance by 2010, the equivalent of 15 Million vehicles' annual amount of CO<sub>2</sub> emissions. Ecodriving turns out to be a promising low-cost "no regret" option that helps achieving Kyoto targets and to improve air quality.

Ecodriving reduces:

- fuel consumption;
- vehicle repairing and maintenance costs;
- stress;
- noise nuisance;
- local air pollutants;
- green house gasses;
- accident rates.

Ecodriving improves:

- traffic safety;
- comfort.

**Ecodriving is safer driving**

The safer driving behaviour results from:

- An anticipating driving style
- Maintaining a steady speed
- Less speeding
- Less overtaking
- Less stress/aggressiveness

## 4. The 'how' of ecodriving

In this chapter an overview is given of the most relevant tips on ecodriving. Each tip is accompanied by an explanation of why it contributes to a more rational and efficient way of driving.

These tips and tricks can be used in training programmes and communication and in all other activities concerning the awareness raising or implementation of ecodriving elements.

### Tip

#### 1. Shift up as soon as possible

Shift up as soon as possible. For petrol/LPG cars, shift up before 2,500 RPM, for diesel cars before 2,000 RPM.



Figure 4.1: Shift up before 2,000-2,500 RPM (Revolutions per minute = engine speed)

### Shifting

Part of the power of a passenger car's engine is lost by internal friction. These losses increase with engine speed. By driving at low engine speeds these losses remain limited, which reduces fuel consumption. The efficiency of a car engine also increases when a high engine load is used (giving more gas at low engine RPM (revolutions per minute)). Under these conditions the engine power is generated more efficiently. During acceleration the most efficient way of driving is therefore to shift up as soon as possible (at low engine speed) and to apply a relatively high load on the engine. Driving in a high gear automatically requires a high engine load to keep up with traffic.

### Petrol cars

In order to use the efficiency of a car engine in an optimal way, a maximum engine speed of 2,500 RPM for shifting is recommended for petrol/LPG engines. A rev(olution) counter is a useful aid to determine the right shifting moment.

### Diesel cars

Because diesel engines generally reach their optimal efficiency at lower engine speeds, a maximum engine speed of 2,000 RPM for shifting is recommended.

Note that the recommended numbers of revolutions for shifting are only rules of thumb. The optimal number of revolutions varies with different engines and according to different traffic and weather conditions. Information on the optimal numbers of revolutions for shifting might be found in the user manuals of most vehicles.

The shifting recommendations are anyhow applicable to cars with a manual gearbox, but they can also partly be applied by cars with an automatic transmission (see 'cars with an automatic gearbox'). The recommended way of shifting is in no way harmful to a properly

maintained engine.

**Tip**

**2. Maintain a steady speed**

Maintain a steady speed, using the highest gear possible.

**Steady speed**

When accelerating, energy in the fuel is used to propel the car. Part of this energy is wasted when you brake. You may experience this phenomenon after hard braking; the brakes have become very hot because of the transformation of propulsion energy into heat. Therefore, repeated acceleration and braking requires a lot of energy (fuel).

This can also be explained by the fact that the average car only needs 5 kW of power to drive at a steady speed of 50 km/h (at 120 km/h the amount of power needed increases to approximately 25 kW). The remaining 90% (or more) of the engine's power is only needed for acceleration or for driving at very high speeds. By driving steadily as much as possible, the wastage of energy and fuel remains limited. Try to avoid unnecessary acceleration and braking. Cruise control is a useful aid for smooth and steady driving.

Driving at steady speed not only increase fuel-economy, but it also has a positive effect on exhaust emissions, traffic safety, traffic flow and passenger comfort.

*High gear and low engine RPM*

**High gear at low engine speeds**

As already mentioned, the power needed to drive at a steady speed is rather low. Therefore, a high gear can be engaged without any problem at low engine speeds. This saves fuel and is in no way harmful to the engine, when it is properly maintained

In case of modern petrol engines the position of the accelerator pedal is not directly fixed to the fuel consumption. The accelerator pedal only operates the throttle/butterfly valve and consequently only the air quantity. Depending on the position of the accelerator pedal and several other parameters like e.g. the momentary number of revolutions and the air temperature, the motor management system calculates the fuel quantity to be injected. Lower levels of revolutions in generally mean a lower fuel consumption.

**Tip**

**3. Anticipate traffic flow**

Look ahead as far as possible and anticipate to surrounding traffic and traffic situations.

**Steady and smooth driving**

In order to drive at a steady speed (as discussed in tip 2), it is important to anticipate to surrounding traffic and traffic situations to avoid unnecessary braking and accelerating. For example, when approaching traffic lights, when overtaking traffic like cyclists or agricultural vehicles or when driving on busy highways, anticipating to other traffic can have a big influence on how steadily and smoothly you drive.



Figure 4.2: Anticipate surrounding traffic and traffic situations

Many situations can already be noticed far ahead, long before approaching the situation itself. In case you use cruise control (see tip 2) you will have to anticipate even more intensely to be able to take full advantage of its benefits.

**Tip**

**Deceleration**

**4. Decelerate smoothly**

When you have to slow down or to stop, decelerate smoothly by releasing the accelerator in time, leaving the car in gear.

**Fuel injected petrol and diesel cars**

Petrol and diesel cars manufactured from 1990 onwards are generally equipped with fuel injection combined with an electronic function that cuts off the engine's fuel supply under engine braking (accelerator released and a gear engaged). The advantages of this fuel cut off function can be used by releasing the accelerator in time, for example when approaching traffic lights. This also reduces wear and tear on the brakes, reducing maintenance costs. Engine braking not only has a positive effect on fuel consumption, but also on exhaust emissions, traffic safety, traffic flow and passenger comfort.

**Carburettor operated petrol cars and diesel cars**

In case of less modern cars with a carburettor and older diesel cars (generally manufactured before 1990), for fuel efficiency it makes no difference whether you decelerate with gears engaged or disengaged, for the carburettor is a mechanical device that is not equipped with electronics to cut off fuel supply. These cars consume an equal amount of fuel under engine braking and when idling. However, releasing the accelerator in time still avoids hard braking and improves the durability of the brakes.

**Additional tips**

**5. Additional Tips and Tricks**

**a) Travel on a hill**

In mountainous regions, it is very important to command the right acceleration and brake manipulation to save considerable fuel.

**Hill and mountain driving**

*Uphill:* The target is to travel in the highest possible gear with almost full pressure on the accelerator pedal. It is frequently argued that this level of pressure with low revolutions is too much. Car manufactures build the car in a way that you can travel constantly at 1,000 rpm at full load.

## b) Switch off the engine at short stops

### Engine switch off when idling

Switch off the engine at short stops. For example at a railway crossing, at a traffic light, or while waiting for someone. When switching on the engine again, do not press the accelerator.



Figure 4.3: Avoid idling

### Idling with modern engines

#### *Modern cars*

The fuel consumption of a modern engine during idling is about 0.5 litres per hour, depending on engine type. Therefore switching off the engine in appropriate situations can soon lead to interesting fuel savings. When you expect to be halted for more than 1 minute it already makes sense to switch off the engine. Please again bear in mind that energy efficiency should never prevail over traffic safety. Therefore the engine should only be switched off in situations where there is no risk to traffic safety. This means for example that in case of a red traffic light it is not recommended to switch off the engine when you are first in a row.

### Idling with older cars

#### *Older cars*

Older petrol cars with a carburettor (generally manufactured before 1990) sometimes consume an additional amount of fuel when switching on the engine. In case of carburettor cars it therefore from an energy-efficiency point of view makes less sense to switch off the engine at short stops.

### Engine switch on without pressing the accelerator

## c) Switching on the engine

When switching on a modern fuel injected engine (generally manufactured from 1990 onwards), you should not press the accelerator pedal. The electronic engine management system takes care of a correct start and amount of injected fuel based on the measurement of a lot of parameters. Pressing the accelerator only 'confuses' the system, which makes starting harder and increases both fuel consumption and exhaust emissions.

In older petrol cars with a carburettor (generally manufactured before 1990), you sometimes have to press the accelerator a little for switching on the engine.

### **Curve driving techniques**

#### **d) Driving round curves**

The correct method to drive around curves depends on several aspects including the speed of approach, the weather, the nature of the curve and the condition of the road. When approaching the curve the speed should be reduced by releasing the accelerator and manipulating the brake rather than through engaging a lower gear.

In general, it can be said that when applying an anticipatory driving style the vehicle can be manipulated to approach the curve with the correct speed, possibly without needing to use the brakes. Therefore, the highest possible gear should again be used for manipulating the curve. Using full acceleration with short, sharp pressure on the brakes, and then high revolutions to speed up again round a curve is not only bad in terms of fuel consumption but also for road safety. When manoeuvring the vehicle in relation to the road, heavy use of the brakes causes a distinct transfer of weight on the axes, which can very easily result in malfunctions and accidents.

### **Additional weight**

#### **e) Weight**

The weight of the vehicle has a substantial effect on the fuel consumption. This goes for the weight of the car itself as well as for the added weight in e.g. the boot of a car. An additional load of 100 kg on a medium-class vehicle of 1,500 kg results in an increase in consumption of about 6.7%.

Hence, the additional weight in a vehicle should be kept to a minimum. Typical additional weight found in vehicles includes the usual unnecessary burdens, snow chains (when weather conditions do not ask for them) or reserve tanks which are too large.

### **Air resistance**

#### **f) Aerodynamics**

The second very important factor influencing fuel consumption is aerodynamics. All vehicles are put through thorough testing in wind tunnels to optimise their aerodynamic quality. Additional parts to the basic vehicle which clearly impede the aerodynamic quality include such things as roof racks and bikes on top at the rear of the car. The required performance in terms of speed depends amongst others on the air resistance.



Figure 4.4: Even aerodynamic roof racks increase fuel consumption



A roof rack can greatly increase the c-value (measure for aerodynamics) so that the consumption is noticeably increased, especially at a high speed. At a speed of 120km/h, it can cause at least a 20% increase in the amount of fuel consumption (about € 200,- per year). A journey should never be made with a ski-carrier or general roof box if they are not really needed. Other inappropriate parts can also badly affect the aerodynamics of a vehicle, such as large aerials. Another important point concerns open windows, which cause additional currents and so reduce aerodynamic quality.

### **g) Tyre Pressures**

Check the tyre pressures of your car once a month.

#### **Rolling resistance**

An important part of the energy for propelling a car is needed to overcome the rolling resistance of the tyres. 25% too low tyre pressures increases rolling resistance by 10% and fuel consumption by 2%. Too low tyre pressure also has unfavourable effects on vehicle handling and braking distance.

#### **Monthly check of tyre pressures**

To ensure correct tyre pressures, you need to check your car's tyres at least once a month. Tyre pressures must be checked at cold tyres. This means that you have driven less than three kilometres, otherwise you have to wait for about 10 minutes to let the tyres cool down. Car manufacturers always recommend two different tyre pressures: one for driving unloaded and/or mainly at normal speeds and one for driving fully loaded and/or mainly at high speeds. These pressure indications can be found in the instruction manual, but often also on a label at the door post or at the fuel filling flap of your car.

Nowadays newly sold passenger cars of several makes are already equipped with an electronic system that continually monitors the tyre pressures. Such systems can also be retrofitted in other cars.



Figure 4.5: Correct tyre pressures improve fuel-efficiency and road safety

### **h) Fuel consuming accessories**

Accessories such as air-conditioning systems, big HiFi-systems and rear-window heaters can increase fuel consumption significantly.

#### **Air-conditioners**

It is recommended to limit the use of the air-conditioner to very hot days only and to have it not tuned in on too low temperatures, favourably not lower than 23 degrees. This is also recommendable from a point of healthiness. Too big differences in temperatures inside and outside the car might lead to driver and passengers catching a cold.



Figure 4.6: Use the air-conditioner consciously

In times when it is necessary to cool down the car interior from temperatures above 25°, especially when stationary in traffic, it has been calculated that consumption may rise up to 20%. In general switching on the air conditioner results in a 10% rise of fuel consumption on average.

**i) Make use of fuel saving in-car devices**

Make use of fuel saving in-car devices when available, like rev(olution) counter, cruise control and on-board computer. Modern cars are often equipped with devices that support efficient, safe and comfortable driving.

**Revolution counter**

*Revolution counter*

A rev(olution) counter helps the driver to keep the engine at efficient engine speeds and as a result to optimise the fuel consumption.

**Cruise control**

*Cruise control*

Cruise control makes it easy for you to maintain a steady speed and to avoid fines for unperceived speeding. This saves fuel and exhaust emissions and moreover, contributes to a relaxed driving style.

**On-board computer**

*On-board computer*

Nowadays many cars are equipped with an on-board computer with a variety of functions, such as average and actual fuel consumption. When tuned in the function of actual fuel consumption provides the driver with immediate feedback on his or her driving behaviour and the related fuel consumption.



Figure 4.7: Display of the actual fuel consumption through the on-boardcomputer

**Econometers and shift indicators**

*Econometers and shift indicators*

An econometer is a fuel consumption meter based on a vacuum working principle: in cars with a carburettor the amount of vacuum is an indicator for the amount of fuel consumption. A shift indicator shows the driver when it is most fuel-efficient to shift up.

Econometers and shift indicators can be found in some, mostly older cars of the seventies and early eighties. But they reappear in some newly sold cars, however a little more sophisticated for making use of data of the engine management system.

Econometers and shift indicators support fuel-efficient driving behaviour.

**Speed and RPM limiters**

*Speed limiters and/or RPM limiters*

Speed limiters and/or RPM limiters help avoiding unperceived speeding and excessive engine speeds. The parameters for speed and rev limitations can be determined by legislation, fleet owners or car manufacturers and programmed into the device. In general these limitations can not be overruled by the driver. The use of speed limiters is quite common for trucks and delivery vans. Fleet owners often choose to fit in speed and rev limiters in vehicles of current fleet to reduce fuel consumption, accidents and speeding fines and also to boost their corporate image.

**5% less fuel on average**

Results from several large-scale field tests show that all devices mentioned save about 5% fuel. Combined with driving style training the benefits are significantly higher.

## 5. Facts and figures: Best practices

This chapter comprises a few ecodriving best practices from several European countries. The best practices supply figures for 'proven' effects of ecodriving activities.

### Transport companies, the Netherlands

#### Cost savings for transport companies

In the Netherlands a consultancy has carried out a secondary analysis on data collected from Dutch transport companies over the period 1995-2003. The introduction and implementation of substantial ecodriving activities in transport companies (driver training, fuel registration, feedback mechanisms) turns out to result in cost savings of approximately € 1 per 100 kilometres.

<i>Indicator</i>	<i>Savings per indicator (%)</i>	<i>Cost savings (€ per 100 km)</i>
Fuel consumption	2.1	0.40
Maintenance	3.5	0.19
Accident damage	14.2	0.39
Total	-	0.98

(Source: NEA, 2005)

Table 5.1: Overall effects of the implementation of ecodriving activities in road transport (1995-2003)

For Dutch national transportation (80,000 km per year) this means average cost savings of about € 800 per year per vehicle. For Dutch international transport the cost savings count up to € 1,400 per year per vehicle.

### Car panel Consumentenbond, the Netherlands

#### Long-term fuel reduction of 7% on average

In 2002 a study was held using the car panel of the Dutch Consumer Organisation. This car panel consists of about 6,000 (mostly) private car drivers. In the study the members were, on the basis of self reported behaviour based on the most important ecodriving tips, divided into ecodrivers and non-ecodrivers. These groups were compared with each other for over a year on a.o. fuel consumption. The results proved that over a period of more than a year ecodrivers used 7% less fuel than non-ecodrivers.

### RACC (Real Catalonia Automobile Club), Spain

#### 13.4% average fuel reduction after training

RACC (Real Catalonia Automobile Club) is one of the most important automobile clubs in Spain, involving more than a million members. RACC is also the largest insurance brokerage. In October 2003 RACC held a formation pilot on the ecodriving techniques with private drivers (Focus Group) to test people's interest on these techniques. The results were very positive and average fuel savings of 13.4% were achieved.

### Hamburger Wasserwerke, Germany

#### 5.8% fuel reduction, 40% damage reduction

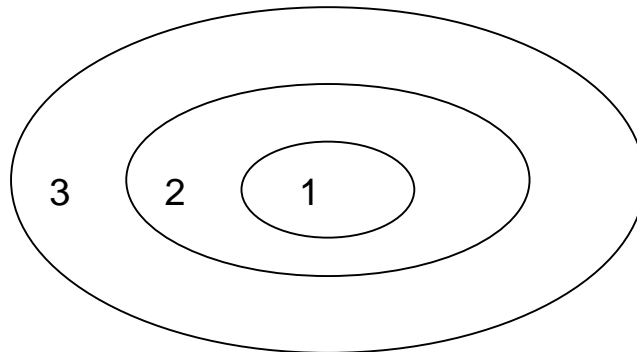
At the end of 2003, 91 delivery van drivers of the Hamburger Wasserwerke (HW) were trained in ecodriving. After the training fuel consumption and accident rates were monitored for half a year. It was found, that the fuel consumption of the car park had fallen by 5.8%. This saves the HW about 10,000 litres of fuel per year. Moreover, the accident damage rates were reduced by 40%.

## 6. How to implement ecodriving

There are many different ways in which organisations can undertake activities in the field of ecodriving. There are also several target groups for which to develop activities:

### Several target groups

1. Own personnel;
2. Direct contacts of organisations or municipalities (local or regional entrepreneurs, relevant co-operation partners) – often intermediary organisations;
3. Citizens and end consumers.



### Various possible scales in ecodriving activities

Activities can either be small or large scale, and anything in between. An organisation or municipality can start by simply informing their own staff on the benefits of and tips on ecodriving. They can also train all their staff. A municipality can involve local entrepreneurs in ecodriving activities, a company could seek co-operation with other companies in the same region or business compound. And the activities with most reach and scale are those involving local citizens, up to communicating to all consumers/drivers in a country and implementing ecodriving in driving school curricula – thus setting up a national or regional programme on ecodriving.

### 6.1 Activities on ecodriving

Underneath clusters of activities can be found, enlightened by examples from various countries. Different types of activities can be distinguished:

1. Awareness raising;
2. Dissemination and distribution of information;
3. Training programmes.

The optimal scenario is a blend of these activities.

#### Awareness raising

### Awareness raising

This can vary from attracting attention through information or through software applications (virtual trainers) up and on to the use of fuel-saving in-car devices. Possible activities:

- Make an overview of facts and figures (e.g. based on this manual).
- Disseminate manuals to easily reachable target groups, such as government officials or civil servants who spend a lot of time on the road.
- Give presentations on the benefits of ecodriving in meetings.

- Deploy the virtual trainer (see later in this chapter for more information on this device) during meetings and days that the organisation opens its doors for the public/customers.
- Record the fuel consumption figures of a group of people for a certain time period, then train these people and measure the effects. Make the effects known to your target groups.
- Organise a competition in a magazine, in which free driving style trainings can be won.
- Install on-board computers with (amongst others) momentaneous fuel consumption feedback in company cars.

Some examples of activities in the field of awareness raising:

### **Examples of awareness raising**

- Deployment of the ecodriving simulator during the Energy Theatre in Den Bosch, the Netherlands in March 2005, with a total of 400 visitors. This event gives information on various ways of saving energy.
- Free training courses to be won in a Dutch regional newspaper. Prize winners had to monitor their fuel consumption for a period before and after the training. In the newspaper there were various articles on the action and on the actual results of the ecodriving training (last article named 'Het Gelijk van Het Nieuwe Rijden' or 'the rightness of ecodriving').
- Ecodriving competition for drivers from all over Austria (with a special competetion for young drivers). The winner got € 4,000 to € 5,000 in cash and got along with a fuel consumption of only 3,76 l/100 km (in a car with a test cycle consumption of 6 l/100 km).
- A present pack of a large bank in Spain (La Caixa) that offers ecodriving courses for free to people who open a specific account.

### **Dissemination and distribution of information**

This can vary from communication of the message through brochures, websites, press conferences, free publicity, TV and radio broadcasting as well as making use of intermediary partners to convey the message.

Possible activities:

### **Dissemination and distribution of information**

- Get articles included in magazines and newspapers.
- Develop and distribute a brochure on ecodriving. Municipalities for example could hand out the brochure when people come to renew their driving license (when applicable), garages could disseminate them when people come to have their car serviced, etc.
- Develop posters and give-aways for meetings and exhibitions.
- Combine information on ecodriving with information on e.g. the use of public transport or car sharing.
- Make sure that ecodriving tips, facts and figures are available for interested persons/organisations, e.g. by putting the information on a website. In this way, relevant information is easily accessible.
- Give information on ecodriving to driving schools.
- Use existing bodies to distribute the tips, e.g. on government websites or environmental helpdesks.
- Make a list of ecodriving trainers and make this publicly available, e.g. through a website.

- Invite well-known people (whom the target group consider trustworthy) to be trained in ecodriving and also invite the press to this event.

## Examples of communication

Some examples of communication activities:

- Spanish brochure 'Conducción eficiente' covering tips and technical information on an energy-efficient driving style.
- Dutch brochure 'Meer plezier achter het stuur' covering driving style tips and ecodriving benefits. Easy-to-read brochure for the general public. Is also used in the Dutch mass medial campaign on ecodriving (with TV and radio broadcasts) and a website ([www.hetnieuwerijden.nl](http://www.hetnieuwerijden.nl)).
- English brochure 'Fuel Saving Tips' distributed by the English Department for Transportation.
- Austrian 'Sprittspar-Initiative' from 2004 onwards, a PR campaign with radiosspots, print media coverage, TV broadcasts, folders and flyers, website, posters, etc. ([www.sprittspar.at](http://www.sprittspar.at)).
- [www.milieuentraal.nl](http://www.milieuentraal.nl). A Dutch website with advises and tips on how to spare the environment, including transport advises.
- Dissemination of a large number of DVDs in Spain, jointly produced by IDEA and Mapfre insurance company.
- Article in the ANWB (Dutch Touring Club) magazine reporting the results of a competition ride between an 'ecodriver' and a common 'old style driver'.

## Training programmes

Training programmes can range from actual on-the-road training courses under close supervision of a driving instructor to individual computer games.

## On-the-road training courses

*On-the-road training courses:*

The most effective way of learning ecodriving is taking an on-the-road training course. The duration of ecodriving training courses varies from several hours to one or more days. A typical ecodriving training course comprises a driving test prior to a theory training session in which the principles of ecodriving are taught. After the theory training session a second driving test is held. After the second driving tests the results of both trips are analysed and compared

Characteristics:

- Relatively expensive;
- Small number of people are willing to invest money;
- Small number of people can be reached due to limited capacity;
- High impact of training.

In several countries there are also ecodriving training programmes available for the education and certification of specialised ecodriving trainers. These certified ecodriving trainers are exclusively allowed to (re-)educate other licensed drivers.

## **Simulator training courses**

### *Simulator training courses:*

Training simulators offer several possibilities and software programmes for the training of ecodriving. Some simulators are mobile while others are not. The advantage of mobile simulators is that they can easily be applied at events where people can get acquainted with the principles of ecodriving. Some people might get curious to take an ecodriving course on the road. Operators of large fleets might use a simulator for the education of drivers at a reasonable costs. Big advantage of simulators is that drivers can be brought into standardised situations which allows easy comparisons of fuel consumption and driving behaviour.

### Characteristics:

- Less expensive;
- Larger (medium) number of people can be reached;
- People who were not interested at first may become interested;
- Medium impact of training.

## **Virtual training courses**

### *Virtual training courses on a pc:*

Computer applications on-line or installed on a personal computer serve as an appetizer, especially attractive to the target group "Youths". Young people can thus find out about ecodriving even before they reach driving age. Games can also serve as an image building instrument and can be used as give aways. Big advantage of ecodriving software applications is that a very large number of both novice drivers and licensed drivers can be reached.

### Characteristics:

- Even less expensive;
- On CD-ROM and internet;
- A very large number of people can be reached;
- People who were not interested at first may become interested;
- Also appeals to younger drivers;
- Low impact of training.

### Possible activities:

- When ecodriving training courses do not yet exist in a country, expertise from other countries can be used to train local ecodriving instructors, thus creating training supply.
- Train own personnel in ecodriving (either on the road or by simulator) and publish the results in the company magazine.
- Train driving instructors in ecodriving.
- Train bus drivers in ecodriving (even up to including criteria in invitations for putting out regional transport in a tender).
- Organise a tour among company subsidiaries or municipalities with a mobile simulator.

## **Examples of training programmes**

### Some examples of training programmes:

- Safe and Fuel Efficient Driving Standard (SAFED) – Good Practice Guide 2100. This guide explains the content and delivery of the one-day SAFED training course, designed to improve safe and fuel-efficient driving ([www.safed.co.uk](http://www.safed.co.uk)).
- Ecodriving training of the drivers of the Spanish Postal Service Fleet (Correos), both in theory and practice.
- Ecodriving training on the road of policy makers within the



**Collaboration with intermediary organisations**

**6.2 Collaboration and participation**

It is recommended to collaborate with intermediary organisations that operate on behalf of your target group. Usually people accept the ecodriving message better from trustworthy and independent companies and organisations (that they expect to get information from on driving or on cars) than from governmental or environmental organisations. Furthermore these organisations have communication channels at their disposal that can be used to convey the ecodriving message to the target groups.

Possible collaboration partners:

- Local public transportation companies;
- Local garages, tyre service companies and car dealers;
- Local driving schools;
- Consumer organisations;
- Automobile clubs;
- Insurance companies;
- Environmental organisations;
- Tourist organisations;
- Etc.

**6.3 Setting up national or regional programmes on ecodriving**

**Setting up national or regional programmes**

For the development of integrated national or regional programmes on ecodriving one may take the following steps:

- a) Development of the provision of high quality training courses for the re-education of licensed drivers;
- b) Development of bespoke training courses for heterogenous target groups;
- c) Development of high quality training courses for the education and certification of specialised ecodriving trainers;
- d) Product placement of ecodriving and content of the message;
- e) Collaboration with a network of partners;
- f) Continuous monitoring and evaluation of the programme;
- g) Using windows of opportunities;
- h) Safeguarding quality standards for trainer education;
- i) Development of business opportunities for educated trainers.

**a) Development of the provision of high quality training courses**

**High quality training courses**

In the starting stage of an ecodriving programme it is important to develop the provision of high quality and sufficient supply of training courses. It is also important to supervise on the quality standards of these training courses. Bad quality training will have a direct negative impact. Not only on the provider of the training courses but also on the ecodriving programme and as a result also on (emissions) targets of the programme.

<b>Bespoke training courses</b>	<p><b>b) Development of bespoke training courses for heterogeneous target groups</b></p> <p>It is important to develop a variety of training courses that meet the demands and interests of heterogeneous target groups. First of all the variety concerns the content of the training programme. On the one hand ecodriving 'pure' training courses can be offered that are entirely dealing with ecodriving. On the other hand ecodriving 'inside' training courses can be offered that are only partly dealing with ecodriving. These include driver abilities courses such as skid and safety courses.</p> <p>Secondly the variety concerns the training facilities such as training on the road, on a simulator or through a virtual trainer software application. Thirdly the variety concerns the length of the training programme. This may vary from one-hour training courses through one or more day courses.</p>
<b>Certification of ecodriving trainers</b>	<p><b>c) Development of high quality training courses for the education and certification of specialised ecodriving trainers</b></p> <p>It is recommended to set up high quality training courses for the education and certification of specialised ecodriving trainers. These certified ecodriving trainers are exclusively allowed to (re-)educate licensed drivers.</p>
<b>Product placement and message</b>	<p><b>d) Product placement and content of the message</b></p> <p>Ecodriving should be product placed as a smart driving style, which is adapted to modern engine technology. In case of a programme it is recommended to use logos and a house style. Focus on the benefits and foremost on the cost savings and traffic safety improvement. Do not focus too much on environmental and green issues. Concerning their cars people are less environmentally aware than we would like them to be. Additionally, do not exaggerate. Limit the message in general communication to those tips that are rather easily accepted to be useful and informative. Only provide the more motivated ones, mostly those who have taken an on-the-road training course, with more detailed tips to optimise an energy-efficient driving style.</p>
<b>Network of partnerships</b>	<p><b>e) Collaboration with a network of partnerships</b></p> <p>It is recommended to establish a wide network of partners and multipliers that operate as intermediaries to the target groups. You may think of automobile and consumer associations, oil companies, tourist clubs, branch organisations and providers of driving style training programmes.</p>
<b>Monitoring and evaluation</b>	<p><b>f) Continuous monitoring and evaluation of the programme</b></p> <p>You have to demonstrate and improve the results of your programme. Therefore periodic evaluation and monitoring to turn your 'soft' behavioural activities into 'hard' evidence is essential. This is a must in order to get public support and financing in the long run. The results of the Dutch and Swiss programmes show that implementing ecodriving activities and programmes is a relatively cheap and no-regret measure to reduce CO<sub>2</sub> emissions. Chapter 7 will address the evaluation and monitoring methodology in more detail.</p>

**Windows of opportunities**

**g) Using windows of opportunities**

The legal, economic or social framework might change and give you new opportunities. The management of the programme should be flexible enough to take up these opportunities and integrate them. In Finland, the introduction of the second phase of the new drivers' education has been used to implement ecodriving in drivers' education. The acceptance of a programme can be improved by fiscal instruments and tax exemption for e.g. fuel saving in-car devices.

**Safeguarding quality standards**

**h) Safeguarding quality standards for trainer education**

An important step is to get ecodriving into the regular further education of driving instructors. From the beginning you have to develop and safeguard the quality of this training.

**Business opportunities for trainers**

**i) Development of business opportunities for educated trainers**

You will get more instructors trained in ecodriving, if you are able to develop business opportunities for them. The Swiss ecodriving programme pays ecodriving trainers for every person trained. Alternatively you may try to establish ecodriving training as a mandatory education for instructors.

## 7. Monitoring and evaluation of CO<sub>2</sub> emissions

It is recommended to monitor the results of the activities that you undertake in the field of ecodriving. The results can be used to prove that behavioural activities on ecodriving can really reduce CO<sub>2</sub> emissions.

### 7.1 Project level

#### *Direct*

Direct projects are e.g. training courses in ecodriving. You know exactly what the effect of the activity is and through the measuring of fuel consumption and kilometres driven you can calculate the amount of CO<sub>2</sub> emission avoidance.

It is recommended to keep other variables like car type and travel type constant. Sometimes fuel consumption per car or lorry is difficult to calculate because various people drive in the same vehicle. If this is the case, try to make sure that all users of the vehicle have had the same information or training.

Fuel consumption per km is calculated by dividing the fuel consumption through the number of km driven by that person. This needs to be calculated before and after the project, preferably 3 months before and after. The difference in fuel consumption multiplied by the amount of km driven in the project results in the amount of litres reduced by the project. Multiplied by the CO<sub>2</sub> emission factor per fuel type this results in the amount of CO<sub>2</sub> emission reduced by the project.

#### **How to monitor direct projects**

<i>CO<sub>2</sub> emission factor per fuel type</i>	
LPG	1,6 kg per litre
Diesel	2,6 kg per litre
Petrol	2,4 kg per litre

Table 7.1: CO<sub>2</sub> emissions factor per fuel type

#### *Indirect*

Indirect projects are e.g. communication campaigns. You do not know the exact effect of your activity but you can make calculations using the best assumptions possible.

Avoided CO<sub>2</sub> emissions = participation rate \* effectiveness \* efficiency

#### **How to monitor indirect projects**

- *Participation rate*: the number of people participating in the project multiplied by the average kilometres driven per person per year. This results in the total amount of kilometres that were targeted in the project;
- *Effectiveness*: the actual change in behaviour of a person participating in a project or other kind of action. Participation rate multiplied by effectiveness results in the amount of kilometres for which a behavioural change was reached;
- *Efficiency rates*: the reduction rates of CO<sub>2</sub> emissions by changing driving style and purchasing behaviour.

## Calculating CO<sub>2</sub> emission avoidance

Information needed to calculate CO<sub>2</sub> emission avoidance:

- Number of persons reached with the activity;
- Average kilometres driven by these persons;
- Effectiveness rate (in %);
- CO<sub>2</sub> emissions per litre fuel;
- Efficiency rate (in %);
- Fuel consumption per kilometre;
- Fuel type: petrol, diesel, LPG and the amount of CO<sub>2</sub> emission

## Monitoring of an ecodriving programme

### 7.2 Programme level

In the Netherlands, there is much experience with the monitoring and evaluation of ecodriving activities. A monitoring method has been developed and tested. The premises of the method are approved by the Dutch Governmental institution on Environment Protection RIVM (Rijksinstituut voor Milieuhygiëne). The monitoring method is an essential tool in a step-by-step evaluation process on programme level.

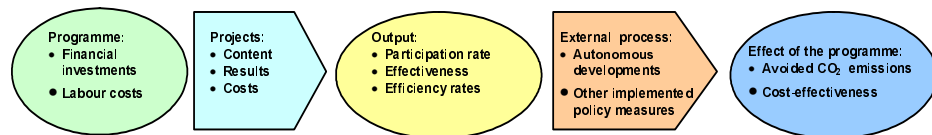


Figure 7.1: Recommended steps to be taken in the evaluation of an ecodriving programme

Because the ecodriving activities partly concern long-term investments, they keep influencing the CO<sub>2</sub> emissions in the years to come. To relate investments to avoided CO<sub>2</sub> emissions an annuity computation is applied, including an interest rate for the money invested. In using an annuity method investments are spread over a long period of time and compared to the mean avoided CO<sub>2</sub> emissions over the same period of time.

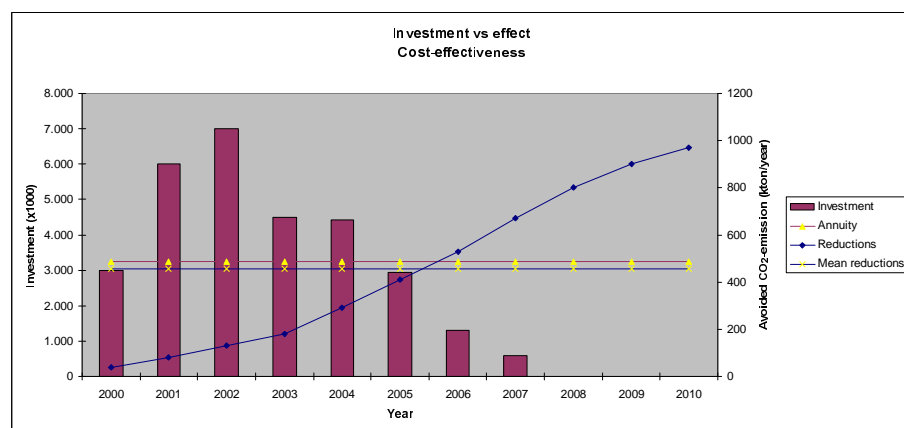


Figure 7.2: Cost-effectiveness of the Dutch ecodriving programme

## Cost-effectiveness

Over a period of ten years the cost-effectiveness of the ecodriving programme in the Netherlands results in € 7 to a maximum of € 4.5 per ton avoided CO<sub>2</sub> emissions.

**Converting 'soft'  
activities into  
'hard' data**

The results of the Netherlands ecodriving programme show that it is possible to assess 'hard' data on a 'soft' issue like influencing purchasing and driving behaviour. From a policy point of view it is evident that the government gets value for money by implementing an ecodriving programme. The implementation of no-regret ecodriving programmes, along with technical measures, proves to be successful in meeting policy targets on the reduction of CO<sub>2</sub> emissions.

## 8. Further information

Further information on ecodriving can be found on the website [www.ecodrive.org](http://www.ecodrive.org).



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On the [www.ecodrive.org](http://www.ecodrive.org) site you will find additional weblinks to ecodriving programmes and projects of most EU countries.