Fuel saving with Eco-Driving – efforts to create the "3-litre driver" in Austria

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Abstract

Eco-Driving is a modern driving-style that reduces fuel consumption, greenhouse gas emissions and accident rates. Eco-driving can be one way to save energy in transport by trying to create the "3-litre driver" instead of the "3-litre car", which we are still waiting for.

In 2004, the Austrian Ministry of Environment, in co-operation with the Austrian Energy Agency and the Association of Driving Schools started aiming to accelerate the establishment of Eco-Driving in Austria. The following parts form the Eco-Driving initiative:

- Eco-Driving Competition: Car drivers in Austria are invited to take part in this competition with an extra valuation for novice drivers.
- Eco-Driving Certificate for driver trainers: In pilot seminars 30 driving teachers have been certified to Eco-Driving-trainers with a certain quality standard (based on European experience).
- Cooperation with fleet operators: Professional drivers in fleets are invited to take part in an Eco-Driving training. Some 100 drivers have been trained in pilot seminars up to now with promising results in terms of CO_2-emission reduction, increased driving comfort and less fuel consumption. Furthermore 4,800 locomotive drivers of the "ÖBB-Traktion GmbH" have been trained. Through their trainings 2,600 tons of CO_2 can be saved every year.
- Awareness raising, marketing and public relations: All parts of the programme are accompanied by radio spots, print media coverage, leaflets with fuel economy tips etc.

For the 2005 campaign a national representative inquiry came up with very positive results of the Austrian wide campaign, therefore in 2006 an again enlarged national Eco-Driving-campaign and competition was organised.

Introduction

WHAT IS ECO-DRIVING [1]

Eco-Driving is very easy. It's a new driving style that is adapted to modern engine technology and allows driving in low revolutions per minute. With Eco-Driving you can sit relaxed behind the steering wheel, you have more comfort, a better overview over the traffic situation and more traffic safety. And you can save a lot of fuel and money!

What are the benefits of Eco-Driving?

1. When driving in low revolutions this can lead to a **consumption reduction** up to 15 % directly after training and about 5% in the long run. An example (see Fig. 1) shows that when driving a steady speed of 60 km/h with a 2.5 litre petrol engine you can save 35 % fuel using the fifth instead of the third gear.
2. Eco-Driving **reduces noise pollutions**. The engine noise of one car driving with 4,000 rpm (revolutions per minute)

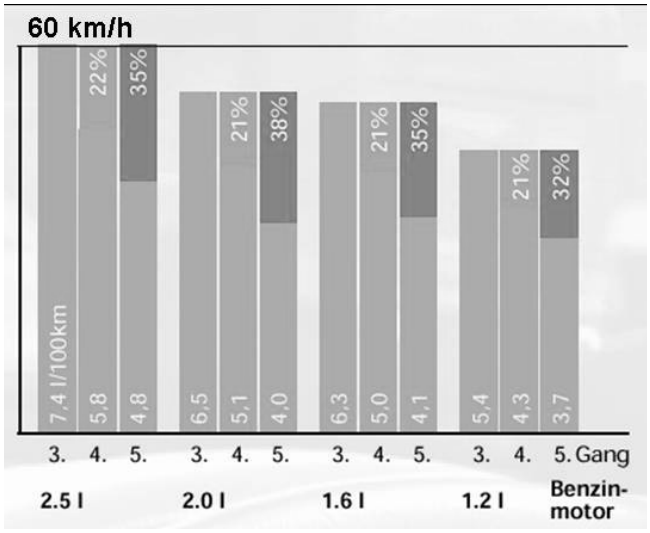

Fig. 1: Fuel consumption reduction with low revolutions

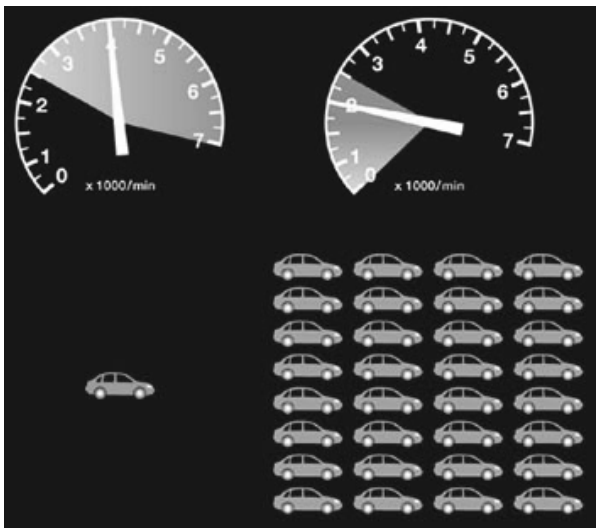

Fig. 2: Noise pollutions

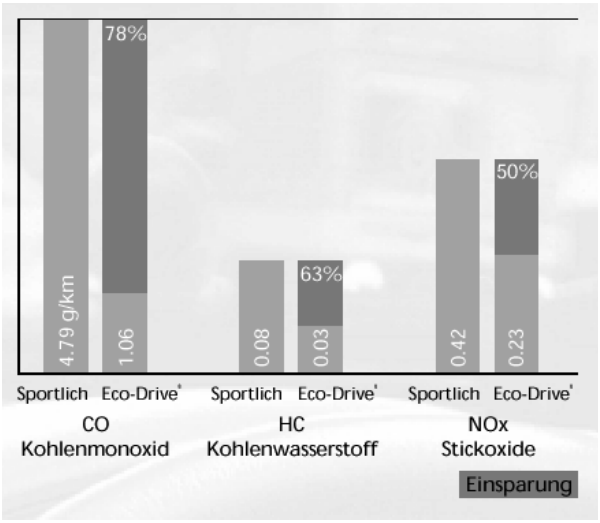

Fig. 3: Reduction of CO, HC and NOx

equals the engine noise of 32 cars at 2,000 rpm (see Fig. 2). Thus, Eco-Driving reduces one of the main problems of traffic in urban areas.

3. When saving fuel you directly **save CO_2-emissions**. But also **other air pollutants** can be reduced, for example carbon monoxide, hydrocarbon or NOx (see Fig. 3).

4. Eco-Driving **reduces** not only fuel **costs**, but also costs for maintenance and costs for repairing cars after accidents. Pilot projects have shown that accident costs can be reduced by 20 %.

Best practises

- Eleven month after Eco-Driving trainings, the German company "HAMBURGER WASSERWERKE"[2] effected fuel consumption reductions of more than 6 %, accidents and related costs could be diminished by more than 25 %.
- The "CANON" company in Switzerland trained the Eco-Driving style with 350 service car drivers. The drivers reduced fuel consumption by 6.1 %, had 22 % more km per accident and 35 % less accidents in total.

The golden rules of Eco-Driving

- Shift up as soon as possible

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.

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

- Maintain a steady speed, using the highest gear possible

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.

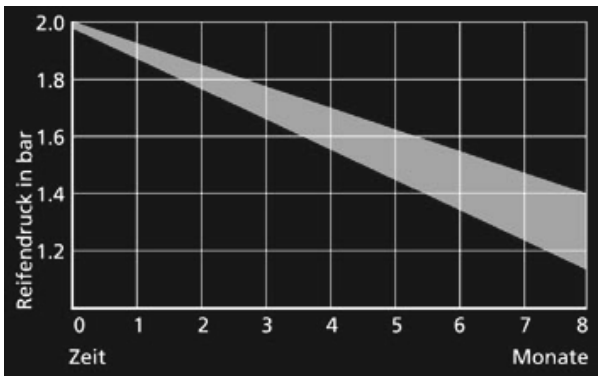

Fig. 4: Decreasing tyre pressure

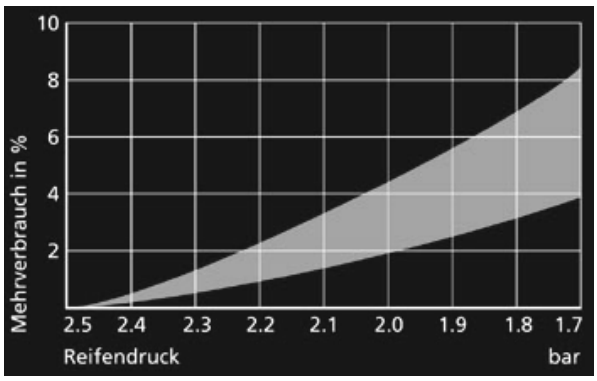

Fig. 5: Tyre pressure and fuel consumption

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.

- Anticipate traffic flow

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

- Decelerate smoothly

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

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, as being described in recommendation 4, not only has a positive effect on fuel consumption, but also on exhaust emissions, traffic safety, traffic flow and passenger comfort.

- Switch off the engine at short stops

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

- Get rid of surplus weight

Of the factors influencing fuel consumption, weight of the vehicle is the most important. Thus, with a load of 100 kg on a medium-class vehicle of 1,500 kg weight, there is an increase in consumption of about 6.7 %. With one full tank being 3.5 litres, in one year this adds up to an increased expenditure of 100 Euro. Considerable are the impacts of surplus weight when you are driving in urban areas (stop + go).

Hence, the minimal additional weight should be used in one's private automobile. Typical additional weight found in vehicles include the usual unnecessary burdens, snow chains, or reserve tanks which are too large.

- Check the tire pressure once a month

An important part of the energy for propelling a car is needed to overcome the rolling resistance of the tyres. 25 % too low tyre pressure increases rolling resistance by 10 % and fuel consumption by 2 % (see Fig. 5). Too low tyre pressure also has unfavourable effects on vehicle handling and braking distance.

To ensure correct tyre pressure, you need to check your car's tyres at least once a month. As you can see in Fig. 4, the tyre pressure decreases continuously. 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 pressure. Such systems can also be fitted in as an accessory in other cars.

- Reduce the use of fuel consuming devices

Air-conditioning systems, big HiFi-systems and heaters can increase fuel consumption significantly. In average the use of an air condition leads to 2 litres more fuel consumption in 100 km.

- Aerodynamics

Another 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 roofboxes and extra aerials. On Fig. 6 it can be seen that the required performance in terms of speed depends on the air resistance.

A ski-carrier 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 120 km/h, it can cause at least a 20 % increase in the amount of fuel consumption (about 200 Euro 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

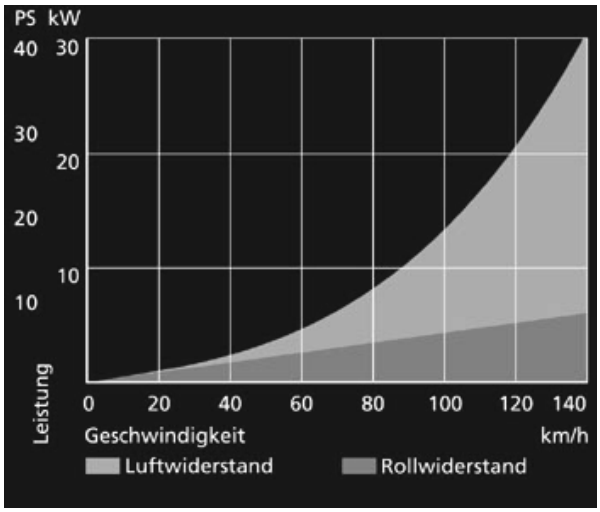

Fig. 6: Air resistance

open windows, which cause additional currents and so reduce aerodynamic quality.

- Make use of in-car devices

Make use of in-car devices, if present, like rev counter, cruise control and on-board computer. Modern cars are often equipped with devices that support efficient, safe and comfortable driving.

Background to Eco-Driving in Austria [2]

The CO_2-emissions of transport constantly increase in Austria (and the entire European Union). Alone since 1990, the basis year for the Kyoto target, the traffic sector registered a rise from over 80 % to 2004. Thus ways must be found to revise and/or at least weaken this trend. Besides traffic avoidance as well as technological developments the spreading of an economic driving style is a simple possibility for the increase of energy efficiency: Investigations in Europe have shown that by the application of Eco-Driving tips 5 to 15 % of the conventional fuel consumption can be saved. The attainable energy consumption and emission reductions go hand in hand with increased road safety and lower noise emissions. And finally drivers and/or fleet operators save also money, not only through the reduced fuel need, but also through lower accident costs and lower wear of engine, transmission and tires.

The Eco-Driving initiative in Austria is part of "**klima**:aktiv", the Austrian initiative for active climate protection (Raimund et al, 2005). The programme started 2004 and is planned to run until 2012. It is "hosted" by the Ministry of Agriculture, Forestry, Environment and Water Management ("Lebensministerium" for short) and managed by the Austrian Energy Agency. The aim is to widely introduce energy efficient and climate-friendly technologies and services in the fields of

- municipalities,
- energy efficiency and buildings,
- renewable energy and
- mobility.

Next to investment subsidy programmes and legal & fiscal instruments, **klima**:aktiv provides targeted support for e.g. further education and vocational training of key players, for quality management or for target-group specific information, motivation and marketing. The single **klima**:aktiv thematic programmes (like Eco-Driving) set targeted impulses and therewith help to transform the market. By following a systematic approach, **klima**:aktiv is determined to effect a breakthrough in the use of climate-friendly technologies and services for increased energy-efficiency and of renewable energy sources, as well as to accrue their market shares.

The central instruments of the national climate strategy (of which **klima**:aktiv is a part) such as subsidies for investments, fiscal measures, legal measures, are now supported and accomplished by **klima**:aktiv.

AIMS OF KLIMA:AKTIV[1] *ARE TO*

- reduce energy consumption and CO_2-emissions and accelerate the use of carbon neutral energy sources
- amend the start chances and raise market share of climate friendly products and services
- create a competitive advantage for the Austrian economy: fit for the future, sustainable and innovative
- activate and network important players and stakeholders

The Eco-Driving initiative [3]

With the promising findings of the EU-project "Eco-Driving Europe" (the Austrian Energy Agency was the coordinator), the Austrian ministry of Life decided to implement an Austrian wide Eco-Driving competition and started hereby the Eco-Driving initiative in 2004. The central target was to locate the topic of the economic and ecological new driving style in the heads of young people, who have just received their driving license. In order to embody the topic "Eco-Driving" in the consciousness of a broader public, the competition was expanded in 2005 to all driving licence owners.

Since 2005 the programme has also enlarged its field of activities. Beside the Eco-Driving competition and the offering of training courses, the programme enforces the cooperation with commercial partners and an EU project. All activities are accompanied by a wide promotion campaign. In order to reach different target groups various instruments are used:

- Eco-Driving competition
- Training courses
- Cooperation with fleet operators
- Public relations and campaign
- Cooperation with commercial partners
- Cooperation with the EU project "ECODRIVEN"

1. Information and contact: http://www.klimaaktiv.at

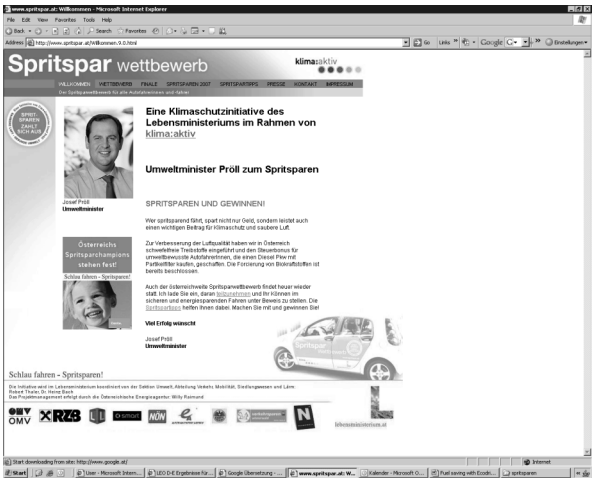

Fig. 7: Eco-Driving Website (www.spritspar.at)

Fig. 8: Minister for environment with young Eco-Driver

ECO-DRIVING COMPETITION

The country wide Eco-Driving competition started in the year 2004 with 100 participants. In the year 2006 3,000 driver license holders applied for the participation. By lot, 602 people could be selected as participants. On 32 half days the applicants could qualify for the finale, which took place on the 8th and 9th of September 2006 in Vienna. Per competition on a half day 16 to 20 applicants tried to be the most efficient driver.

Established drivers had the chance to win the first prize (6,000 Euro in cash) as well as a weekend for two persons in the "soft-mobility" municipality Werfenweng. Younger drivers (those who receives their licence after 1st January 2005, could get an exceptional prize, worth 3,000 Euro in cash. Altogether in 2006 the prices had a total value of 20,000 Euro.

The respective fuel consumption and the average speed were measured during the competition ride by an electronic on board computer. For safety reasons the consumption gauge was not visible during the ride. The driver with the lowest fuel consumption became the half day winner. The 25 best drivers of the half day competition were admitted to the finale in Vienna.

The final competition took place on Friday, 8 September in the Klosterneuburg. The winner ceremony as well as a competition of Austrian celebrities took place on 9 September in Vienna. The winner could reach a fuel consumption of 3.13 litres/ 100 kilometres with a car that has an official driving cycle of 6 litres/100km.

The competitions are documented on the Website http://www.spritspar.at (Fig. 7).

After the competition in 2006 an Austrian mobility research institution interviewed all competition participants [4]. These are the most important findings:

- 95 % of the competition participants would attend the competition again
- 86 % think that since their attendance at the competition family and friends are more interested in the topic Eco-Driving
- 78 % would in future only buy a new car with a very low average consumption
- 97 % think that Eco-Driving competitions are a meaningful measure to reduce CO_2 emissions in Austria

TRAINING COURSES

In order to be able to spread the new driving style it is necessary to establish an organization that offers information material and trainings with equal quality for interested fleet operators. The implementation of the certification for "Eco-Driving trainers" is necessary and important. As a next step the Eco-Driving style must be embodied in the training regulations and examination for learner-drivers.

In autumn 2004 the persons in charge agreed to accomplish a certification of Eco-Driving trainers as pilot project. Altogether 21 driving school teachers were trained, examined and certified in three-day-courses. Now they are allowed to offer quality-secured and standardized Eco-Driving courses for drivers and in particular for fleet operators. In 2006 a manual for trainers was formulated. The board of the Austrian driving schools took over the elaboration of the documents.

Contents of the passenger car manual for trainers:

1. The program klima:aktiv mobil
2. Aims of Eco-Driving
3. Course program Eco-Driving
4. The Eco-Driving training
5. Motivation and information
6. Background knowledge „Climate protection in transport"
7. Entrance to training
8. Training for trainers
9. Literature

In 2006 further 20 trainers were coached in Eco-Driving. Today 40 certified trainers in Austria are available for training car drivers, thereof 6 trainers are allowed to coach the trainers ("train the trainer" principle).

COOPERATION WITH FLEET OPERATORS

This year a large number of drivers could be trained for the first time. Very successful was a cooperation with the Austrian federal railway (ÖBB).

Fig. 9: Eco-Driving subject in print media

Commercial vehicles

With approximately 2,800 drivers and a fleet containing 2,100 busses, the "ÖBB Postbus GmbH" is the biggest fleet operator in Austria. In 2006 the company decided to provide their drivers an Eco-Driving training. The pilot project was started with an internal competition with 77 participants. Later on all 2,800 drivers will be trained. It is estimated to achieve a CO_2 reduction of 5,000 tons per year.

Furthermore 4,800 locomotive drivers of the "ÖBB-Traktion GmbH" have been trained. Through their trainings 2,600 tons of CO_2 can be saved every year.

Passenger cars

In the passenger car range until now 15 trainings with altogether approximately 150 participants could be accomplished.

Service station "Eco-Driving"

For enterprises, which are interested in Eco-Driving trainings, a "service station" was established. It was introduced to offer a "one stop shop" for interested drivers. The tasks of the service station are among other things:

- Support for fleet operators at the internal organization of Eco-Driving trainings
- Supply of trainers and training vehicles

PUBLIC RELATIONS AND CAMPAIGN

A public relations consortium accomplished a broad public campaign to advertise Eco-Driving in Austria. 396,000 Eco-Driving folders and 5,000 give-aways (stickers, t-shirts, billed caps etc.) were distributed to an interested public. 11 circuits of the Eco-Driving subjects were placed in print media (see Fig. 9) and an 8-side printed enclosure about Eco-Driving was added to an Austrian newspaper.

To raise the awareness among car drivers while driving their vehicles 70 large Eco-Driving posters (a 6x2m) were placed on motorway bridges and 300 busses were furnished with rear window stickers.

The presence of Eco-Driving on the radio was with 100 circuits and a coverage of 2.1 million listeners quite high.

The consortium also set up the very informative website http://www.spritspar.at

COOPERATION WITH COMMERCIAL PARTNERS

For the fulfilling of the objectives of the Eco-Driving initiative the cooperation with strong partners is absolutely necessary. In 2006 the public relations consortium managed to win over very important partners. An approved cooperation exists with the professional association of the Austrian driving schools. This association distributes the Eco-Driving folders among the driving schools and assures that driver learners know the Eco-Driving tips. Together with this association the manual for trainers was elaborated, furthermore the association is supporting the development of training manuals and a certification system for commercial vehicles.

Other cooperative companies are the Austrian automobile and touring club (ÖAMTC), an Austrian oil and gas company (OMV), an Austrian bank institute, a leasing company and Mercedes / smart. These partners support the Eco-Driving initiative in different ways e.g. as financial sponsors or as provider for technical equipment (cars).

COOPERATION WITH THE EU-PROJECT "ECODRIVEN"

The national initiative is interlaced with the EU project ECO-DRIVEN also on European level. A target of this project is to win passenger drivers, truck drivers and bus drivers for the Eco-Driving style. The project runs from January 2006 until December 2008.

The following partners are involved in the project:

- SenterNovem (project co-ordinator), the Netherlands
- Energy Saving Trust, U.K.
- Motiva Oy, Finland
- Austrian Energy Agency, Austria
- Centre for Renewable Energy SOURCEs, Greece
- bond Beter Leefmilieu, Belgium
- The polish national Energy Conservation Agency, Poland
- Stredisko pro efektivi vyuzivani energie, Czech republic
- Regie Autonome des transport parisiens (RATP), France

Starting from mid-year 2007 ECODRIVEN will start a synchronized campaign in nine EU member countries, reaching a number of 2.5 million drivers among Europe. Until 2010 500,000 tons of CO_2 should have been saved by the project.

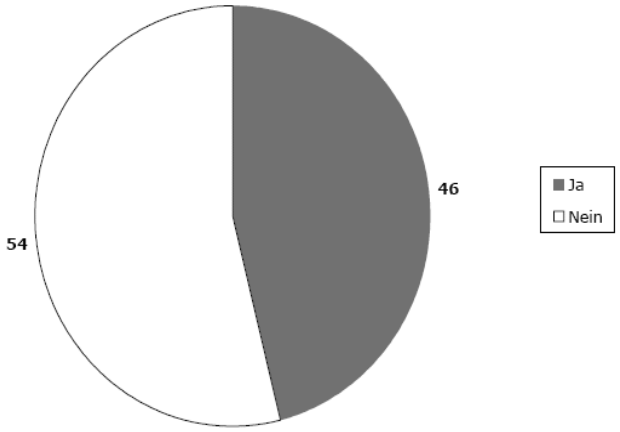

Fig. 10: Did you hear about the Eco-Driving initiative last year? (coloured=yes, white=no)

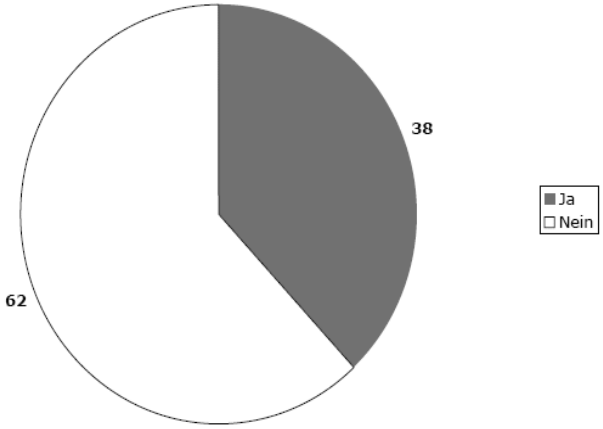

Fig. 12: Did you notice an Eco-Driving competition last year? (coloured=yes, white=no)

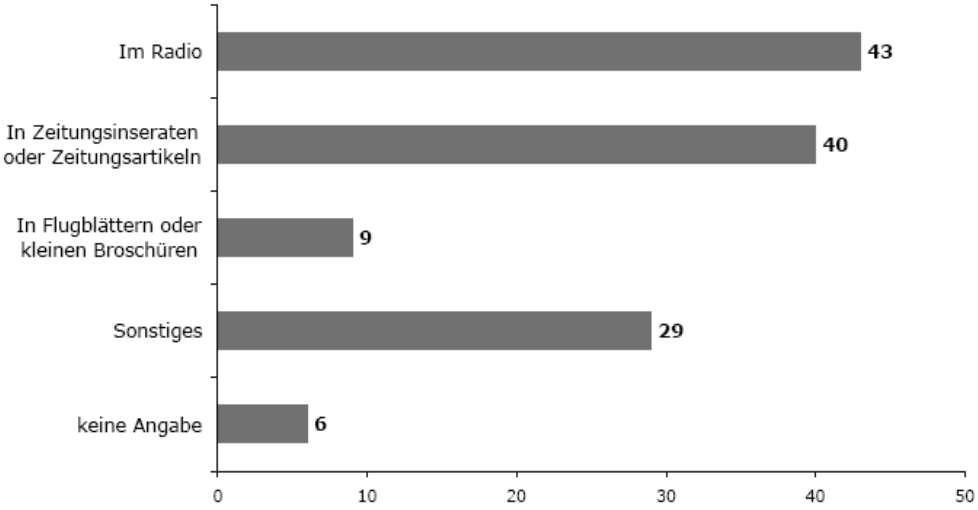

Fig. 11: From where do you have your information concerning the Eco-Driving initiative (top down: radio, print media, folders and brochures, others, no indication)

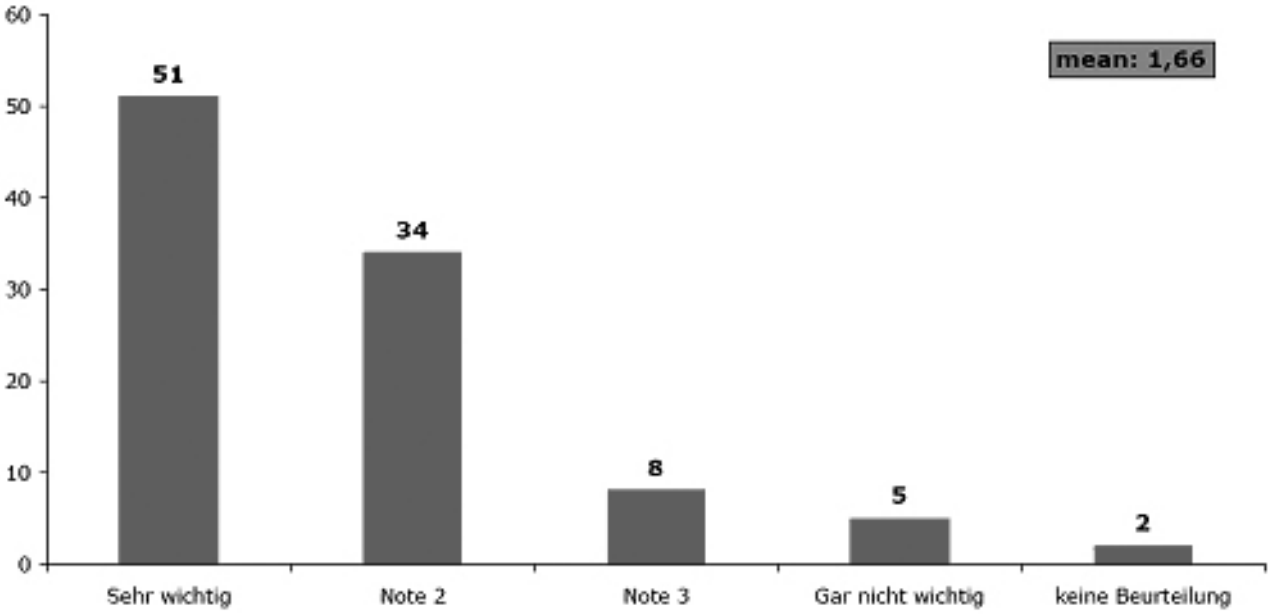

Fig. 13: How important is it to inform about Eco-Driving in your opinion? (from left to right: 1=very important, 2, 3, 4=not important, no indication)

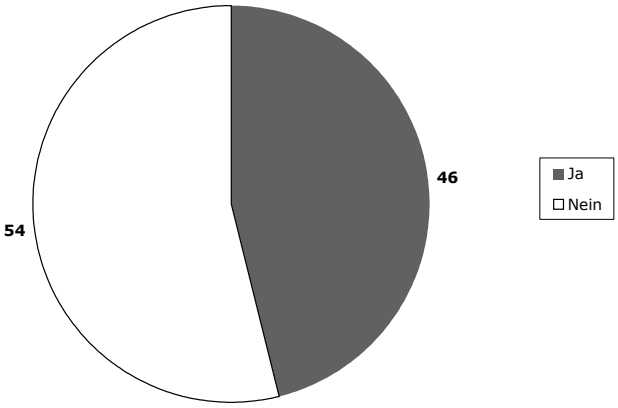

Fig 14: Can you imagine to attend an Eco-Driving training? (coloured=yes, white=no)

Awareness level

The Eco-Driving initiative in Austria has well represented its topics and made it known a wide range of public. To proof the awareness level of the Eco-Driving initiative among Austrian inhabitants the market research institute Gallup has started a representative telephone survey with 1,000 respondents [5]. These are the results:

The Eco-Driving initiative in 2007 – future plans

The Eco-Driving initiative will again be enlarged in 2007 and for the Austrian environmental policy Eco-Driving is a fix element when defining measures to reduce CO_2 emissions in the transport sector. Following tasks and targets for 2007 were appointed to again reach a higher range of people and to increase the positive effects on Eco-Driving:

- Enlargement of the Eco-Driving competition: In 2007 it is aimed to admit 650 participants
- Enhancement of certified Eco-Driving trainings for passenger car drivers: 300-500 drivers should be trained in 2007
- Enhancement of certified Eco-Driving trainings for commercial vehicle drivers: Therefore instruction materials and the trainer manual will be advanced. Hence a certification system for trainers will be established Sensitisation of driving schools, driving teachers and novice drivers for the theme of Eco-Driving
- Evaluation of the CO_2 and fuel reduction potential: Studies to investigate the CO_2 savings for passenger cars, commercial vehicles and busses are planned

Eco-Driving – just do it!

There exists a measure in the transport sector that reduces fuel consumption, CO_2 and costs.

This measure is working without any financial investments.

Is it the 3-litre car that has finally been invented?

No. It is the 3-litre driver, that everyone can be within a very short period of time, learning and practising the most important Eco-Driving tips.

Eco-Driving – Just do it!

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