Improving the energy efficiency of road transport: the case of eco-driving in the Netherlands

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Abstract
In this article we present the results of an in-depth ex-post evaluation of the Dutch Eco-driving program carried out within the framework of the AID-EE[1] project which has been supported by the Intelligent Energy for Europe Program. The Eco-driving program is a policy package with the objective to stimulate more energy-efficient purchase and driving behaviour. While focusing on behavioural aspects, the program is complementary to the ACEA covenant which has purely technical objectives, i.e. making cars more efficient.

The analysis shows that:

- Between 1999 and 2004 energy savings of 1.3 – 3.0 PJ (corresponding with 0.1-0.2 million tonnes of CO_2 emission reductions) have been achieved, which is 0.3-0.8 % of total fuel consumption of Dutch road transport.
- The intermediate target of 2005 to reduce 0.4 million tonnes of CO_2 emissions has probably not been met.
- Up to now, the program has been less successful in training existing drivers.
- However, both the already realized savings and the remaining potential for further savings mainly come from the group of existing drivers.
- In addition, it should be stressed that the effectiveness of the program, e.g. regarding the actual driving style of trained drivers and the persistence of changes in driving style, is hard to assess.
- Eco-driving is profitable for car owners due to lower fuel costs
- In 2004, 31 % of the general public was familiar with the Eco-driving program.
- Currently, 76 % of the driving instructors have been trained in eco-driving.
- The principles of eco-driving have been incorporated in the theory examination and it is envisaged to be included in the practical examination procedure
- When comparing the Dutch Eco-driving program with the Finnish program, it is shown that the Dutch package approach seems to be a relatively effective manner of improving energy efficiency with an extremely difficult target group.

Introduction
In October 2006 the European Commission presented its "Action Plan for Energy Efficiency: Realizing the Potential". With the Action Plan the Commission shows ambition and aims to achieve an additional energy efficiency improvement of 20 % in the period 2005-2020. Part of these additional savings should come from the transport sector which accounts for almost 20 % of total primary energy consumption in the European Union.

1. Active Implementation of the Directive on End-Use Energy Efficiency and Energy Services.

One of the priority actions of the Commission is to ensure that the 120 gr. CO_2/km target is achieved in 2012. Currently the energy efficiency improvement of cars is addressed by the ACEA covenant, which is a voluntary agreement of the European car manufacturers and the European Commission that runs until 2008[2]. Evaluation results[3] of the agreement show on the one hand that technical progress has been made, but on the other that efficiency gains have been partly offset by due to increasing sales of heavier and more powerful cars. To achieve further CO_2 emission reductions more efforts are needed to influence driving behaviour and accelerate the diffusion of more energy efficient cars. Policy instruments focusing on changing driving behaviour are commonly referred to as "Eco-driving".

In the AID-EE project which has been supported by the Intelligent Energy for Europe Program an ex-post evaluation of the Dutch Eco-driving program has been carried out. In this paper we present and discuss the main results.

AID-EE project

AID-EE is an acronym for Active Implementation of the Directive on End-Use Energy Efficiency and Energy Services (in short: Energy Services Directive). A consortium of Ecofys Netherlands (coordinator), Wuppertal Institute, Lund University Sweden and Politecnico Milano has worked on this project in the previous two years. The objective of the project was to contribute to a successful implementation of the Energy Services Directive which was published at 5 April 2006. In the project 20 ex-post evaluation studies of different energy efficiency policy instruments in various countries have been carried out. For each instrument it has been analyzed which factors determine its success or failure.

The evaluation method that has been applied in the AID-EE project is the so-called theory based policy evaluation. Most methods used in ex-post evaluation focus on final effects only, i.e. on energy savings, CO_2 emission reductions and costs. Theory based policy evaluation focuses on the whole policy process and considers both quantitative and qualitative aspects. In doing so, it provides insight in the success or failure of policy instruments and can be used to improve the impact and cost-efficiency of policy instruments.

Dutch Eco-driving Program: characterization

The Dutch Eco-driving program aims to increase application of energy-efficient driving and purchase of more energy efficient cars. This should lead to 0.8 million tonnes of CO_2 emission reductions in the period 1999-2010. For 2005 an intermediate target of 0.4 million tonnes has been set. The total direct CO_2 emissions of the transport sector in the Netherlands add up to 35.2 million tonnes (2003), with an expected rise to 38.1 million tonnes in 2010 and 45.8 million tonnes in 2020. Road transport is the largest contributor with 87 %.[4]

Apart from the targets related to CO_2 emission reduction, the program emphasises additional advantages of eco-driving such as financial benefits, increased comfort and safety.

The Dutch Eco-driving program targets individual drivers, professional drivers and fleet owners. Target areas are passenger road transport and freight road transport. The program distinguishes five different types of actions[5]:

1. Stimulating energy efficient driving style: subsidizing training courses for groups of (professional) drivers, development of a drive simulator (which is used for demonstrations during workshops and exhibitions) and extensive promotional campaigns (television, radio, websites, leaflets).
2. Integrating eco-driving principles in the driving school curriculum: In order to reach new drivers, the program has facilitated the training of driving instructors in eco-driving. In addition, eco-driving principles have been integrated in the driving school curriculum for new drivers. Eco-driving is now integrated in the theory exam. It is currently studied how eco-driving can be integrated in the practical examination.
3. Stimulating in-car devices: In order to stimulate the purchase and use of fuel-saving in-car devices, member organisations of the Dutch Eco-driving program have lobbied for a tax-exemption for these devices. The tax exemption has been in place from May 2000 until January 2005. Within the Eco-driving program the use of in-car devices has been promoted via public campaigns and demonstration programs.
4. Facilitating optimal tyre pressures: In order to more frequently check tyre pressures of cars, the program has organized demonstration and training projects checks. Furthermore extensive information campaigns and targeted marketing activities (e.g. leaflets to service stations) were set up. Lastly, the objective of the programme is to get tyre pressure checks integrated in the periodic motor vehicle test.
5. Stimulating purchase of more energy efficient cars: No specific activities have been set up for purchasing behaviour as this already covered by EU requirements regarding the labelling of cars. Nevertheless, purchase of more efficient vehicles is stimulated by raising awareness in the driving school curriculum, driving style training courses and communication campaigns. Effects of the activities focusing on purchase behaviour have not been attributed to the Eco-driving program.

Right from the start of the Eco-driving program much effort has been put in setting up a detailed monitoring program to facilitate regular evaluation of the program.

2. The European Commission negotiated similar agreements with the Japanese (JAMA covenant) and Korean (KAMA covenant) car manufacturers.

3. See for example D. Bongardt and K. Kebeck, Evaluation of the ACEA agreement, AID-EE project, 2006 (http://www.aid-ee.org/documents).

4. See A.W.N. van Dril and H.E. Elzenga, Referentieramingen energie en emissies 2005-2020, ECN Petten, 2005.

5. SenterNovem, Jaarverslag 2004. Het Nieuwe Rijden, Utrecht, 2005.

Evaluation of the Program

PARTICIPATION OF STAKEHOLDERS

The involvement and active participation of stakeholders is assumed to be an important supporting factor for the Eco-driving program. The Dutch program has been successful in creating a network of representative stakeholders relevant for bringing eco-driving to the attention of the end-user. Among the participating stakeholders are consumer organizations, environmental NGOs, professional organizations (e.g. for drivers, car dealers, logistics companies, driving schools), tire suppliers, oil companies and car lease companies.

The level of participation varies, from just adopting the program to actively organizing training courses and communicating the Program to its members. In general the *commitment* of the majority of the stakeholders is limited.

TRAIN THE TRAINERS

One of the objectives formulated at the start of the program was to include the principles of eco-driving into the training curriculum of driving school trainers and to train all driving instructors and examiners in eco-driving by 2005. As a result of training activities for instructors 76 % of the 7850 instructors (passenger cars and trucks) have been trained in eco-driving by 2004.

DRIVING SCHOOL CURRICULUM

Since 2001 the principles of eco-driving has been integrated in instruction books and theory exams in the Netherlands, and has thus become part of the new drivers' curriculum.

NEW DRIVERS TRAINED

It has been reported that 92 % of the instructors claim that they plan to include eco-driving in their training for new drivers.[6] It is assumed that approximately 35 % of the new drivers will actually apply eco-driving in daily practice,[7] although limited research is available regarding the correct application of eco-driving principles by new drivers, 2) the share of eco-driving principles new drivers are aware of and 3) the long term retention of the principles by the drivers. Given that eco-driving is not a hard examination criterion in the practical driving test, it is questionable whether 92 % of new drivers have become acquainted with all eco-driving principles and apply them correctly.

TRAINING STRUCTURES FOR EXISTING DRIVERS

The second line of activities of the eco-driving program is focused on reaching existing drivers. Objectives include the training of 10,000 license holders by 2005, and that 100 % of all licence holders in 2010 have been trained in eco-driving.[8] Between 2000 and 2004 more than 100 projects have been contracted by the Dutch Energy Agency SenterNovem, the executive body of the Dutch Eco-driving program, to stimulate eco-driving by existing drivers. A majority of these projects involve driving style training courses. Just a few number of projects are related to in-car devices. Participants in subsidized projects had to report on their activities and monitor improvements in fuel use. Typically, fleet owners and large organizations are involved in projects. In 2004 approximately 75,000 existing drivers were reached: 26,000 via a multimedia game, 25,000 by tire pressure training courses and 16,000 by the above subsidized projects. In addition, over 8,500 professional drivers such as taxi drivers and other collective transport drivers have been reached as well as 750 truck drivers. Between 1999 and 2004 the Eco-driving program has reached more than 150,000 existing drivers. This represents 1.5 % of the total driver population in the Netherlands. The reach of subsidized projects seems therefore limited to cover a large share of existing drivers.

COMMUNICATION CAMPAIGN / PROGRAM RECOGNITION

An extensive communication campaign was set up with the objective to achieve program recognition of 60 % among all drivers in the Netherlands[9]. The communication campaign focused on different types of media, including radio & television, internet, newspapers and magazines. In total approximately 25-30 % of the total budget of the program was used for communication purposes (between 0.8 – 1 million EURO per year). Recognition of the Eco-driving program by the target group has increased significantly over the last 5 years. In telephone surveys (n=1100) the spontaneous recognition has increased from 18 % (1999) to 31 % (2004). Supported recognition in 2004 was 50 % (36 % in 2003)[10]. The survey showed that television is most effective in reaching the target group: 78 % of the respondents have learned about eco-driving from television, followed by radio (16 %) and newspaper (17 %).

FAMILIARITY WITH ECO-DRIVING PRINCIPLES

The typical eco-driving principles are not well known among the respondents: early gear shifting (14 %), anticipating traffic (3 %), driving with constant speed (9 %), rolling out in gears (7 %), lower rpm (revolutions per minute) level (10 %), and steady acceleration (7 %). It can therefore be concluded that the familiarity with the eco-driving principles is lower than the recognition of the program itself.

CHANGES IN DRIVING BEHAVIOUR

The level to which eco-driving driving style suggestions are applied by existing drivers has been assessed through annual telephone surveys. In the survey 1100 respondents were asked to rate the extent to which they applied 3 selected eco-driving principles (constant speed driving, limited revolutions, anticipation behaviour). The results show a gradual increase of the use of all three eco-driving principles (from 10 % of the respondents in 1999 to 22 % in 2004). In 2004 4 % of the respondents did not apply any of the suggested principles (7 % in 1999). The data support the objective of the program to catalyse more energy-efficient driving behaviour.

6. Traffic Test, Het Nieuwe Rijden-B en CE: resultaten van de trainingen voor rijinstructeurs en examinatoren, 2002.

7. SenterNovem, Jaarverslag 2004. Het Nieuwe Rijden, Utrecht, 2005.

8. Novem, Meerjarenvoorstel Het Nieuwe Rijden 1999-2005, Utrecht, 1999.

9. Novem, Meerjarenvoorstel Het Nieuwe Rijden 1999-2005, Utrecht, 1999.

10. SenterNovem, Jaarverslag 2004. Het Nieuwe Rijden, Utrecht, 2005.

CHECKING TIRE PRESSURES

Research in 1999 showed that the tire pressure of 45 % of the vehicles is too low[11]. Objectives of the Eco-driving program regarding tire pressures include that 1) at least 75 % of all drivers should have minimum (or higher) tire pressures in 2005 (95 % in 2010), 2) at least 10 gasoline stations should have automatic tyre pressure systems (100 in 2010) and 3) checking tire pressures should be part of the periodical motor vehicle test. Recent studies show that the number of cars with correct tire pressure has not significantly increased between 1999 and 2004. It may therefore be concluded that the Eco-driving program has had limited effect on the increased checking of tyre pressure by drivers.

PURCHASE OF IN-CAR DEVICES

Based on the annual telephone survey an increase in in-car device possession in the *current car stock* can be observed from 13 % in 2000 to 33 % in 2004. Furthermore, integration of in-car devices in *new cars* has increased to over 70 % in 2004[12]. The majority of sold in-car devices are on-board computers (70 % in 2003) and cruise controls (60 % in 2003). As both cruise controls and board computers have multiple functionalities, it should be noted that it is unlikely that these devices are solely purchased and used to increase energy-efficiency alone. A device for reducing fuel consumption has reached only a limited penetration in new car sales (1 %). The tax exemption scheme is likely to have played a major role in the increased penetration of in-car devices. Based on research of the automotive sector it is estimated that 45-60 % of the in-car devices would not have been purchased without the tax exemption[13]. Abolishment of the tax exemption scheme is likely to have been related to shifted priorities in the tax exemption program and the general idea that many consumers would purchase the in-car devices also without the tax exemption scheme.

APPLICATION OF IN-CAR DEVICES

In 2004 14 % of the respondents in the annual survey claim to use their devices regularly (2 % in 2000). Respondents with knowledge of the eco-driving principles are more inclined to use the in-car devices on a regular basis, which confirms the assumption that the Eco-driving program has played a supporting role in the application of in-car devices.[14]

Energy savings & CO_2 emission reductions

Between 1999 and 2004 energy savings of 1.3 – 3.0 PJ[15] have been achieved, which is 0.3-0.8 % of the total fuel use by Dutch road transport. This corresponds with 0.1-0.2 million tonnes of CO_2 emission reduction. The impact can be differentiated to three 'policy-modules', i.e. 1) in-car devices, 2) existing drivers / communication and 3) new drivers / driving school curricula. Figures 1 and 2 show the increase of CO_2 emission reduction for the high range and as well as the low range. The high range corresponds to the assumptions made by the Dutch Energy Agency, whereas the low range is based on alternative assumptions used in the evaluation for the AID-EE project. The figures show that:

- The module 'existing drivers' dominates CO_2 emissions reductions in 2000 and 2001, as a result of the relative early communication activities.
- By 2004 activities concerning new drivers have the highest contribution to CO_2 emission reduction.

The results show that the range of emission reductions is rather large. It seems however clear that the intermediate target of 2005 (minus 0.4 million tonnes of CO_2 emission reductions) will not be achieved.

MODULE 1: IN-CAR DEVICES

CO_2 emission reductions as a result of in-car devices have increased significantly from 2000 to 2004, up to 16-42 ktonnes in 2004. The difference between the high and the low range reductions is explained by:

- *Share of free riders*: in-car devices would also have been sold without the tax exemption scheme, leading to free riders. A free rider share of 33 % (based on sales of in-car devices with neighbouring countries without tax exemption) to 50 % (based on estimates from the automotive sector) is taken into account.
- *Realised savings*: For actual savings achieved by applying in-car devices a range of 1.25-2.5 % is assumed. The 2.5 % reflects the savings achieved by drivers being trained on how to use in-car devices. A lower range of 1.25 % is assumed for untrained drivers. Untrained drivers will be less aware and competent to achieve savings and it is questionable whether the in-car devices (particularly on-board computers with a 70 % penetration) will be used for realising fuel savings given their multiple functions.

Several assumptions used in the annual evaluation of the program by the Dutch Energy Agency have not been altered in this study, but require more investigation as they are important parameters in the calculation of the program impact. They include high persistence levels of using in-car devices over time, the assumption regarding the regular use of in-car devices by drivers (80 %) and uncertainties introduced by the use of surveys (respondents might overestimate their behaviour).

MODULE 2: EXISTING DRIVERS / COMMUNICATION CAMPAIGN

CO_2 emission reduction as a result of targeting licence owners has increased from 8-39 ktonnes in 2000 to 34-86 ktonnes in 2004. A majority of the reductions results from communication activities. Subsidized training activities account for approximately 10-20 % of total reductions. A growing share of the reductions results from activities carried out in previous years, adding to 17-36 % of the total CO_2 emission reductions in 2004. In order to achieve the intermediate reduction target for 2005 and the final target for 2010, more efforts are needed to change the driving behaviour of existing drivers and yield the great energy savings potential in this target group. Increasing fuel prices might be supportive in this respect. The difference

11. Novem, Meerjarenvoorstel Het Nieuwe Rijden 1999-2005, Utrecht, 1999.
12. RAI Vereniging, Inventarisatie BPM-vrije accessoires 2003, Amsterdam, 2004.
13. RAI Vereniging, Inventarisatie BPM-vrije accessoires 2003, Amsterdam, 2004.
14. SenterNovem, Jaarverslag 2004. Het Nieuwe Rijden, Utrecht, 2005.
15. The influence of fuel price levels has not been studied.

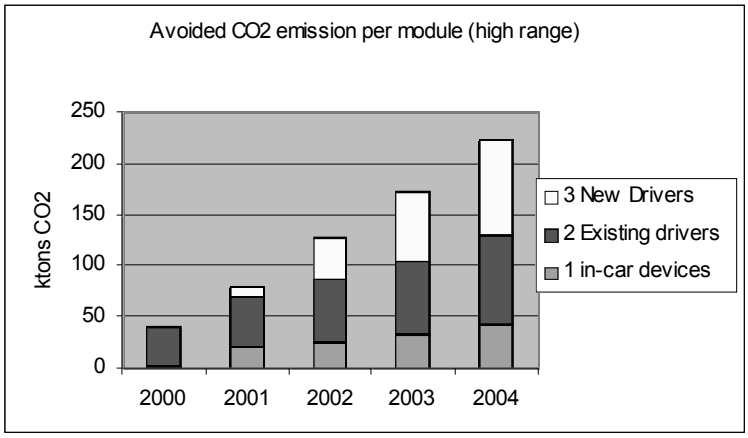

Figure 1: High range CO2 emission reductions Dutch Eco-driving program

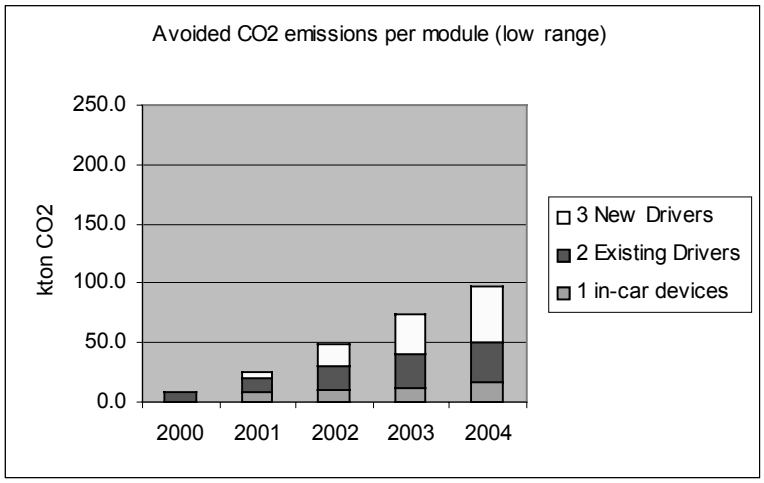

Figure 2: Low range CO2 emission reductions Dutch Eco-driving program

between the high and the low range reductions is explained by:

- *Percentage of drivers reached through the program*: Assumptions regarding the percentage of drivers reached through the communication campaign range from 12 % (based on the annual survey data) to 29 % (the level used by Dutch Energy Agency). The survey indicates that, although respondents are familiar with the Eco-driving program, respondents are not very well known with the actual eco-driving principles.
- *The effectiveness of communication campaigns*: it is recognised that training courses are more effective than communication and creating awareness alone. For the high range respectively 10 % and 2 % are assumed whereas these potentials are halved for the lower range.

Assumptions that have not been altered, but which may require more investigation, are the 90 % persistence level of eco-driving per year used by the Dutch Energy Agency and the uncertainties introduced by the use of surveys (see also above).

MODULE 3: NEW DRIVERS / DRIVE SCHOOL CURRICULUM

The integration of eco-driving in the driving school curriculum has led to a reduction of CO_2 emissions of 47-94 ktonnes in 2004. The difference between the high and the low range reductions is explained by:

- *Persistence of driving behaviour by truck drivers*: The Dutch Energy Agency assumes 100 % reach (all professional drivers apply eco-driving as a result of the programme) and 100 % persistence of this behaviour over time. Although it is likely that freight transport is likely to be more focused on applying eco-driving for economic reasons, also without the eco-driving program more efficient driving will be propagated in this sector. Therefore, for the low range 50 % reach and persistence will be assumed as a result of the Eco-driving program.
- *Use of eco-driving principles without being familiar with the program*: One can assume that a large share of new drivers to some extent will be applying eco-driving principles without being familiar with the programme. Margins considered in this study range from 17.5 % (low range) to 35 % (high range).

	Low	High	Relevant for:
Average tax exemption for each in-car devices	EURO 150	EURO 200	In-car device costs for government (deferred tax income)
Average end-user contribution to in-car device	EURO 50	EURO 150	In-car device costs for end-users / cost efficiency for society
Free riders in-car devices	33 %	50 %	In-car devices costs for 1) government (deferred tax income) and 2) end-users (contribution in purchase of devices)
Use level of in-car devices	50 %	80 %	1) Cost savings (end users) and 2) tax income losses (government)
Annual savings with in-car device	1.25 %	2.5 %	1) Cost savings (end users) and 2) tax income losses (government)

Not being changed are the assumptions regarding the high involvement and commitment of instructors (92 %), the high persistence levels of applying eco-driving over time (90 % for drivers) and the uncertainties introduced by the use of surveys (see also above).

Cost-effectiveness

The Eco-driving program aimed at government costs of 9 EURO per avoided ton CO_2[16]. In this evaluation study the cost-efficiency has been assessed for the government, society and the end-user. The following assumptions were made to calculate a low and high[17] range – See Table above.

Average gasoline prices of EUR 1.15 are considered of which EUR 0.84 is taxed by government. An annual gasoline consumption of 1250 litres per car is considered.

COSTS FOR THE GOVERNMENT

Costs for government include 1) Eco-driving program costs (about EUR 2 million annually) and 2) costs for in-car devices (incurred by the Ministry of Finance). These costs are divided by the CO_2 emission reductions in order to obtain the cost-efficiency of the government. Between 2000 and 2004 the cost-effectiveness of the Eco-driving program for the government ranges from EUR 9-20 per avoided ton CO_2 emission when the tax exemption costs are not included and EUR 68-99 per avoided ton CO_2 emission including tax exemption costs[18]. Not included in this analysis are the deferred taxes on fuels: fuel savings achieved due to the Eco-driving program counts up to a loss in tax income of EUR 34-78 million in 2004 alone. Similarly value added tax for in-car devices are not taken into account.

COSTS FOR SOCIETY

Societal costs as a result of the Eco-driving programme include importing and instalment costs for in-car devices. These costs are subtracted by fuel cost savings as a result of the Eco-driving program (excluding levies and taxes), and subsequently divided by the CO_2 emission reductions in order to obtain the cost-effectiveness of society. The cost-effectiveness for society amount to EUR 350 to 38 per ton avoided CO_2 emission. Particularly in-car devices costs are high (EUR 11-27 million in 2004); cost savings as a result of fuel savings count up to EUR 12-28 million in 2004.[19]

END-USER

Cost efficiency of the end-user includes costs for purchasing in-car devices (including tax exemption) subtracted by cost savings as a result of the Eco-driving program, divided by the gross CO_2 emission reductions.[20]

The cost-efficiency for end users ranged from EURO -210 to -418 per avoided ton CO_2 emission, which is the result of the high annual fuel cost savings (EURO 46 – 106 million in 2004), and relatively low investments by car owners for in-car devices (EURO 3 – 14 million in 2004).

Country comparison: the Finnish Eco-driving program

Finland also has an Eco-driving program. The program was introduced in 1995 and is closely linked to the Cycling Policy Program (to double cycling use from the 1998-99 level up to the year 2020), the National Walking Policy Program (to incorporate walking into transport policy and planning) and the Public Transport Strategy (to increase the attractiveness and competitiveness of public transport). The Finnish Eco-driving program does not have an overall energy savings or CO_2 emissions reduction target. The Finnish Information Centre on Energy Efficiency and RES, Motiva, analyzed the effects of eco-driving in 1990. It was estimated that eco-driving could reduce the average fuel consumption by 1.3 litres per 100 km, which equals an energy saving of 10-16 %. Training courses which have been planned for 1,000 bus and truck drivers and 15,000 car drivers in the period 2005-2006 are expected to result in about 0.1 PJ energy savings (9 ktonnes of CO_2 emission reduction). New drivers are an important target area of the program. In the period 2003-2005 200,000 driving school students and over 3,500 drivers, who already have a driving license, have been trained.

Both the Finnish and Dutch programs contribute to a wider European program on eco-driving involving also Austria, Switzerland and Germany and are part of their respective national

16. Novem, Meerjarenvoorstel Het Nieuwe Rijden 1999-2005, Utrecht, 1999.

17. The data of SenterNovem were used for the high range assumptions.

18. In this calculation it is taken into account that the Eco-driving program has been partly responsible in arranging the tax exemption and supporting its application. Rather than taking the full costs of the tax exemption into account, only 50 % of these costs of the Ministry of Finance are included in the cost-efficiency calculation (i.e. EURO 2.5 - 4.5 million instead of EURO 5 – 9 million).

19. A discount of 4 % is used to calculate annuities.

20. A discount of 8 % is used to calculate annuities.

climate change action plans. There are several similarities in the approach and means employed to promote eco-driving.

Differences between the programs also exist:

- Systematic ex-post evaluations of the Finnish program are missing which makes it difficult to compare both programs in terms of achieved effects.
- The Finnish Eco-driving program mainly focuses on increasing the number of drivers attending courses, whilst the Dutch program relies on a larger number of instruments (see earlier) for the promotion and application of eco-driving principles. Information and marketing campaigns undertaken in Finland primarily focus on having as much as possible drivers trained and do not seem to have the objective to disseminate information on eco-driving principles. Training courses are seen as the main instrument through which drivers can learn to apply such principles. This probably limits the number of drivers that can be approached.
- Subsidies for eco-driving training of professional drivers appear to be less applied in Finland. Installation of in-car devices for efficient driving does not receive as much attention in the Finnish Eco-driving program as in the Dutch program, which may be partially explained by the absence of tax-incentives for such devices in Finland.

Conclusions

PROGRAM EVALUATION

- Although the program has been successful in creating a network of stakeholders, it is observed that the level of commitment is relatively low. This should be increased to enhance the success of the program.
- The principles of eco-driving have been incorporated in the theory examination and are envisaged to be included in the practical examination procedure. 76 % of the instructors have been trained in the principles of eco-driving and 92 % of them claim to teach these principles to their students. Altogether, the Eco-driving program has been successful in reaching new drivers and making them acquainted with the principles of eco-driving.
- Up to now, the program has been less successful in training a significant part of the existing drivers. This is an important observation since the majority of the remaining potential for energy savings comes from the group of existing drivers. Increased efforts are needed as the effect of communication and awareness raising is relatively small. Training courses proof to be more efficient but much effort is needed to have a significant amount of the existing drivers trained.

ENERGY SAVINGS & CO2 REDUCTION

- Between 1999 and 2004 energy savings of 1.3 – 3.0 PJ (corresponding with 0.1-0.2 million tonnes of CO_2 emission reductions) have been achieved, which is 0.3 – 0.8 % of total fuel use by Dutch road transport. Eco-driving, therefore, seems to be a useful addition to other policy instruments like the ACEA covenant in reducing CO_2 emissions from transport.
- However, the intermediate target to reduce 0.4 million tonnes of CO_2 emission reduction in 2005 will not be met and increased efforts (mainly targeting existing drivers) are needed to meet the 2010 target.
- In addition, it should be stressed that the effectiveness of the program, e.g. regarding the actual driving style of trained drivers and the persistence of changes in driving style, is hard to assess.
- As CO_2 emission reduction figures are rather uncertain, it is recommended to focus on intermediate indicators (such as the familiarity with the program and the percentage of adaptation of eco-driving principles by drivers) to "measure" the success of the program components.

COST-EFFECTIVENESS

- Eco-driving is cost-beneficiary for car owners due to lower fuel costs. It can be expected that higher fuel prices will enhance the energy savings effects (people do not tend to drive less because of high fuel prices, but they do tend to driver more energy efficient). It is recommended to further study this effect.
- The lower range cost-effectiveness for the government corresponds to the program objective. However, when efforts are increased in order to catch up with the desired reduction levels, costs for the government might increase.

COUNTRY COMPARISON

- When comparing the Dutch Eco-driving program with the Finnish program, it is shown that the Dutch package approach is a relatively effective manner of improving energy efficiency in an extremely difficult target area.
- The systematic monitoring of data in the Netherlands makes it possible to evaluate the program and adjust it where needed. Such a tool is missing in Finland.