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Evaluation and Monitoring for the EU Directive on Energy End-Use Efficiency and Energy Services

EMEEES bottom-up case application 16: Ecodriving

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The Project in brief

The objective of this project is to assist the European Commission in developing harmonised evaluation methods. It aims to design methods to evaluate the measures implemented to achieve the 9% energy savings target set out in the EU Directive (2006/32/EC) (ESD) on energy end-use efficiency and energy services. The assistance by the project and its partners is delivered through practical advice, technical support and results. It includes the development of concrete methods for the evaluation of single programmes, services and measures (mostly bottom-up), as well as schemes for monitoring the overall impact of all measures implemented in a Member State (combination of bottom-up and top-down).

Consortium

The project is co-ordinated by the Wuppertal Institute. The 21 project partners are:

Project Partner	Country
Wuppertal Institute for Climate, Environment and Energy (WI)	DE
Agence de l'Environnement et de la Maitrise de l'Energie (ADEME)	FR
SenterNovem	NL
Energy research Centre of the Netherlands (ECN)	NL
Enerdata sas	FR
Fraunhofer-Institut für System- und Innovationsforschung (FhG-ISI)	DE
SRC International A/S (SRCI)	DK
Politecnico di Milano, Dipartimento di Energetica, eERG	IT
AGH University of Science and Technology (AGH-UST)	PL
Österreichische Energieagentur – Austrian Energy Agency (A.E.A.)	AT
Ekodoma	LV
Istituto di Studi per l'Integrazione dei Sistemi (ISIS)	IT
Swedish Energy Agency (STEM)	SE
Association pour la Recherche et le Développement des Méthodes et Processus Industriels (ARMINES)	FR
Electricité de France (EdF)	FR
Enova SF	NO
Motiva Oy	FI
Department for Environment, Food and Rural Affairs (DEFRA)	UK
ISR – University of Coimbra (ISR-UC)	PT
DONG Energy (DONG)	DK
Centre for Renewable Energy Sources (CRES)	EL

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Contents

1 Summary

1.1 Title of the method

Ecodriving

1.2 Type of EEI activities covered

End-use EEI action	
Sector	Transport
Energy end-use	Fuel in road transport [persons and freight]
Efficient solution	More energy-efficient use of vehicles through driver behaviour
EEI Facilitating measure	
Types of EEI facilitating measures	Information (awareness, training and education) Co-operative instruments (agreements with stakeholders)

1.3 Detailed definition of EEI activities covered

The EEI activities are listed in section 1.2 ahead. Additional information includes:

Ecodriving encompasses all kinds of measures meant to stimulate more efficient driving on road, both in personal and freight transport, e.g. (see also annex 1; flow chart):

- Specific driver training (incl. simulator courses) and modules integrated in driving courses

- Integrating ecodriving in the driver test and driving school curricula. Judging learner drivers on their ecodriving applications

- Stimulating fuel saving in-car devices (e.g. on-board computers, cruise controls, stop-start systems and tyre pressure monitoring systems (tpms))

- Communication campaigns on possibilities and benefits of more efficient driving behaviour and correct tyre pressures (through promotional material, news bulletin/newspaper/magazines towards drivers and specific information for use in driving lessons to driving instructors)

- Supporting regular consultation with stakeholders (professional transport companies, bus companies, driving instructors, associations of drivers, etc.) on targets, means and implementation of supporting measures

- Longer term agreements and uniform partnership agreements with clear targets, strategy and at least a soft compliance regime for partner organisations. Collaboration with a range of stakeholders (automobile clubs, industry associations and consumer organisation) reaches a wide audience and target groups

The categorization of database ecodrive.org will be similar to the activities that are distinguished in the monitoring.

1.4 General specifications

The monitoring of energy savings due to behavioural changes in a bottom up manner is not easy. Behaviour can hardly be measured, neither is it tangible. For each of the eco driving activities (training, information, etc) the energy savings can, at first, be calculated separately. However, later the combined energy savings must be corrected to eliminate double-counting. Furthermore the different end use sub sectors need to be taken into account:

- Passenger cars
- Light commercial vehicles (below 3.5 t)
- Buses and trucks (above 3.5 t)

1.5 Formula for unitary gross annual energy savings

For ecodriving, the unit used in the formula is a **participant in a specific measure** that is part of the ecodriving programme (e.g. one out of the types presented ahead). The formula for unitary gross annual energy savings is:

Unitary gross annual energy savings = Effectiveness (E) x Efficiency rate (ER) x average annual energy use per participant

Effectiveness (E) = % of drivers that change their behaviour due to the activity or activities conducted for a specific measure

Efficiency rate (ER) = effect of the change of behaviour on energy savings in %

1.6 Formula for total ESD annual energy savings

The total energy savings are the sum of the unitary gross annual energy savings. The interactions between the individual measures (with the risk of double counting) can primarily be covered by making regular updates of the effectiveness and efficiency. One exception on this is described in paragraph 5.2.

Total ESD annual energy savings =

$$\left[\sum_{i=1}^{Nst} NP * E * ER * Ea \right]$$

Where:

NP = number of participant
E (Effectiveness) = % of drivers that changes its behaviour due to the activity or activities conducted for a specific measure

ER (Efficiency rate) = effect of the change of behaviour on energy savings in %
Ea = average annual fuel use for participant
Summation is over types of measure within ecodrive

1.7 Indicative default value for energy savings lifetime

In available literature (see appendix I) often it is indicated that the effects of training etc diminish each year with 10%. This means that after 10 years the effect has decreased to $(100\%-10\%)^{\wedge 10}$= 35% of the original value.

1.8 Main data to collect

Data needed in calculation for values (level 1)	Corresponding data sources
Average energy use per driver	National statistics
Number of participants per measure	National monitoring data per measure
Efficiency and effectiveness per measure	Database (e.g. www.ecodrive.org)

Data to be collected (level 2)	Corresponding data sources
Average energy use per driver	National statistics
Number of participants per measure	National monitoring data per measure
Effectiveness and efficiency per measure	National monitoring data/research per measure

Data to be collected (level 3) additional to data collected at level 1 and 2	Corresponding data sources
Average energy use per driver	National statistics
Number of participants per measure	National monitoring data per measure
Effectiveness and efficiency per measure	National monitoring data/research per measure
Questionnaire on reported behaviour to incorporate effect of supporting measures	Annual survey (licenced drivers)
Effects of communication campaign	National survey(s)
Test results	Field tests. These are also used as contribution to the databank, see annex 1

2 Introduction

2.1 Twenty bottom-up case applications of methods

Within EMEEES, task 4.1 provided methodological materials in the internal working paper “Definition of the process to develop harmonised bottom-up evaluation methods”, version 20 April 2007; an update has been published as an Appendix to the report on Bottom-up methods at www.evaluate-energy-savings.eu. Based on this draft report, concrete bottom-up case applications were developed by EMEEES partners within task 4.2, and reference values were to be specified within task 4.3.

This report deals with case application 16 “Ecodriving” developed by SenterNovem.

Eleven project partners have developed concrete bottom-up case applications for a specific type of technology or energy efficiency improvement measure or end-use action. All gave comments and input to the methods developed by the other organisations.

The 20 case applications developed are presented in the table below:

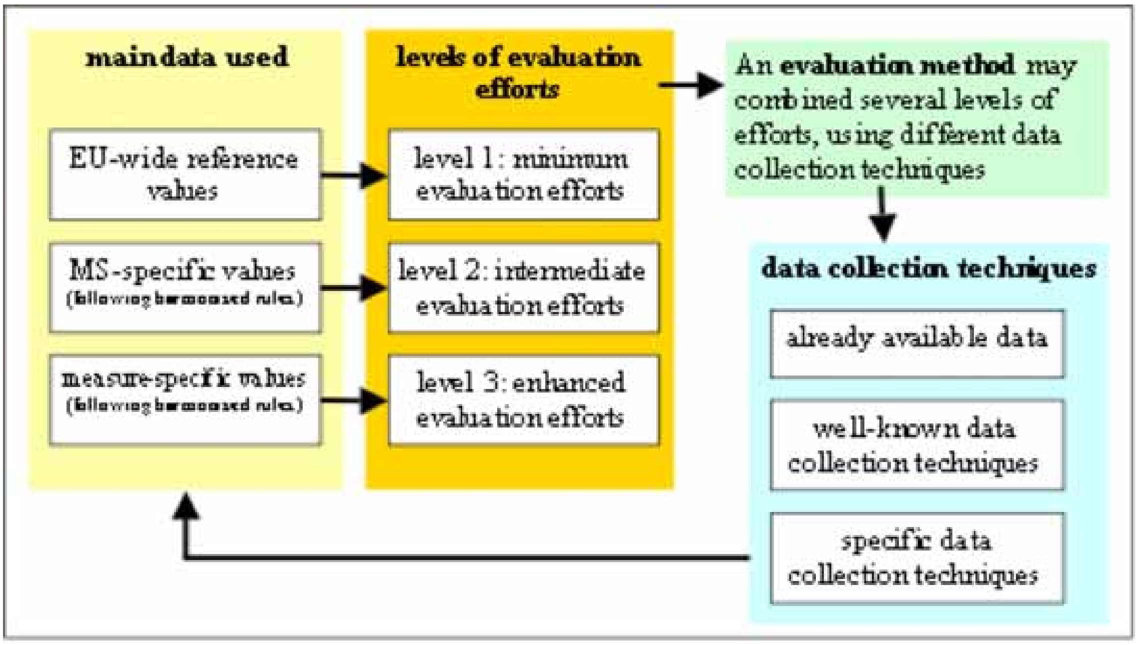
N°	End-use or end-use action, technology, or facilitating measure	Sector	Responsible organisation
1	Building regulations for new residential buildings	Residential	SenterNovem
2	Improvement of the building envelope of residential buildings	Residential	AEA
3	Biomass boilers	Residential	AGH-UST
4	Residential condensing boilers in space heating	Residential	Armines
5	Energy efficient cold appliances and washing machines	Residential	ADEME
6	Domestic Hot Water – Solar water heaters	Residential	AGH-UST
7	Domestic Hot Water - Heat Pumps	Residential	AGH-UST
8	Non residential space heating improvement in case of heating distribution by a water loop	Tertiary	eERG
9	Improvement of lighting systems	Tertiary (industry)	eERG
10	Improvement of central air conditioning	Tertiary	Armines

N°	End-use or end-use action, technology, or facilitating measure	Sector	Responsible organisation
11	Office equipment	Tertiary	Fraunhofer
12	Energy-efficient motors	Industry	ISR-UC
13	Variable speed drives	Industry	ISR-UC
14	Vehicle energy efficiency	Transport	Wuppertal Institute
15	Modal shifts in passenger transport	Transport	Wuppertal Institute
16	Ecodriving	Transport	SenterNovem
17	Energy performance contracting	Tertiary and industry end-uses	STEM
18	Energy audits	Tertiary and industry end-uses	Motiva
19	Voluntary agreements – billing analysis method	Tertiary and industry end-uses	SenterNovem
20	Voluntary agreements with individual companies – engineering method	Tertiary and industry end-uses	STEM

2.2 Three levels of harmonisation

In order to be as practicable as possible and to stimulate continued improvement, the harmonised reporting on bottom-up evaluation is structured on three levels (cf. figure 1).

Figure 1: Three levels of harmonisation



As a consequence, the EMEEES case applications for bottom-up evaluation methods present:

- EU wide reference values, if applicable;
- Guidelines how Member States can use country-specific values following harmonised rules;
- Guidelines how measure- or action-specific (national) values can be developed, following harmonised rules.

2.3 Four steps in the calculation process

The harmonised rules for bottom-up evaluation methods are organised around four steps in the calculation process (cf. figure 2). These steps are presented in detail in the report for WP 4.1.

Figure 2: Four steps in the calculation process

	Step 1: unitary gross annual energy savings (in kWh/year per participant or unit) *Example: how much energy is saved annually by using an A+ fridge instead of an A fridge?*
+ number of participants or units	
	Step 2: total gross annual energy savings (taking into account the number of participants or units, in kWh/year) *Example: how many A+ fridges were sold within the EEI programme?*
***+ double counting, multiplier effect**, + other gross-to-net correction factors (e.g. free-rider)*	
	Step 3: total ESD annual energy savings in the **first year** of the EEI measures (taking into account double counting, multiplier effect, and other gross-to-net correction factors (e.g. free-riders) ?, in kWh/year) *Example: how many A+ fridges would not have been sold if the EEI programme had not existed?*
+ timing and lifetime of the end-use EEI action within ESD period, and performance degradation	
	Step 4: total ESD energy savings achieved in the year 2016 (in kWh/year, taking account of the timing of the end-use EEI action, its lifetime and eventual performance degradation) Example: how many A+ fridges due to the programme are still effective in 2016? And has their energy performance changed over time?

The reports on the concrete bottom-up case applications follow the format of these four steps and they each hold six chapters plus some annexes:

1. summary
2. introduction
3. step 1: unitary gross annual energy saving
4. step 2: total gross annual energy savings
5. step 3: total ESD annual energy savings
6. step 4: total ESD energy savings for year “i”

2.4 Pilot tests

Additional to the development of the 20 bottom-up case applications, some of these cases were tested in practice in Work Package 8.
Pilot tests of the following case applications were performed by EMEEES partners in Italy, France, Denmark, and Sweden:

EMEEES case application	Sector	Italy	France	Denmark	Sweden
Building envelope improvement	Residential		X		
Energy-efficient white goods	Residential	X			
Biomass boilers in the residential sector	Residential		X		
Condensing Boilers	Residential	X	X		
Improvement of lighting system	Tertiary (industry)				X
High efficiency electric motors	Industry	X			
Variable speed drives	Industry	X			
Energy audits	Tertiary and industry end uses			X	
Energy performance contracting	Tertiary and industry				X

The following EEI measures were evaluated ex-post using the above-mentioned EMEEES bottom-up case applications:

Country	Subject	Sector(s) addressed
France	Condensing boilers, building envelope improvements and compact fluorescent lamps under the French White Certificates.	Residential
Italy	Schemes under the Italian White Certificates system	Residential, tertiary, industry
Sweden	Energy Efficiency Investment Programme for Public Buildings (2005-2008)	Public non-residential buildings
Denmark	Energy audits performed in Denmark between 2006 and 2008	Industry, tertiary

As a result of the pilot tests, some of the case applications tested were updated to reflect the findings of the tests.

3 Step 1: Unitary gross annual energy savings

Ecodriving encompasses all kinds of measures meant to stimulate more efficient driving on road, both in personal and freight transport:

1. Specific driver training (incl. simulator courses) and modules integrated in driving courses
2. Integrating ecodriving in the driver test and driving school curricula. Judging trainee drivers on their ecodriving applications
3. Stimulating fuel saving in-car devices (e.g. on-board computers, cruise controls, stop-start systems and tyre pressure monitoring systems (tpms)
4. Communication campaigns on possibilities and benefits of more efficient driving behaviour and correct tyre pressures (through promotional material, news bulletin/newspaper/magazines towards drivers and specific information for use in driving lessons to driving instructors)
5. Supporting regular consultation with stakeholders (professional transport companies, bus companies, driving instructors, associations of drivers, etc.) on targets, means and implementation of supporting measures
6. Longer term agreements and uniform partnership agreements with clear targets, strategy and at least a soft compliance regime for partner organisations. Collaboration with a range of stakeholders (automobile clubs, industry associations and consumer organisation) reaches a wide audience and target groups

Often the following end use sub sectors are treated separately:

- Passenger cars
- Light commercial vehicles (below 3.5 t)
- Buses and trucks (above 3.5 t)

3.1 Step 1.1: General formula and calculation model

For ecodriving, the unit used in the formula is a **participant in a specific measure** that is part of the ecodriving programme (e.g. one out of the types presented ahead). So the energy savings are, at first, calculated for each type of measure.

The basic formula for calculating the unitary gross annual energy savings is for each specific measure the same:

Unitary gross annual energy savings (PJ) = Effectiveness (E) x Efficiency rate (ER) x average annual energy use per participant

The average energy use is calculated by dividing the total energy use for transport (based on national statistics) divided by the number of drivers. If the number of drivers is not available, the number of cars can be used as a proxy. In the freight-transport sector other units like freight km's may be more suitable in specific situations. The most important aspect is to be consistent in the use of formula with regard to the applied unit for number of participants and average annual energy use.

Effectiveness (E) = % of drivers that changes its behaviour due to the activity or activities conducted for a specific measure

Efficiency rate (ER) = effect of the change of behaviour on energy savings in %

(equation 1)

This formula forms the basis for all the 3 monitoring levels. Level 1 and 2 focus on the ecodriving measures, which allow both for a reliable estimate of participants and a relatively direct relation between the measures and the effects on energy use. These are:

- Specific driver trainings
- Integrating ecodriving in driver license training
- Simulators/ virtual trainers
- Stimulating fuel-saving in-car devices

In level 3 the effects of the remaining measures (communication, stakeholder consultation and long term agreements) are also taken into account.

If new measures with regard to ecodriving are implemented, which also fit the criteria of having reliable estimates of participants and a relatively direct relation between the measure and the effects on energy use, these measures can be treated the same way.

3.2 Step 1.2: Baseline

The baseline is only related to average annual energy use. As this average has to be calculated on regular bases (preferable each year) it reflects the market stock at that moment.

Since it is possible that a part of the car drivers already applied energy efficient driving behaviour before the ecodriving programme, it is important to have a zero measurement to enable the determination of the effects of the eco driving programme. Such a zero measurement also provides input for the choices of measures to be carried out within the programme.

3.3 Step 1.3: Requirements for normalisation factors

No normalisation factors are relevant for this case, if the average annual energy use is evaluated each year. If it is determined by a zero measurement, it has to be normalised by the development of the average km driven per year, and the average fuel consumption of the car stock in l/100 km as measured by standard tests.

3.4 Step 1.4 Specifying the calculation method and its three related levels

Level 1

At level 1 the monitoring activities should focus on acquiring the following data:

- Average annual energy use per participant (GJ/year) (as described in the text box)
- The number of driver trainings that has been given
- The number of drivers having passed a driver license training with integrated ecodriving training
- Number of participants in simulators/virtual trainings
- The number of fuel saving devices in cars per type of device

These data can be used in equation 1. For the effectiveness and efficiency standard values can be used, indicating the minimum amount of energy savings that can be expected as a result of the measure.

Ideally these standard values should be based on the range of effectivenesses and efficiencies found in all EU countries. For now, due to lack of data for other countries, we have based these values on the Dutch situation with a correction factor of 75% for both efficiency and effectiveness. The correction for effectiveness and efficiency together implies a decrease of the estimated effect of about 50%. This decrease is probably too strong compared to reality, however we want to reduce the risk of overestimating the savings at level 1.

Right now the parameters are mainly based on Dutch information. In the coming years the database at ecodrive.org is expected to grow, when the monitoring data from various countries become available and are added to this database. For now we propose to use the following default values for the efficiency (E) and the effectiveness (ER). From the evaluation of the Dutch ecodriving programme the following values for participation effectiveness and efficiency have been derived, multiplied with 0.75[1]:

	Effectiveness (E)	Efficiency Rate (ER)
1. Specific training	26 %	7.5 %
2. Driver licenses	26 %	7.5 %

[1] These effects are assumed to be independent of other parameters like volume (km/driver) or car efficiency. If more information on this becomes available, this can be incorporated in the formula.

3. Virtual trainer/simulator	10 %	7.5 %
4. In-car devices	67.5%	3.8 %

These values shall be maintained in Ecodrive.org. As stated at the beginning of this pargraph, the monitoring of the effects of the supporting measures is not incorporated separately at level 1.

Level 2

Monitoring at level 2 is based on the same formula and activities as level 1. The same value for annual energy consumption per participant can be used. However at level two, country-specific values for effectiveness and efficiency need to be used to calculate the energy savings. These values should be based on national monitoring. For the Netherlands these values are:

	Effectiveness (E)	Efficiency Rate (ER)
1. Specific training	35%	10%
2. Driver licenses	35%	10%
3. Virtual trainer/simulator	13%	10%
4. Use of in-car devices	90%	5%

Level 3

Actually measuring the effect of Eco driving would require specific technology on board of all car drivers. Since we do not regard this as a realistic option, we have chosen for an estimate based on reported behaviour in stead of actual behaviour. Level 3 implies a comprehensive monitoring of all ecodriving measures and activities. It is based both on country specific information with regard to effectiveness and efficiency of specific measures as well as an indirect method to incorporate the effects of communication, stakeholder consultations and long term agreements. By means of a questionnaire the car drivers are asked to what extent they really act according to the principles of a specific measure within Ecodriving. Also measurements from situations in practice can be used. These questionnaires may also provide additional information on the specific values for the Effectiveness (E) and Efficiency rate (ER) used at level 1 and 2.

The experiences from the Netherlands show that it is recommendable to base the final estimate on both the level 2 savings and the results from the questionnaire. The differences, that will undoubtedly exist between both, provide a basis for further analysis for instance the triggering of socially desired responses in the survey. Depending on this analysis, the final outcome can be based on the average of both, however it is often preferable to use both results to create a range, between which the savings are expected to be. This way results are more stable in time and, in that respect, more reliable. The questionnaire should also properly address the awareness on the ecodriving activities. By taking the differences between those people who are aware of the ecodriving measures and those who are not, the distinction between autonomous and policy dependent developments can be estimated.

Figures from ECODRIVEN (European Campaign On improving DRIVing behaviour, ENergy-efficiency and traffic behaviour) concern a synchronised European-wide ecodriving campaign aiming at licensed drivers in 9 EU-countries (NL, UK, FI, AT, GR, BE, PL, CZ, FR). Database is under construction.

The approach at the three levels implies the following country specific data requirements. For the other parameters required for the calculation of savings, standard values can be used.

level 1	Average energy use per driver Number of participants per measure
level 2	Average energy use per driver Number of participants per measure Effectiveness and efficiency per measure
level 3	Average energy use per driver Number of participants per measure Effectiveness and efficiency per measure Questionnaire on reported behaviour to incorporate effect of supporting measures

3.4.1 Conversion factors

As cars can use different types of fuels (gasoline, diesel, natural gas) the average fuel use can be an average for all fuel types together or an average per fuel type. In this it is important to use adequate conversion factors for different fuel types (diesel, oil, gas, biofuel…), having only one unit at the end. Mainly due to expected limits with regard to data availability, we advise not to make a split between fuel types, ages of cars, etc, in the further analysis, since this would also require specific parameters with regard to effectiveness and efficiency. Furthermore we expect the differences between the subcategories to be limited.

3.4.2 Considering the direct rebound effect

The direct rebound effect is not explicitly mentioned in the ESD. It is created by final energy consumers who increase the intensity of the use of energy-efficient equipment after an EEI measure, e.g., when the internal temperature of a building is increased after insulation. This reduces the energy savings achieved in comparison to the baseline of autonomous consumption changes. Consequently, including energy savings “eaten up” by the direct rebound effect in the total ESD annual energy savings would mean to include too high energy savings compared to the autonomous energy consumption changes. It has not yet been decided by the European Commission and the ESD committee, whether this effect shall be included in the total ESD annual energy savings or eliminated from them. In the latter case, the following requirements apply.

Rebound effects are considered to be low in all type of measures. There are no indications that significantly more mileage will result from the fuel savings that result from eco-drive, especially given the generally low sensitivity of mileage to fuel prices fluctuations as well as the fact that driving behaviour oriented programmes will likely increase awareness of climate change problems and thus counteract impulses towards more mileage because of cost savings.

4 Step 2: Total gross annual energy savings

4.1 Step 2.1: Formula for summing up the number of actions

For ecodriving, the unit used in the formula in chapter 3 is a **participant in a specific measure** that is part of the ecodriving programme (e.g. one out of the three types presented in section 3.1). So the unitary annual energy savings are calculated for each type of measure and the participants to it.

So the total gross annual energy saving is the summing of the energy savings calculated for each type of measure that is implemented within the programme of ecodriving.

In formula form:

Total gross annual energy savings =

$$\left[\sum_i NP_i * E_i * ER_i * Ea\right]$$

Where

NP_i = number of participants measure type i

E_i (Effectiveness) = % of drivers that changes its behaviour due to the activity or activities conducted for a specific measure type i

ER_i (Efficiency rate) = effect of the change of behaviour on energy savings in % for measure type i

Ea = average annual energy use per participant

Summation is over types of measure within ecodrive

(equation 3)

4.2 Step 2.2: Requirements and methods for accounting for the number of actions

The measures included in the ecodrive should can be classified in the following groups:

1. Specific driver training
2. Integrating ecodriving in the driver test and driving school curricula.

3. Fuel saving in-car devices (e.g. on-board computers, cruise controls, stop-start systems and tyre pressure monitoring systems (tpms)
4. Communication campaigns
5. Supporting regular consultation with stakeholders on targets, means and implementation of supporting measures
6. Longer term agreements and uniform partnership aggreements with targets, strategy and some kind of compliance regime for partner organisations.

For each type of measure the gross annual energy savings are calculated.
In case the energy savings for measures are not in the same energy unit, this should be tranformed to kJ, kWh or kgoe.

It should be documented how (potential) double counting over the individual measures is handled (cf. chapter 5.2).

5 Step 3: Total ESD annual energy savings

5.1 Step 3.1: Formula for ESD annual savings

The total gross unitary annual savings do not take into account effects, such as rebound, free-riders and multplier. So this results in no changes of the formula as presented ahead in step 2.

5.2 Step 3.2: Requirements for double counting

The respective measures all relate to the average fuel use per driver and the changes in driving behaviour to reduce the fuel use. This implies that the measures and its effects influence each other. In the beginning of campaigns for ecodriving it may be expected that the double counting is relatively limited. However if ecodriving matures, this may become significant. This should be covered by regular updates of the effectiveness and efficiency factors (if energy efficient driving is growing, the additional number of drivers and the potential savings per driver decrease). Alternatively, surveys could produce combined effectiveness and efficiency factors for drivers having participated in more than one measures.

In the Dutch situation one exception has been made, namely for the in-car devices. Since these devices are regarded as means to support the behavioural changes, overlap can be expected with the effects of trainings. Therefore the effects of in-car devices are divided by two when the aggregate of all measures is determined.

In order to determine the amount of savings that can be attributed to Eco driving, it is important to be aware of other parameters influencing driving behaviour (such as the fuel price or speed limits).

5.3 Step 3.3: Requirements for technical interactions

If the baseline is normalised for the change in average fuel consumption as measured by standard tests, the technical interactions will be covered.

5.4 Step 3.4: Requirements for multiplier energy savings

Multiplier effects in this type of behaviourial programmes are likely to be measured as ‘part’ of the programme effects in surveys or in evaluations, Thus they will likely be included in indicative values and survey results. No correction factors will be suggested therefore. If measured explicitly in level 3 surveys, they may be taken into account.

5.5 Step 3.5: Requirements for the free-rider effect

The free-rider effect is not explicitly mentioned in the ESD. Free riders are final energy users who are counted when monitoring the effects of facilitating measures but would have taken the end-use actions promoted also without the facilitating measure. Consequently, including energy savings achieved by free riders in the total ESD annual energy savings would mean to include a part of the autonomous energy efficiency improvements. It has not yet been decided by the European Commission and the ESD committee, whether this effect shall be included in the total ESD annual energy savings or eliminated from them. In the latter case, the following requirements apply.

Together with uncertainties, the free rider effects are expected to be covered by the conservative factor. For level 3, free rider effects can be taken into account, based on the results from the annual surveys amongst participants and non-participants in programme actions.

6 Step 4: total ESD energy savings for 2010 and 2016

6.1 Requirements for the energy saving lifetime

In available literature (cf. Appendix I) often it is indicated that the effects of training etc diminish each year with 10%. This means that after 10 years the effect has decreased to $(100\%-10\%)^{10}$= 35% of the original value. For communication, the lifetime is assumed to be one year only. In the Dutch situation, for the moment in the calculation of the behavourial effects a lasting factor is used.

These lasting factors are recommended to be used as a default value, unless more/better information becomes available. It may turn out that the effects of supportive measures, like communication, can help to increase the lasting factor.

6.2 Special requirements for early actions

Given the saving lifetime (see section 6.1), no special requirements for early actions are needed.

6.3 Uncertainties

In determining the effects of a programme like ecodriving, uncertainties play an important role. Since hardly any measures or effects can exactly be measured, a number of assumptions needs to be made.

The assumptions with regard to effectiveness, efficiency and lasting factor are expected to have the largest uncertainties, especially the way they develop over time. Furthermore it is hard to separate the effects of ecodriving campaigns from other aspects influencing the driving behaviour like fuel prices and environmental awareness.

In order to improve reliability it is important to carry out regular updates of the suitability of the parameters used. Also the comparison of the estimated effects of individual measures with the questionnaire results on reported behaviour have proven very valuable in the Netherlands. Finally one should be careful by comparing year to year results, the trends over periods of several years provide more reliable information than the differences between individual years.

Appendix I: Justifications and sources

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