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ACTUATE

REPORT

Concept for implementation of safe eco-driving training programmes for different clean vehicle types:

trolleybus **tram** **hybrid bus**

Advanced Training and Education for Safe Eco-driving of Clean Vehicles



Site notice

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1 Introduction

This concept presents the aims, objectives, content and tips for the implementation of safe eco-driving trainings for clean vehicles. The concept has been developed in the course of the ACTUATE project (Advanced Training and Education for Safe Eco-driving of Clean Vehicles), a project of the EU's Intelligent Energy Europe Programme. Funded through the Executive Agency for Small and Medium-sized Enterprises (EASME), the aim of ACTUATE was to develop, test and implement advanced driver training and education concepts for safe eco-driving in the public transport sector.

Starting from the principle functions of clean vehicles, ACTUATE developed training materials and raised awareness about the role of drivers in improving the environmental performance of vehicles. Besides technical improvements, the correct vehicle handling in terms of eco-driving has a distinctive influence on both aspects the environment protection and the economics due to energy savings and optimised operation costs.

Therefore, the safe eco-driving training programmes of ACTUATE shall raise awareness for the knowledge, skills and competencies necessary to perform safe eco-driving as a professional driver of the clean vehicle types tram, hybrid bus and trolleybus. However, many trainings fail due to a number of reasons. Among other things a poor instructional design, a lack of managerial support, missing personal or organisational value or visibility of trainings, poor facilitators or trainers, technology failure or the wrong training method are usual reasons for failure. Against this background and the positive experience made with the trainings in the course of the ACTUATE project, this concept provides the essence of the development, testing and implementation process of the safe eco-driving training programmes.

It shall be a helpful instructional guide for preparing and implementing your own safe eco-driving training programme for clean vehicles in your company or driving school.

We wish you every success!

2 Aim of the training

The overall aim and purpose of ACTUATE's trainings for safe eco-driving of clean vehicles is: **"To impart knowledge and stimulate skills and expertise in energy-efficient, eco-friendly and safe driving of clean vehicles".**

It is up to the partner organisations whether the training organiser/operator sets up sub-aims which will support the achievement of the overall aim as stated above.

3 Learning Objectives and Learning Outcomes

Learning objectives

The learning objectives, as intended information/input for the learner, are the basis for the framework of the curricular.
The ACTUATE partners defined the following learning objectives to be transferred during the ACTUATE trainings:

- Information about environmental impact of safe eco-driving
- Information about energy flow in vehicles and characteristics of electrical parts and losses (incl. energy consumption of different aggregates, e.g. heating and air-conditioning technology)
- Information about efficient braking and accelerating to optimise energy-efficiency of clean vehicle types
- Information about the ideal drive-cycle between stops
- Information about interrelation of economics and safety and driving style
- Information about dangerous high voltage parts in the vehicles
- Information about behavior in the event of malfunctioning or accidents

Recommendation

To ensure well-formed learning objectives and that no important objective is lacking, it is important to involve all target-groups, i.e. management, trainers/instructors, technicians and drivers from the beginning into the training development process to discuss the aim and the learning objectives and how these come across to the learner/driver.

It is up to the partner organisations to add additional content to the training(s), if required, but all listed topics/information shall be integrated into the ACTUATE trainings as basic content.

Learning Outcomes

The Learning Outcomes fill the learning objectives with **„life“.**

Clarification of the objectives of training is the key to successful training. A uniform understanding of learning outcomes is required to facilitate communication between trainers, drivers and, where appropriate, management. Planning and preparation of training content and its presentation are determined by learning outcomes.

A learning outcome is defined as a statement of what a learner knows, understands and is able to do on completion of a learning process.

Thus, the ACTUATE “learning outcomes” describe what a bus/tram driver can do (skills), knows (knowledge) and applies/considers (competence as right handling) in certain situations (e.g. in case of an emergency with high voltage components of a clean vehicle) after completing the training. The learning outcomes of the ACTUATE trainings are categorized along the European Qualification Framework categories skills, knowledge and competencies and they describe which additional skills, knowledge and competencies a bus/tram driver should achieve by attending the safe eco-driving training.

Please find ACTUATE’s learning outcomes in the following table:

	Learning outcomes
Skills	To be able to drive electric powered clean vehicles in an energy efficient and safe way
	To be able to brake and accelerate in the most energy efficient way
Knowledge	Knowledge about characteristics of different clean vehicle types
	Knowledge about characteristics of electrical parts and losses
	Knowledge about path of the current (electricity) from sub-stations via the network to the vehicle (N/A for hybrid bus or any electric bus without catenary connection)
	Knowledge about the differences between electrical power unit and diesel engine
	Knowledge about kinematic chain
	Knowledge about the ideal drive-cycle between stops incl. topographic conditions
	Knowledge about behavior in the event of malfunctioning or accidents
	Knowledge about dangerous high voltage parts in vehicles

	Knowledge about environmental impact of eco driving
Competence	Ability to apply knowledge about ideal drive-cycle between stops and recuperate highest possible amount of energy based on knowledge about topographic conditions
	Responsible and autonomous acting in cases of accidents with electric-driven vehicles (input for mandatory safety at work trainings)
	Ability to communicate to passengers the importance of eco-driving

Recommendation

In case you want to develop new learning outcomes to add these to the training, the learning outcomes should be defined broadly enough in order to allow adaptation of ACTUATE's training programme without losing impact on the specific learning outcome or training respectively.

4 Content of the training

The following content of ACTUATE training's course of instruction is intended to impart abilities, knowledge and competence so drivers can achieve the learning outcomes described above and hence learn a safe style of driving for clean vehicles that saves energy.

- Learn the ideal style of driving between stops in order to achieve the best possible contribution to energy saving and the ability to apply this style of driving. The driver learns how to regulate the voltage of the electric motor via the accelerator pedal or lever and what influence the style of driving has on energy consumption or fuel consumption.
- Knowledge of efficient braking and acceleration of electrically powered vehicles. The driver must know how to utilise braking energy efficiently in order to feedback energy into the traction network or to energy storage devices.
- Knowledge of energy flow in vehicles and the characteristics of electrical components and energy loss. The driver should be familiar with the principle of the electrical power supply

in the vehicle and be able to identify the main components. He should be able to name possible sources of loss in the electric circuit.

- Awareness of topographic conditions and their impact on an energy-efficient style of driving.
- It should be made clear to the driver that it is important to consider topographic conditions as well as traffic, time of day and weather conditions in order to drive in a safe and energy-efficient manner.
- Understanding of the impact of vehicle dynamics on power consumption as well as the current path from the substation to the network and from there to the vehicle. The driver must know how to utilise braking energy efficiently as well as in conjunction with acceleration. Furthermore an understanding of the design and working principle of electric motors as well as the structure of the network, separators, etc. must be communicated.
- Knowledge of dangerous high voltage parts in vehicles. Vehicles with electric drives have a larger number of electric components installed. These are divided into control and drive units. Control units use low voltages, while normally the voltage levels in the drive unit pose a lethal hazard. The driver learns which features he can use to identify live components and how he can disconnect or switch them off if an accident occurs.
- Knowing what to do if a malfunction or accident occurs. The driver should know the general rules for recording accidents and must have mastered specific rules to observe when handling electrically powered vehicles. In particular the driver must be aware of the danger of coming into contact with live parts.
- Understanding of the interactions between safety, economy and the style of driving. The driver should understand that there is essentially no conflict of interest between these aspects. Training must teach drivers that the timetable is an important reference for determining how to work but adherence to the timetable may not under any circumstances result in the vehicle being driven to its maximum capacity and hence the safety of passengers being endangered.
- Understanding of the impact on the environment of an energy-efficient style of driving (e.g. environmental performance evaluation, CO^2 emissions of vehicles). The driver must be familiar with emission standards (for hybrid bus training) and environmental compliance as well as the impact of the style of driving on the vehicle's consumption of energy or fuel.
- Ability to act responsibly and independently following an accident involving an electrically powered vehicle. The driver must know what to do if a malfunction or accident occurs where electrically powered vehicles are involved. This includes:
    - how can a driver recognise high-voltage cables?
    - risk of injury/electric shock
    - securing the vehicle
    - disconnecting/powering down electric circuits
    - information for emergency services/fire brigade in relation to high voltages
- Ability to communicate the significance of eco-driving to passengers (may be taught as part of communication training).

Additional section: Hybrid training

The driver must be able, with the introduction of hybrid technology, to use existing systems appropriately to lower operating costs.

Understanding of the differences between diesel and electric motors. This includes:

- repetition of the working principle of the combustion engine
- design/working principle of an electric motor
- performance chart for a combustion engine/electric motor
- differences to standard power progression and effects of a hybrid drive on driving operations

Understanding of the features of the various alternative drive systems. This includes:

- parallel drive
- serial drive
- hybrid drive
- different electricity storage devices (supercapacitors, capacitors, batteries)

Figure 1: Hybrid bus

5 Target groups

Management

A commitment from top level management must be a driving force for the introduction of safe eco-driving training programmes for clean vehicle drivers, as this initiative is not simply introducing a training programme, but a Management of Change process. The "change" is related to the behavioral change of the drivers workforce and the learning culture of the company as well as regarding the alignment of corporate goals and management strategies. The senior management level of the public transport company should promote and communicate a learning culture among the driver's workforce as part of this **Management of Change** process when introducing a safe eco-driving training programme. This senior management "engagement" is critical to the effective implementation of the safe eco-driving training programme as the management should set the overall aim and a clear measurable target of the training initiative and also raise awareness for it, e.g. through a company-wide kick-off communication or the participation of decision makers at a safe eco-driving training during an early implementation phase of the training programme.

Example for an objective target by the management of the ACTUATE partner Barnim Bus Company (BBG):

- Company management has, together with BBG trainers, set the objective of lowering energy consumption in the traction network by 5 %. After the training course, the 30 trolleybus drivers in the company will be given added encouragement through greater transparency to appreciate what influence their style of driving has on a reduction in driving power in order to achieve this goal as a team.

Trainers

Trainers are the key to the success of the training sessions and the transfer of the new eco-driving style into practice. The role of the trainer is highly demanding, because professional requirements are not reduced by the introduction of new clean vehicle types in a company's fleet. Far from it, as the trainer has to be professionally well grounded, in order to plan, organise and execute the safe eco-driving training to optimally implement the learning objectives and learning outcomes in a pedagogical way.

The basis for the requirements for trainers is contained in the compliance criteria stipulated in the provisions of the pertinent laws of the country concerned. The following requirements were formulated by ACTUATE partners for conducting ACTUATE training:

- Trainers must be well informed of the latest technical developments and safety regulations for the relevant (new) clean vehicles (e.g. they should be informed of all technical details of vehicles, how they are operated and what to do if a malfunction occurs).
- They must have the specialised knowledge required to teach the subject of eco-driving and, where necessary, extend their knowledge and competence through regular advanced training sessions appropriate to the subject matter.
- Trainers who teach eco-driving and who are responsible for the practical sessions during training must enable participants to drive a vehicle safely and responsibly, while taking

passenger comfort and the environment into consideration. This means promoting a defensive style of driving and teaching drivers how to anticipate dangers as well as conveying the necessity and capability of economical fuel or energy consumption and a style of driving that reduces wear on materials.

- Trainers must be capable of designing and conducting the theoretical and practical part of safe eco-driving training and extending it as appropriate as well as adapting it to current technical, methodological and didactic requirements.

Drivers

As a matter of course, the role of drivers is crucial in improving the economic and environmental performance of vehicles. Besides technical improvements, the correct vehicle handling in terms of safety and eco-driving has a distinctive influence on both aspects the environment protection and the economics due to energy savings and optimised operation costs. Thus, drivers are the main target group of safe eco-driving training programmes.

In addition, the introduction of safe eco-driving trainings could lead to a higher level of participation and empowerment of the driver's workforce. As the job of driver normally offers limited career development opportunities, a new option could be to become a multiplier (status of a "driving tutor") for the transfer and dissemination of training content to drivers during regular line operation. Such internal promotion measures like guidance and support by multipliers or other learners are vital to get a collective view on the key learning and development issues addressed through the safe eco-driving training programme.

Recommendation

Consultation of the driver's workforce, e.g. of a few chosen drivers, at an early stage of the introduction process can lead to a feeling of "shared ownership" of the training programme and can result in greater commitment to its implementation. Furthermore, a constructive feedback communication process on the driver's performance with regard to safe eco-driving by a trainer mentor/multiplier should be integrated on a continuous basis as part of the training programme.

Walter Müller, driver at Salzburg AG:

„It's possible for us to contribute significantly to environmentally-friendly and safe public transport services. During the training sessions we received valuable feedback on our own driving style and tips on how we can perfect our technique."

6 Role of trainer and driving school

Driving schools or internal training departments are responsible in the individual countries for providing the best possible quality of training and advanced training for drivers with due consideration for all current statutory conditions.
In order to offer a well prepared eco-driving training, the initial focus must be on the existing fleet of vehicles. How well versed are drivers in the vehicles? How confident are drivers when dealing with faults? What is the current status/baseline (level of energy consumption) and what is actually to be achieved by the training course?

When defining the aim it is important to set a realistic goal and decision-makers must be clear about where savings can be made and a time must be set by which the goal must have been achieved. This goal must be developed jointly by the management and training department and then be communicated accordingly.
The success of the training course depends, of course, on a well-equipped driving school and competent driving instructors/trainers who are convinced of the usefulness of training and can act both as role models as well as figures of authority. This also means that all driving instructors must be very well trained and, where possible, should have completed a recognised form of training (foreman, trainer, technician). Their level of knowledge and methodology must be kept up to date through regular advanced training sessions.

Furthermore, a good training course depends on how well the instruction rooms are equipped, as well as on vehicles and measuring technology. Modern aids such as:

- laptop
- LCD projector
- whiteboard or blackboard
- pin board
- flip chart

should be available.


Figure 2: Training room examples (LAB, Leipzig)

7 Training Methodology

The ACTUATE pilot trainings for trolleybuses, hybrid buses and trams showed that the biggest "aha-experiences" for learners (drivers) were achieved during the practical sessions of the first ACTUATE trainings for safe eco-driving. The drivers learning effect was mainly based on concrete driving experiences regarding the comparison of the old driving behavior and testing the new eco-friendly driving style (incl. the debriefing with actual energy consumption data).
However, the integration of practical parts into trainings is only in rare cases a part of periodic training of safe eco-driving, e.g. in the Netherlands, Sweden or Spain (as part of diesel bus eco-driving training modules). Current training practice concentrates strongly on providing theoretical knowledge about fuel-efficient driving for diesel buses. However, it only rarely supports drivers in actually accumulating necessary skills and competences; that means using theoretical knowledge in real working practice.

An educational principle which supports this experience-based learning approach is the Kolb learning cycle (Kolb 1984). This "experiential" approach means that learning is relating to or resulting from experience. Kolb differentiates between four modes in his learning cycle:

1. **Concrete experience (doing / having an experience)**
2. **Reflective observation (reviewing / reflecting on the experience)**
3. **Abstract conceptualisation (concluding / learning from the experience)**
4. **Active experimentation (planning / trying out what you have learned)**

Recommendation

To experience the difference and the impact of the new safe and eco-friendly driving behavior, each driver should have two short practical driving sessions to enable a comparison between the "old" driving style and the "new" eco-friendly driving style. Therefore, the practical part of the trainings should take approx. half of the time of the total training session (depending on the size of learner groups). To support the learning effect and to have evidence for the impact of the "new" driving style on energy-efficiency optimisation of the clean vehicle, the practical sessions should be evaluated together with the drivers by measuring the energy consumption and discussing the results during the training courses.

Transferred to the ACTUATE trainings for safe eco-driving the learning cycle has the following 4 modes, in which drivers should experience concrete eco-driving experience. An observation of and reflection on that driving experience should be made:

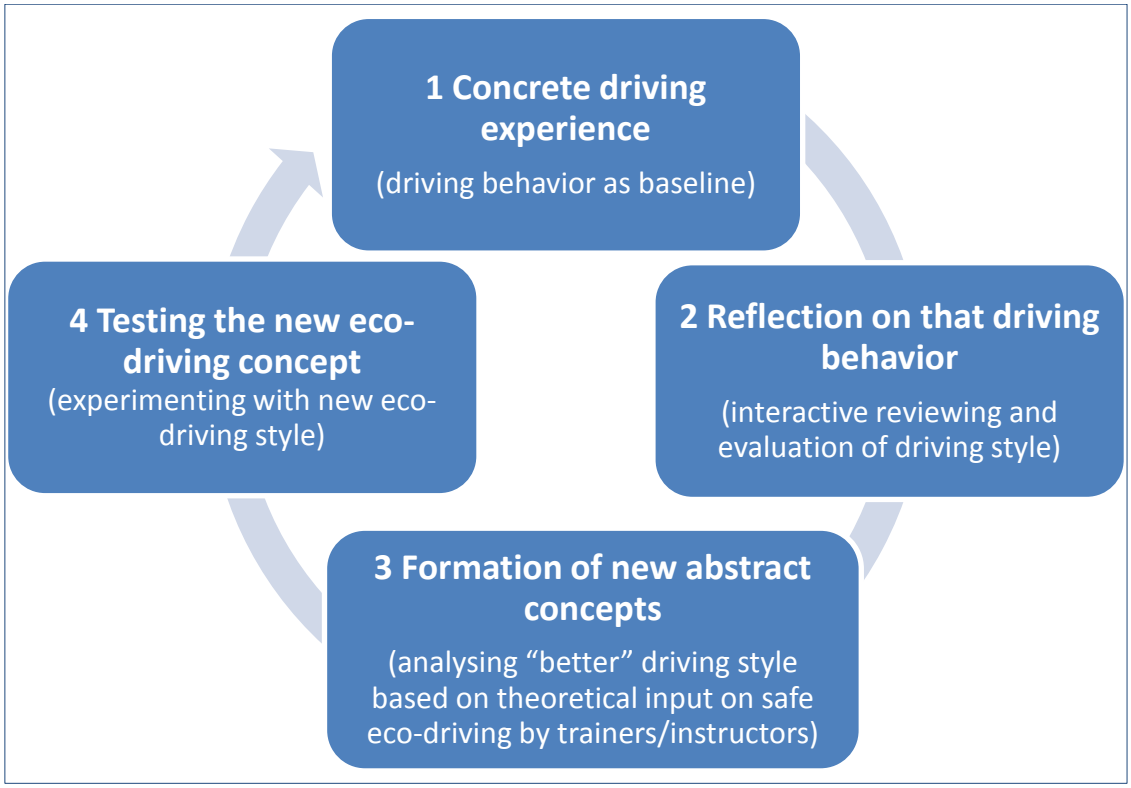


Figure 3: ACTUATE's experiential four stages learning cycle (adapted after Kolb's learning cycle)

8 Training materials

The following documents/materials can be used by public transport operators and/or driving schools to fulfill the defined basic requirements and to start their internal development of training programs for safe eco-driving training for clean vehicles:

- the ACTUATE training materials for safe eco-driving training of trams, trolley- and hybrid buses

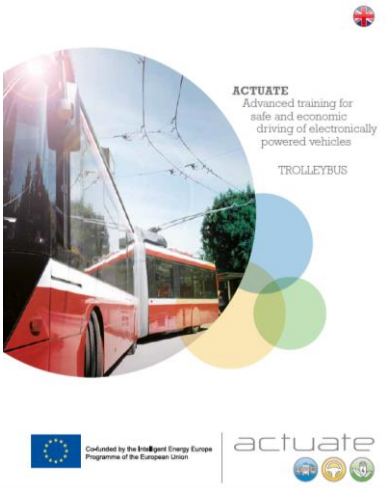


Figure 4: ACTUATE brochures
Trolleybus *Tram* *Hybrid bus*

- the evaluation results in terms of energy savings through safe eco-driving and drivers feedback about quality of trainings and in-house campaigns
- the report on an introduction strategy for the safe eco-driving training programme for clean vehicles
- the lessons learnt brochure

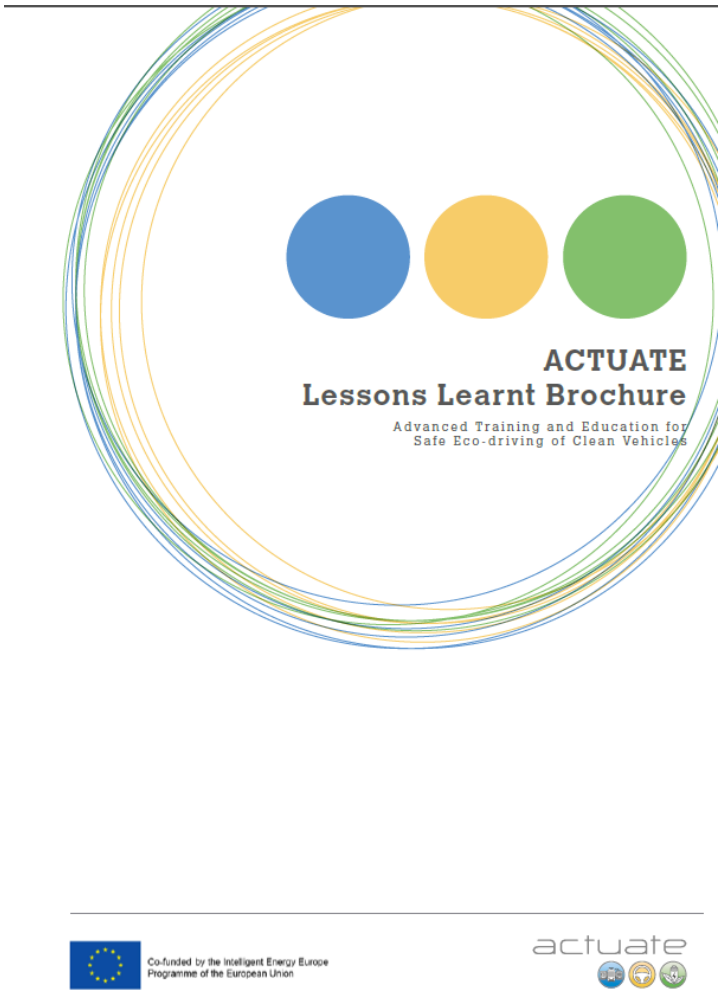


Figure 5: ACTUATE Lessons learnt brochure

All materials are available via ACTUATE's project website www.actuate-ecodriving.eu.

9 Training preparation and implementation

Preparation

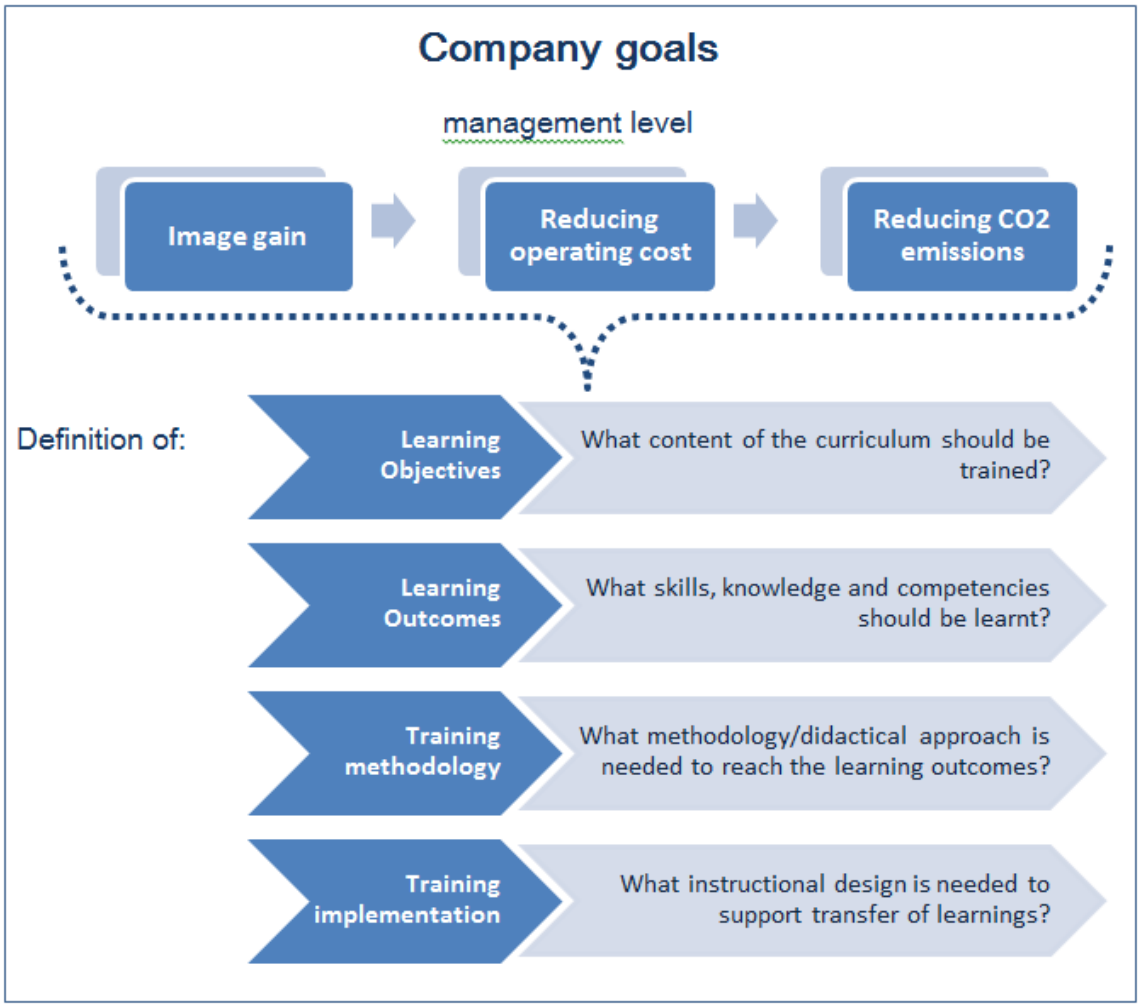


Figure 5: Main goals and implementation scheme on eco-driving

Planning the eco-driving initiative in reverse, it starts with defining the main goals and impact that should be achieved through the implementation of an eco-driving training programme.

Besides the main goal of reducing operating cost through safe eco-driving training, the environmental impact and an image gain are essential goals of the safe eco-driving initiative, as public transport passengers will also benefit from improved service quality with regard to better security or more passenger comfort through a forward-looking driving style.

The main purpose of the eco-driving training should be to reduce energy consumption through an optimized and trained driving style of clean vehicles (different types). To prove and document such impact of an optimised trained driving behavior of the clean vehicle, pre-surveys or tests measuring the energy consumption related to different driving behaviors/styles should be carried out before the training development starts.

Thus, before starting the development of a safe eco-driving training programme, the involved people at planning stage should have notice of the actual energy consumption related to the operation of clean vehicle fleets. Therefore, a monitoring of the energy consumption is a

precondition to start eco-driving initiatives, as the actual energy consumption rates build the baseline against which improvement, thus, reduced energy consumption through a trained eco-friendly driving behavior could be monitored/measured. The profound knowledge about actual energy consumption related to the drive train of a clean vehicle is basis for the formulation of targets, what wants to be reached by the safe eco-driving trainings. E.g. in terms of reduction of energy consumption a target corridor, for example reduction of diesel fuel of hybrid buses through eco-driving between 5% and 10%, could be set as the overall goal of the eco-driving initiative.

Reminder

Great progress has been made in technical improvements to the energy efficiency of vehicles and the operational infrastructure. However, as long as journeys cannot be carried out in automatic mode, drivers continue to exert a not insignificant impact on energy efficiency. This impact must be influenced positively in terms of eco-driving through appropriate training and persuasive methods.

This needs generally technological knowledge and technical support by the engineering department installing the hard- and software needed to measure the energy consumption and to readout the monitored data. With regard to the data monitoring, the consultation of the works council should be realised at an early stage and should become part of the personnel and labour policies when introducing safe-eco driving trainings to discuss privacy policies and data security.

Furthermore, pre-instruction and briefing of trainers and technical experts by bus and tram manufacturers about specifics of the clean vehicle types is needed beforehand.

Manuals, operating instructions and manufacturers' instructions for clean vehicles must be available in the planning phase. Furthermore, a list of questions is to be compiled by all participants and discussed and worked through with the manufacturers.

For the training of the driving instructors regarding the content and methodology of the new training programme a "train-the-trainer" concept should be realised.
When planning training, it is essential to clarify how many drivers are to be trained and how much time is available. This will define the number of vehicles and the number of training staff required. It may be necessary to select participants if only certain drivers are allowed to drive these vehicles.
Furthermore, the needed hard- and software for energy consumption measurements and/or monitoring should be purchased/provisioned and implemented to start with test series regarding the influence of the driving style on new and more effective clean vehicle technologies like for example "supercaps" or the hybrid technology.

Therefore, also the choice of an appropriate test route, on which eco-driving effects become obvious (under highest possible real life conditions), is very important.

Pilot training

The aim of the pilot phase is to test a full workable training session in a sense of a "final rehearsal". This pilot test training should be carried out with representatives from the (senior)

management level and selected drivers, who should be widely accepted and experienced. This will support communication about the benefits of the safe eco-driving training and hopefully the training will become already a “success story” in the “office grapevine”.

A detailed and comprehensive feedback from the participants is important after the planning, organisation and implementation of the pilot training. Each pilot training should give opportunities to practice the eco-driving style, to assess comprehension of the training material and to document the progress in terms of energy savings reached by the drivers during the training. Also the feedback/evaluation template should be tested at the end of the pilot training (see Annex II).

Training implementation

There are two ways of providing training on eco-driving. The first method is for all drivers in the driving school to be trained by the driving instructors themselves. Whether this is possible depends on the size of the company and the number of instructors as well as the training workload of the driving school. The second method is to select certain employees (for example, trainee drivers) who receive intensive and thorough training on this subject in the driving school with instruction on methodology. These well trained employees then act as multipliers and pass on their new knowledge to other drivers. Each company must take the decision, which way fits best to its organizational structure, itself.

The training is set up in five phases:

1. Introduction and functioning of clean vehicle „system“
2. Practical driving (before theoretical input about safe eco-driving principles)
3. Theoretical input about safe eco-driving principles
4. Practical driving (using (new) knowledge about safe eco-driving principles)
5. Safety aspects and emergency procedures for clean vehicle type

During the practical part of the training energy consumption will be measured and recorded by customised software and subsequently displayed on a protocol (if possible). The protocol should include general data like trip duration, trip length, average speed, weather conditions, and time of day.

Regarding reduced energy consumption of safe eco-driving two measure indicators are crucially important: total energy consumed for each kilometre in operation and energy consumption per kilometre solely related to driving operation.

An example of a training agenda can be seen in Annex I - according to a seven hours training module in line with European directive 2003/59.

The Directive also provides the opportunity to take practical driving hours at a top-of-the-range simulator. Almost all Member States, with the exception of Austria and Lithuania, allow the use of simulators for driving training, but this practice is not widespread. For example, France and Denmark offer the possibility to participants of periodic trainings to complete some of their practice (30 minutes) on a simulator.

A study conducted in ACTUATE showed that in general the practical driving part of safe eco-driving trainings can be performed as a simulator-based training – also for new and innovative electric driven vehicles in the public transport sector. Eco-driving is a good topic to be trained on a simulator, as several traffic, weather or topographic situations/conditions could be simulated to train eco-driving and even a desktop simulator could be used to achieve pedagogical and didactical pre-defined goals raising awareness for this topic. Higher sophisticated simulators of course could also be used for further training topics and are not limited to eco-driving training.

The conditions for a successful simulation of eco-driving training must be well defined and in many cases the costs are suitable in comparison to the achievable savings. However, costs for simulator are always an add-on and compared to traditional training simulator-based eco-driving training only make sense when substituting original clean vehicles used for training by a simulator to a certain extent to achieve cost savings. Nevertheless, besides the cost aspect, there is quality-related aspect to provide situation-based and more intensive training options than possible with traditional methods. But often high acquisition costs require for accurate cost/benefit analysis and calculation of economic and energy savings potentials of simulator-based practical training sessions. Finally, the ACTUATE partners think that practical “real” further training is indispensable and most effective and sustainable, but driving simulators could be useful for basic skills eco-driving training during basic qualification of professional drivers (in case the cost-benefit analysis is positive for simulator-based trainings).

Roll-out phase

Main activities during the roll-out phase are measuring the performance indicators to help assess the specific impact of the training and the communication to the driver’s workforce who will be affected by the training (see above). Furthermore, it will be important to respond to difficulties during the implementation of the training programme (e.g. related to negative feedback about the training quality or problems with the measurement equipment) to ensure or optimise the quality of the safe eco-driving training programmes.
It is important to review possible implementation risks beforehand and to allocate sufficient resources to provide appropriate response capacity, including the worst-case option to pause or roll back the implementation of the training programme if serious difficulties emerge.

10 Training evaluation and impact assessment

Assessment

The evaluation and impact assessment of the training programmes for safe eco-driving of clean vehicles should give information about the following aspects (according to the four levels of evaluating training programmes by Kirkpatrick (1994)):

- Reaction – a measure of satisfaction (what the trainees thought and felt about the training);
- Learning – a measure of learning (the resulting increase in knowledge or capability as reflected in end of course assessment);
- Behaviour – a measure of behaviour change (extent of behaviour and capability improvement as reflected in on the job performance);
- Results – a measure of results (the effects on the institutional environment resulting from the performance).

Transferred to the ACTUATE context, the essential questions the evaluation needs to address on the five levels of the ACTUATE evaluation framework are illustrated in the table below:

Level	Measurement focus	Questions addressed
Reaction	Driver's perception	What did drivers think of the safe eco-driving training programmes?
Learning	Knowledge/skills gained	Was there an increase in knowledge or skill level of the trained drivers?
Behaviour	Worksite (the driver's workplace, line operation) implementation	Is the new knowledge/skill being used on the job/in line operation by the trained drivers?
Results	Business impact on organisation (Public Transport Company)	What effect did the safe eco-driving training have on energy consumption of clean vehicles?
Long-term impact	Return on investment and intangible outcomes	Were the benefits/impacts greater than the cost for the safe eco-driving training programmes? Was there a reduction of greenhouse gas emissions through safe eco-driving of clean vehicles? What effect did the safe eco-driving training have on the drivers' workforce

		satisfaction? Are there corporate image benefits through improved passenger satisfaction?

Table 1. Kirkpatrick's evaluation levels - adopted to ACTUATE

The feedback to these aspects should be reviewed and the training should be adopted afterwards, if necessary, for a further successful implementation. The ACTUATE partners followed the above described evaluation approach and results can be found in more detail in the evaluation report available on ACTUATE's project website www.actuate-ecodriving.eu.

The experience and testing of IT driving assistance devices in ACTUATE showed that higher energy savings can be reached through the use of these devices. In order to optimize drivers' learning effects, the installation of tools providing constant feedback helps drivers to bear in mind and apply the rules of eco-driving. Making use of an easy-to-understand and highly-illustrative IT driving assistance (and monitoring) tool such as a red/ green traffic light device that is installed in the operator's cabin and displays whether the driver is making use of an eco-friendly driving style is highly recommendable.

11 Motivational campaigns to sustain training impact

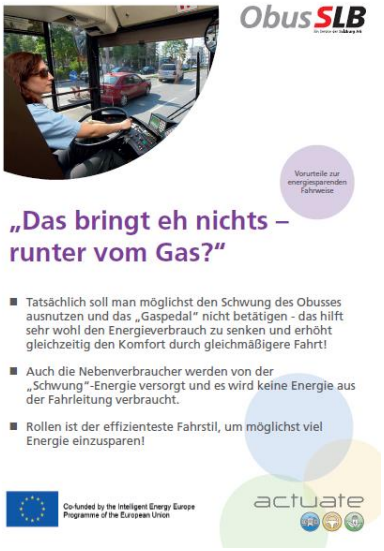
Once the set goal of reduced energy consumption (and by this operating cost) through safe eco-driving has been achieved, complacency should not be allowed to set in. It is very important, albeit very difficult; to ensure the new skill of eco- driving is sustained. To sustain the training effect with regard to an eco-friendly and economic driving behavior in the long-term, an in-house (motivation) campaign, targeted at the driver's workforce, could be implemented as additional measure. The ACTUATE partners developed different concepts for in-house campaigns ranging from poster campaigns and drivers championships to green licenses with a bonus point system (as incentive system). For example, a repeat training session, an elearning programme or questions set as a postcard quiz as possible elements of an accompanying motivation/in-house campaign can help to sustain the training effect.
Furthermore, experience from the ACTUATE project has shown that small gifts, such as coffee mugs, a lunch box, a pen, etc. as a small thank-you and an aid to memory were met with very positive acceptance by the drivers of the companies participating in the project.

The ACTUATE partners developed simple non-interactive eLearning resources like short Power Point presentations, documents with photos from ACTUATE partner cities and experiences made with safe eco-driving trainings or formats like a short quiz etc. These eLearning resources can be provided via web-based access on computers, e.g. in the break rooms of the driver's workforce.
The feedback from drivers who tested the e-learning modules was almost consistently positive with regards to format and content – the drivers even recommended the modules to colleagues – , but there was only very limited interest of drivers from ACTUATE's partner companies in testing the e-learning modules. Reasons for this lack of motivation can be seen in missing incentives and the inaccessibility of modules in the respective working environments.
Nevertheless, with regards to the feedback given by the participating drivers, e-learning can be a very attractive, alternative learning channel to refresh the knowledge of professional drivers. However, eLearning cannot replace practical eco-driving courses and eLearning could be

integrated into regular (Directive-specific) compulsory trainings to ensure at least annual refreshes of the drivers' knowledge.

Figure 6: Motivational campaign, TEP, Parma, Italy

Motivational campaign LVB, Leipzig, Germany



Motivational campaign SAG, Salzburg, Austria

12 Closing words

If your company intends to save energy with well-trained drivers, you can utilize this training concept and the related training materials booklet, adapt these to your corporate identity and local conditions and put the training programme for safe eco-driving of clean vehicles into practice.

We hope that our materials, developed in the course of the ACTUATE project, will help you to start to tackle the subject of saving energy through eco-driving in your company.

We wish you every success!

Figure 7. The ACTUATE team

13 Annexes

Annex I: Example agenda for an ACTUATE training session in Salzburg – trolleybus eco-driving

Time	Agenda items
07:15 – 07:30	Welcome address
07:30 – 9:00	Classroom training (introduction to topic; „system“ trolleybus)
09:00 – 09:30	Coffee break & exchange of experiences with training instructor
09:30 – 11:00	Practical training: safe eco-driving (measuring energy consumption)
11:00 – 11:30	Classroom training: eco-driving with trolleybuses (theoretical input)
11:30 – 12:30	Lunch break
12:30 – 14:00	Practical training: safe eco-driving (measuring energy consumption)
14:00 – 14:30	Coffee break
14:30 – 15:00	Evaluation, de-briefing, discussion of measurement results
15:00 – 16:00	Classroom training: Safety aspects, procedures in case of emergency and/or service interruption
16:00 – 16:30	Feedback and question and answer session

Annex II: Feedback questionnaire: ACTUATE-specific set of questions to evaluate quality of trainings

Dear employee/ colleague,
With your help we would like to evaluate the quality of our education and training programme. We would appreciate if you can take some time to go through this questionnaire and answer the following questions:

1. How do you assess the overall quality of the training?
(1 excellent/ 2 very good/ 3 average / 4 poor/ 5 very poor)
remarks:…….

2. Were you already aware of the topic of eco-driving before the training?
Yes, through……. No

3. How do you rate the relevance of this topic?

- for the public transport operator:
very relevant/ relevant/ less relevant/ not relevant/ I don't know

- for your daily work routine:
very relevant/ relevant/ less relevant/ not relevant/ I don't know

4. How do you assess the quality of the written training and education material being used?
Amount/scope: exactly right/ too little/ too much/ useless/ did not receive any

Quality: very good/ good/ sufficient/ poor/ very poor

5. How do you assess the content of the training and the way it was brought across?
(1 excellent/ 2 very good/ 3 average / 4 poor/ 5 very poor)