

ACTUATE **Lessons Learnt Brochure**

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



Co-funded by the Intelligent Energy Europe
Programme of the European Union

actuate





ACTUATE

Advanced training for safe and economic driving of electronically powered vehicles
Co-funded by the Intelligent Energy Europe Programme of the European Union

Site notice

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WELCOME!

ACTUATE (Advanced Training and Education for Safe Eco-driving of Clean Vehicles) was 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.

Previously existing eco-driving initiatives had mainly focused on diesel vehicles, so there was a real void to fill. By supporting the introduction of safe eco-driving training, ACTUATE was able to further exploit additional energy savings potential, by getting the most out of clean vehicles such as trams, hybrid buses and trolleybuses.

In order to unlock this potential, the project put a particular focus on the drivers, as they are the pivotal element for better vehicle handling, safer performance and optimised energy savings. ACTUATE developed numerous sets of training materials, such as concepts, brochures and presentations, in order to implement comprehensive programmes for safe eco-driving. Motivational campaign materials to start up targeted initiatives at public transport companies were also produced. ACTUATE focused on sharing knowledge and helping build momentum with dedicated "train-the-trainer" workshops. All of the training materials are available free of charge on the project website: www.actuate-ecodriving.eu.

We want you to benefit from our experience and this document therefore summarises the lessons that were learnt. Please consider this brochure a helpful instructional guide for preparing, developing and implementing a safe eco-driving training programme for clean vehicles.

Find out more on the following pages and enjoy learning about the impressive project results!

Your ACTUATE team



The ACTUATE team



ACTUATE – WHAT IS IT ABOUT?

The ACTUATE project can sincerely be called the first of its kind dealing with the topic of eco-driving of clean vehicles in the public transport sector.

In response to the introduction of new clean vehicles and technologies and a lack of corresponding skill sets and divergence in implementation, the ACTUATE partners developed the necessary safe eco-driving trainings for clean vehicles. Hereby, ACTUATE made an attempt to match the clean vehicle technology market with the required skills needs.

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

ACTUATE Objectives and Main Steps

Integrate ACTUATE trainings for safe eco-driving into formal bus driver qualification of public transport (PT) companies;

- Development and testing of safe eco-driving training programmes for tram drivers as well as hybrid- and trolleybus drivers (in accordance with EU Directive 2003/59/EC)

Enhance the quality of bus driver training and expand the training to the special requirements of clean vehicles;

- Definition of minimum quality criteria & learning outcomes

Demonstrate the energy saving potentials on the basis of capacity building in energy efficient driving of clean vehicles;

- Evaluation of training sessions with more than 1.500 drivers

Upscale the outcomes for wider up-take at European level.

- Test of trainings at additional PT companies & “starter kits”

THE ACTUATE PROJECT can sincerely be called the first of its kind dealing with the topic of eco-driving of clean vehicles in the public transport sector.

In response to the introduction of new clean vehicles and technologies and a lack of corresponding skill sets and divergence in implementation, the ACTUATE partners developed the necessary safe eco-driving trainings for clean vehicles. Hereby, ACTUATE made an attempt to match the clean vehicle technology market with the required skills needs. The ACTUATE project used a dual approach regarding the measurement of progress and success.

1. It aimed at integrating safe eco-driving in formal driver qualification systems of public transport operators, thus generally raising the driver’s workforce awareness of energy efficiency as a standard.
2. The trainings conducted during the past two years resulted in very concrete energy savings and reductions of greenhouse gas emissions, not only during the project’s lifetime but also in the long-term by providing other public transport operators with the opportunity to adopt the developed training concepts. These very concrete results became visible immediately after drivers had participated in the trainings when applying the newly acquired safe eco-driving techniques in regular operation.

In conclusion, the project was based on a sustained change in driving habits. It laid a particular focus on drivers as the pivotal element for better driving performance and energy saving. Through the use of encouragement campaigns, the trainings were designed to achieve immediate energy savings and to motivate the drivers to use their newly acquired eco-driving skills in the long term.

ACTUATE IN A NUTSHELL

With the aim **to optimize driving performance for reduced energy consumption**, the ACTUATE team developed and applied advanced driver training and education concepts on **safe eco-driving of clean vehicles** in the public transport sector. Eco-driving has the potential to reduce both emissions and operating costs as well as to increase passenger safety. By understanding and using the whole potential of clean vehicles, the energy consumption can be reduced by 10%, and by that also the CO₂ emissions, because of an optimised driver’s behaviour. ACTUATE provides a range of **key benefits** for interested stakeholders, including information materials on training and promotion campaigns. All **outputs and results of the project** – such as minimum training criteria, learning outcomes and training concepts/material for eco-driving – will help other public transport providers to train their own drivers in a tried and tested manner.

ACTUATE FACTS AND FIGURES

- Project duration: May 2012 to January 2015
- Altogether, the public transport companies directly involved in the project operate fleets consisting of 635 trams, 261 trolleybuses and 19 hybrid buses and employ 1.237 tram and 1.306 (trolley-)bus drivers (incl. sub-contracted drivers)
- Project budget: 1.345.568 EURO (of which about 1 Mio. EURO or 75% funding)



CONTEXT INFORMATION

Environmental aspects

Clean public transport vehicles, such as trams, hybrid buses or trolleybuses offer a number of ecological advantages when compared to ordinary diesel-powered vehicles. They either run on electricity or consume less fuel, thus reducing CO₂ emissions in both instances.

Therefore, these clean vehicle types are more environmentally-friendly and constitute an important component for the achievement of the European Union's 2020 targets for improving the energy efficiency and reducing CO₂ emissions of vehicles.

The vehicle market

The approach of the clean vehicle directive of the EU to include the vehicle's lifetime operational cost for energy consumption, CO₂ and pollutant emissions into the economic assessment of public transport vehicles can change purchase decisions and accelerate the market penetration of clean vehicles. The costs for line operation of clean vehicles can be optimised by reduced energy consumption through an optimised driving behaviour or eco-driving respectively.

Professional drivers education

Another point is that the introduction

of new clean vehicles is accompanied by increasing demands with respect to the qualification of professional drivers concerning driving behaviour and new safety standards. Yet, no specific requirements and vocational/ further trainings for safe eco-driving of clean vehicles existed so far and trainings are limited to eco-driving training programmes for diesel buses and workshop/maintenance safety regulations only.

Therefore, ACTUATE developed a comprehensive and thoroughly tested training programme for safe eco-driving of clean vehicles.

According to the directive 2003/59/EC, which regulates basic and further (vocational) training for professional drivers in Europe, eco-driving and safety trainings are a mandatory further education module. Yet, the implementation of the directive varies strongly from country to country and did not overcome a diverse qualification and training situation in Europe. This has negative impacts on quality aspects, not leading necessarily to a common level of initial qualification or training quality and thus, professional drivers' abilities. Hence, ACTUATE's training programmes are based on jointly defined learning outcomes and minimum quality criteria.

Before developing the actual training concept on eco-driving, the ACTUATE project partners defined minimum criteria and standards, e.g. with respect to quality aspects of the trainings that had to be attained. This would allow for the integration of the trainings into future trainings of public transport providers as well as future qualification frameworks for professional drivers. Additionally, all project partners and external public transport operators reviewed and validated the training concept.

The ACTUATE project consortium

consists of five public transport operators from four European countries and three other European experts in the field of clean urban mobility, including a bus manufacturer, a trolleybus association and a consulting firm.

The ACTUATE public transport partners:

- Salzburg AG für Energie, Verkehr und Telekommunikation, Austria
- Leipziger Verkehrsbetriebe GmbH, Germany
- Leipziger Aus- und Weiterbildungsbetriebe, Germany
- Trasporti Pubblici Parma S.p.A., Italy
- Dopravní podnik města Brna a.s., Czech Republic
- Barnimer Busgesellschaft mbH, Germany

European experts in the field of clean urban mobility:

- Rupprecht Consult Forschung und Beratung GmbH, Germany
- trolley:motion, Austria

Industry partner:

- Van Hool NV (VH), Lier, Belgium

WHAT IS ECO-DRIVING?

Eco-driving is driving that optimises energy use and contributes significantly to emission reduction as promoted by the European Commission. Identifying and reducing inefficient driving habits and energy-wasting manoeuvres (e.g. harsh braking, needless accelerating) has the potential to reduce both operating costs and emissions as well as to increase passenger safety.

While the potential of eco-driving for private cars and diesel buses is well understood, eco-driving for electric fleets in the public transport sector is not yet widely known or practiced.

achievements



OUR FOOTPRINTS – THE ACTUATE PROJECT RESULTS

ACTUATE PROJECT ACHIEVEMENTS

- More than **1.700 drivers** have been trained with ACTUATE's training programmes for safe eco-driving of clean vehicles (800 tram and 944 bus drivers).
- More than 250 training sessions have been carried out.
- More than 1.500 training rides have been evaluated to determine energy savings potentials of safe eco-driving behaviour.
- More than 90% of the trained drivers rated the overall quality of the ACTUATE training as either 'excellent' or 'very good'.
- More than 40 multipliers have been skilled to train tram drivers in Leipzig and Brno in safe eco-driving.
- More than 70 trainers from 28 public transport operators have been educated in train-the-trainer workshops to perform the safe eco-driving trainings at their companies.
- More than 70 drivers tested the ACTUATE e-learning modules to refresh drivers' knowledge on eco-driving and rated the modules almost completely as successful and recommendable.

ACTUATE's project results confirm potential savings of several thousands of tons of greenhouse gas emissions and Euros per vehicle and year!

Our results show that eco-driving boasts a huge potential to make bus and tram fleets safer and significantly more energy efficient. By training drivers how to operate the vehicle adapting an eco-driving style, entire electric bus and tram fleets can be made much more energy efficient. Thus, several thousand Euros and vast quantities of energy can be saved per vehicle and year. This also means a reduction of air pollution and CO₂ emissions in our cities.

Furthermore, it creates an even bigger environmental advantage for clean public transport vehicles over comparable diesel vehicles or private cars.

Energy savings and the reduction of greenhouse gas emissions achieved by each project partner varied depending on the type and number of vehicles operated, local geographical conditions and other external factors (i.e. weather and traffic conditions). In order to assess the impact of the safe-eco driving trainings for clean vehicles, a reliable database was necessary. Thus, before and after training measurements

on energy consumption for each vehicle type were conducted by the participating operators.

Due to technical reasons, different approaches were followed to measure and compare the energy consumption before and after the ACTUATE trainings. For the ACTUATE partners LVB (Leipzig) and DPMB (Brno) it was technically only possible to measure the energy consumption of their trams between two substations.

Measurements for individual vehicles were not possible. The same approach was used by SAG (Salzburg), where the energy consumption of its trolleybuses was measured between two substations in normal operation, before and after the trainings took place. Trolleybuses operated by TEP (Parma), BBG (Eberswalde) and DPMB (Brno) are equipped with energy consumption meters that allow for data collection for each individual vehicle.



Many people trust our project partners' public transport on a daily basis.



Van Hool's articulated ExQuiCity trolley bus is used in the city of Parma - it is equipped with supercapacitors.



Christian Osterer, ACTUATE project manager, Salzburg AG

„During the first training session, all energy consumption measurements were still made without the drivers having been educated in the principles of eco-driving. It was only in the second “hands-on” session that the drivers started to apply in practice what they had learnt in theory and immediately 20% electricity savings on average became apparent. This formidable figure clearly demonstrates the huge savings potential, if eco-driving is consistently and continuously applied. In a best-case scenario, we could save 6% of our total annual energy consumption through the introduction and application of eco-driving and therefore believe that 3% will be realistic on a long term basis.”

Energy savings per year by ACTUATE partners¹ based on a 4,5% scenario

	Tram	Trolleybus	Hybrid Bus	Total
Number of vehicles in ACTUATE's partner fleets	635	261	19	915
Total annual energy consumption of vehicles before the action (kWh)	105.113.225	30.846.829	5.987.800	141.947.854
Annual energy consumption after trainings with 4,5% savings (kWh)	100.383.130	29.458.722	5.718.349	135.560.201
Energy saved during the ACTUATE project (kWh)	4.730.095	1.388.107	269.451	6.387.653

Project partner results (calculated for one year)

	Approximate annual costs for energy to operate clean vehicle fleets (in EURO)	Average energy savings – based on long-term evaluation	Money savings (in EURO)
Eberswalde (Trolleybus)	353.303	6.4%	ca. 22.500
Salzburg (Trolleybus)	540.000	6%	ca. 32.000
Leipzig (Trams)	7.000.000	3%	ca. 210.000
Leipzig (Bus)	5.625.000	4%	ca. 225.000
Brno (Tram)	3.043.370	2.5%	ca. 76.000
Brno (Trolleybus)	1.126.950	6.5%	ca. 73.250
Parma	300.000	4%	ca. 12.000
Total money savings for ACTUATE partners			ca. 650.750
Average energy savings		4.6%	

Based on the overall reduction of energy consumption by 4,5% as a result of the eco-driving trainings applied in ACTUATE's public transport partner companies, this leads to

- primary energy savings of 549 tons of oil equivalent per year and a
- reduction of 2.938 tons of greenhouse gas emissions per year!

Projected by 2020 (starting from 2015), the ACTUATE partners would save

- primary energy savings of 3.294 tons of oil equivalent by 2020 and a
- reduction of 17.628 tons of greenhouse gas emissions by 2020!

ACTUATE partners will save nearly 18.000 tons of greenhouse gas emissions by 2020 through the application of safe eco-driving of their clean vehicle fleets!

With about 190 tram, 150 trolleybus and approximately 50 cities operating hybrid, battery-powered or hydrogen-fuelled buses in Europe, there is vast potential to upscale the effects of the ACTUATE project.

¹ 12 months of reduced energy consumption calculated for all other partners and vehicle types till October 2014
² Calculation of energy consumption for hybrid buses is based on annual diesel fuel consumption (1 litre diesel fuel = 9,8 kWh).

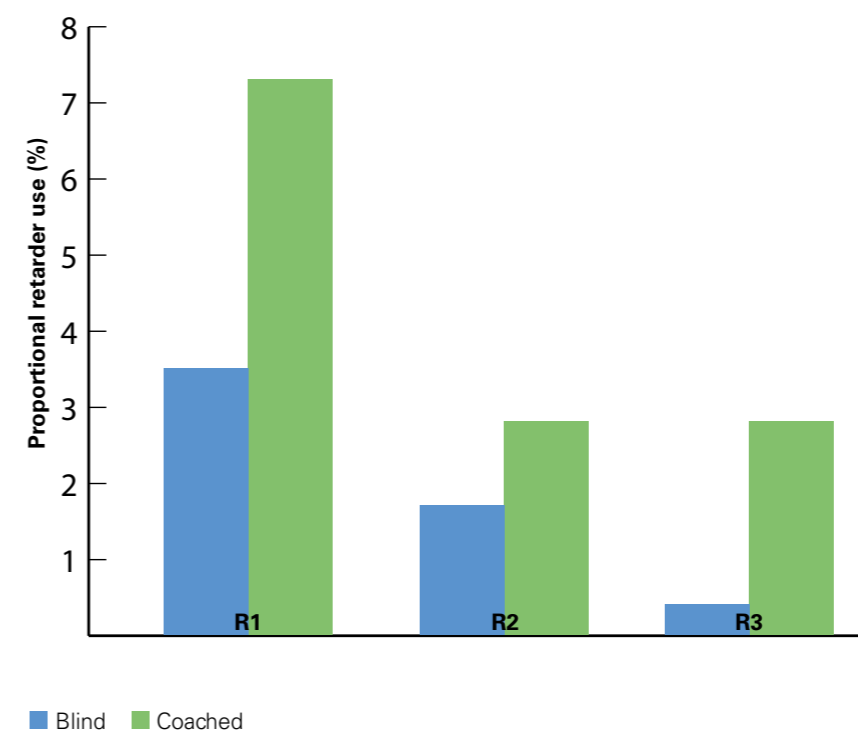


SAG's new trolley buses in metro-design are all equipped with devices that constantly measure the energy consumption of each vehicle.



Recuperated energy is valuable: 98% of the energy fed back into the grid is being used by our project partner LVB.

Increase of retarder use during coached eco-driving training rides with trolleybus drivers in Parma





LESSONS LEARNT

ACTUATE's consortium members from Salzburg, Leipzig, Parma, Brno and Eberswalde as well as the industry partner van Hool made a cumulative investment of about 682.000 EURO into the development of the safe eco-driving programmes for clean vehicles. This includes all costs, also spent on measurement equipment, printing of training materials and the accompanying implementation of in-house motivation campaigns (but without project management cost and overhead rates). This investment pays off already almost one year after the implementation of the safe eco-driving trainings, as the companies can save about 650.000 EURO per year in total (see tables on page 13).

The following example shows the cost-benefit ratio for the LVB in Leipzig, which trained 1.350 drivers (750 tram and 600 bus drivers) in safe eco-driving (supported by a driving school partner from Leipzig):

Cost-benefit ratio for ACTUATE project partner LVB

	Costs in EURO: (mainly personnel cost)
Training development and introduction	40.000
Training implementation	50.000
Training monitoring and evaluation	20.000
In-house motivation campaign	20.000
Drivers personnel cost ⁴	-
Total cost:	130.000

	Benefits:
Energy saved (tons of oil equivalent / year)	299
CO ₂ emissions avoided (tons / year)	1.597
Money saved (EURO / year)	435.000

LEARNING I
Money invested in eco-driving pays off quickly!

⁴ In Leipzig, drivers participated in their free time at further trainings and thus, no personnel cost for drivers have been included in the example shown in the table above. But even with additional personnel costs of about 170.000 EURO for budgeted hours to train 1.350 drivers, the training cost amount to 300.000 EURO and the initiative still has a positive cost-benefit ratio after one year!

The costs of launching a safe eco-driving training programme at your public transport company can be budgeted as staff training and continuing education expenses. The actual costs to your company should be significantly reduced, as you may use for free all of the training materials that were developed by the ACTUATE project. These documents can easily be adapted and also visually modified to reflect your own corporate identity. Please visit the following site: www.actuate-ecodiving.eu/index.php?id=21

In case you require files that can be edited, please get in touch with the project coordinator. You will find the contact details on the last page of this brochure.

But not only energy costs can be saved by safe eco-driving training, but also further tangible benefits like the reduction of abrasion effects on clean vehicles, which are of importance due to high cost per unit for clean vehicles, and on the required infrastructure in case of trolleybus or tram systems. Furthermore, many drivers gave the feedback that the emphasis on “looking ahead” through eco-driving helps them

to reduce stress, which is a health benefit becoming a monetary benefit due to the comparatively high sick leave rates of professional tram and bus drivers across Europe. However, these monetary benefits are difficult to be valued and need long-term monitoring of the effects.

The driver makes a difference!
Leipzig's bus and tram drivers save about 1.600 tons of CO₂ emissions per year and more than 400.000 EURO by applying safe eco-driving techniques!

On the following pages, further lessons learnt are structured chronologically along the steps that need to be taken when introducing eco-driving in your organization. First, you will learn about what needs to be done upfront before the implementation of the actual trainings – what are the prerequisites of a successful eco-driving campaign, who are the people that need to be involved? Second, based on our experiences we have some valuable recommendations regarding the eco-driving training itself. Here, you will find information on what material should be used and how the training is best set up. Third, we will provide some tips on subsequent steps to be taken when trainings have been carried out.

Here, we will write about our experiences on how to achieve the desirable long-term effects of trainings and how to best communicate, both internally and externally, about eco-driving.



1. PREPARING THE TRAINING

LEARNING II
Be well organized and plan ahead when introducing safe eco-driving training programmes!

The introduction of safe eco-driving training programmes at public transport companies requires a strategic approach.

Not only is it necessary to involve the drivers, clearly representing the majority of staff in public transport companies, but also the management level. In addition, certain personnel and labour policies should be adapted. The safe eco-driving trainings of clean vehicles make this link more tangible and demonstrate the direct relationship between the technology dimension (clean vehicle technologies) and the learning and training needs (of drivers

of newly introduced clean vehicles). Therefore, it is of particular importance to pay attention to the evaluation and monitoring methodologies to be able to assess impacts from the beginning on in order to ensure the sustainability of measures when introducing safe eco-driving training programmes for clean vehicles. Transferred to the ACTUATE context, the ACTUATE project partners built their training programme evaluation on the model developed by Kirkpatrick (1994). The essential questions that the evaluation needs to address on five different levels are illustrated in the table below:

Kirkpatrick's evaluation levels, measurement focuses and questions addressed in ACTUATE

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 driver's workforce satisfaction? Are there corporate image benefits through improved passenger satisfaction?

LEARNING III
A profound understanding of the existing energy consumption levels in your public transport company by different types of vehicles actually forms the basis of learning how clean vehicles can save even more energy through the use of eco-driving!

Ensure sound monitoring!

Before starting the development of a safe eco-driving training programme, your organization should know about the actual energy consumption related to the operation of the clean vehicles in your fleet. Therefore, detailed monitoring of energy consumption is a precondition to the initiation of eco-driving initiatives, as the actual energy consumption rates build the baseline against which potential improvements need to be compared. A profound understanding of the existing energy consumption levels of clean vehicles

will allow you to establish new targets for saving even more energy. Only then, realistic goals aiming for the reduction of energy consumption, for example a 5% reduction of diesel fuel for hybrid buses within a time period of one year, can be set for the eco-driving initiative.

This generally requires technological knowledge and technical support by the engineering department of your public transport organization in order to install the necessary hardware and software and to understand the monitored data.

During the train-the-trainer workshops, participating driving instructors emphasised the lack of sufficient energy measurement technologies and monitoring devices in their fleet as a main barrier to introduce safe eco-driving training programmes in a sustainable way. To provide a sound basis for safe eco-driving training programmes, public transport companies should include such technologies and devices in futures tenders for clean vehicles, just like the ACTUATE partner LVB did for tendering new trams for Leipzig.

Measurement technology used by TEP in Parma, including hardware and software.



Source: TELEPARKING Srl

Good driving behavior

Bad driving behavior



Michael Schoppe during a pilot safe eco-driving training session for hybrid bus drivers in Leipzig.

Michael Schoppe (LVB) on the successfulness of the project

„Even at first sight, the results are very impressive. The difference between a normal ride and an eco-optimised run, which applies all of the concepts and rules of eco-driving, is a significant 40%-60% of extra time in electric mode, when the diesel motor is not active on our hybrid buses. Mind you, these values are for the exact same service in the timetable.“

Directive 2003/59/EC on the initial qualification and periodic training of drivers of certain road vehicles for the carriage of goods or passengers could be seen as an entry point for the introduction and standardisation of safe eco-driving training for clean bus drivers. As such, eco-driving can be seen as a mandatory subject of the initial qualification and periodic training of drivers, including practical parts of the eco-driving courses.

Constant feedback helps drivers to bear in mind and apply the rules of eco-driving. Making use of an easy-to-understand 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. In particular for the quite new clean vehicle type "hybrid bus" it showed that due to frequent technical problems with this vehicle type, the technology factors have great impact on the diesel consumption (or the time in e-mode), which cannot be influenced by the driving behaviour. Therefore, the preparation of the practical part, including the adjustment of the measurement software and the choice of an appropriate test route, on which eco-driving effects become obvious (under the most possible real life conditions), is very important.

LEARNING IV

Higher energy savings can be reached through the use of IT driving assistance devices. In order to optimize drivers' learning effects, install these easy-to-understand and highly-illustrative tools.

A commitment from the senior-level management is a crucial factor to the introduction of safe eco-driving training programmes for clean vehicle drivers, since this initiative is not simply introducing a training programme, but a wholesome Management of Change process. This is not only related to the long-term behavioural change of the drivers' workforce and the learning culture of the organization but as well to the alignment of corporate goals and management strategies. Eco-driving should become part of the organization's holistic energy management plan. Overall, the public transport operator's goals with the implementation of a safe eco-driving training programme should be very clear and communicated in a transparent way.

LEARNING V

Make sure the senior-level management is committed to the eco-driving training programmes!

For most public transport operators, drivers constitute a large share of their workforce. Naturally, drivers should then also play a critical role when it comes to the implementation of eco-driving. Also, it needs to be ensured that drivers' rights are protected throughout the whole implementation lifecycle and steps are being communicated with the local employee council.

Don't misuse the data resulting from the monitoring of energy consumption for the purpose of controlling individual driving performances! The work load and stress level is already higher-than-average for bus or tram drivers, leading to considerably high levels of employee sickness. Issues arising from eco-driving training programmes should be discussed between the company management and the works council from the very beginning. Make use of encouraging personnel and labour policies, for example implement a reward system (rather than a controlling system) for safe and eco-friendly driving performances.

LEARNING VI

Be transparent and involve relevant actors! Drivers and trainers as main target groups for eco-driving initiatives as well as employee councils should be consulted from the very beginning.



2. CARRYING OUT THE TRAINING

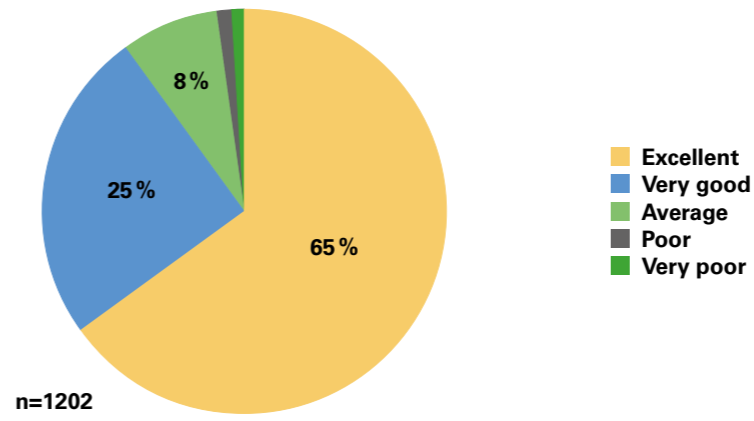
90% of trained drivers evaluated the quality of the ACTUATE trainings as either excellent or very good.
In addition to these highly-positive results, almost 90% of all drivers evaluated the topic safe eco-driving as either “very relevant” or “relevant” for the public transport operator they are working for. About 80% of the drivers found the training to be (very) relevant for their daily work. These are exceptionally good results with respect to the perceived usefulness of the trainings. The 10% gap between “perceived relevance of the training

for the public transport operator” and “perceived relevance of the training for daily work” needs to be acknowledged though and taken seriously. Apparently, drivers see more of a benefit and need of eco-driving for their organization than for themselves. Reward and bonus systems as incentives to apply safe eco-driving in daily operation could be introduced to create monetary benefits for both the company and the driver! It might also well be the case that drivers underestimate the benefits of eco-driving for their own stress-levels. Thus, this would need to be emphasised more in future projects related to eco-driving.

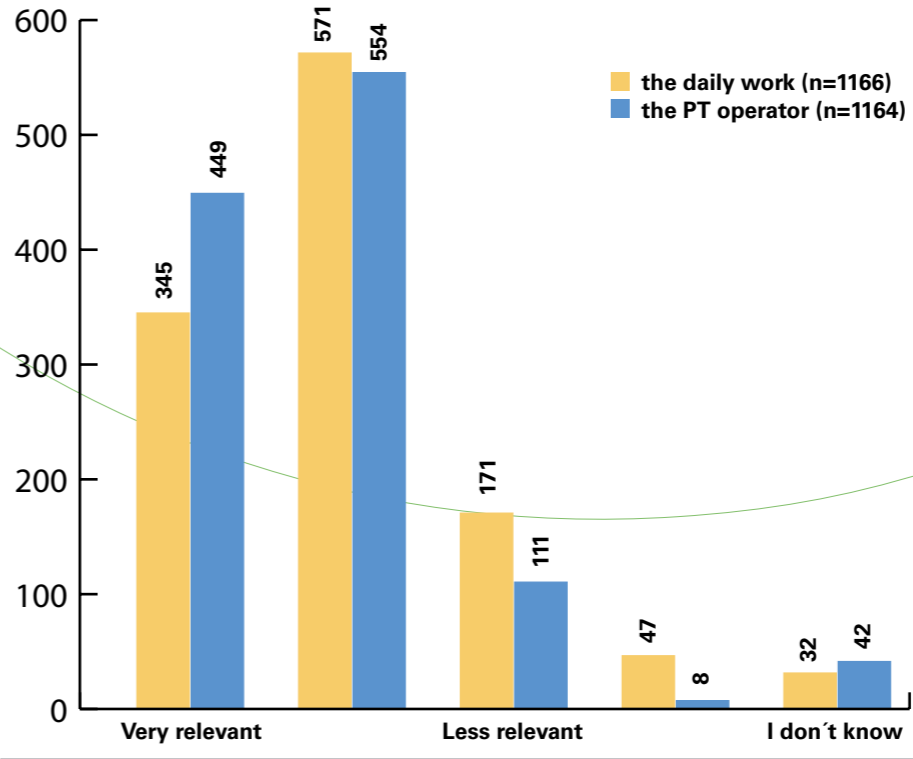
Walter Müller, driver at Salzburg AG

„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.”

Overall Quality of the Training



Perceived relevance of the training for...



The ACTUATE project partners were clear in their recommendation that the training groups should not exceed a certain, small number. In order to make sure that a substantial amount of time can be dedicated to each driver’s practical training, more than six people per vehicle should be avoided. The desired learning outcome relies heavily on the practical part. It was perceived as more effective than only theory-based trainings with better retention of the learning outcomes. To experience the difference and the impact of the new safe and eco-friendly driving behaviour, 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. A minimum of 40% of the training session should be realised as practical driving parts.

LEARNING VII

Organize the practical part of the trainings in small groups of not more than 4 to 6 people per vehicle so that you can engage all drivers in the training session. Dedicate a substantial amount of time to the application of what was learnt in theory!



The energy savings in kWh are not the only valid data for assessing the application of safe eco-driving!
The ACTUATE project partners have also developed alternative evaluation methods that range from improved measuring software to more qualitative criteria, such as through observations of the drivers' driving behaviour. In Salzburg for instance, "quality inspectors" have observed in greater detail criteria such as the realization

of long idling-times, the utilization of the electric brake, the realization of foresighted driving behaviour (as little braking and accelerating as possible) and the selective use of auxiliaries such as heating and lightning during daily driving operation. The overwhelming majority of drivers have either fully or mostly made use of these eco-driving recommendations. Only occasionally did drivers not make use at all of these eco-driving elements.

Energy consumed when applying different driving styles



Good practice I: Brno – Illustrative eco-driving video material

Brno's trolleybus company has produced illustrative videos depicting typical situations for drivers in which guidance is provided through the use of subtitles. These situations were chosen and serve as examples for the theoretic learning material, which later is experienced in practical driving sessions.

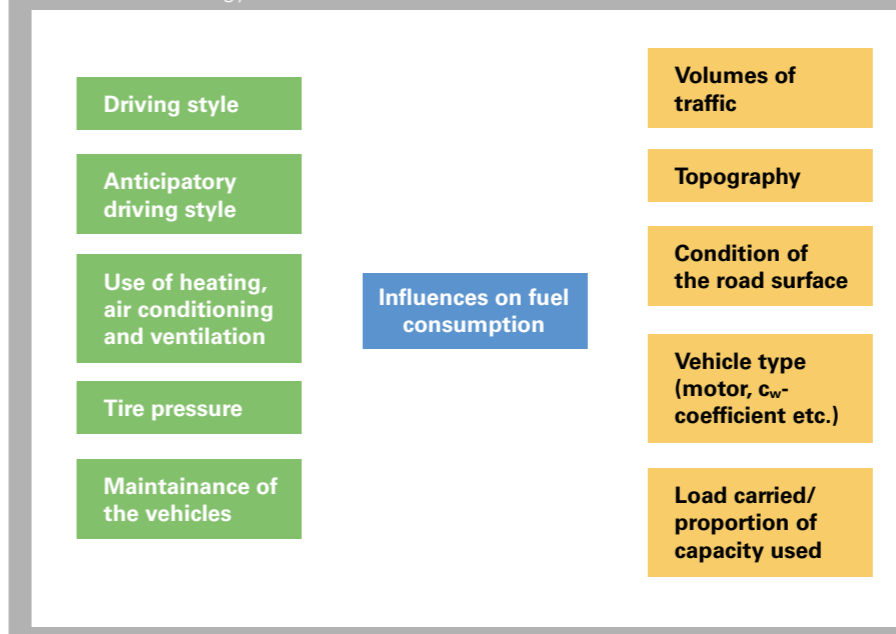


LEARNING VIII

Make use of illustrative training material such as colour codes or eco-driving instruction movies!

Good practice II: Salzburg – illustrative eco-driving video material

Salzburg's trolleybus operator used color codes in the training brochure for the safe eco-driving of trolleybuses to illustrate clearly how energy savings can be influenced by the driver (human factor; green color code) and what conditions exist that cannot be influenced by the driver (non-human factor; yellow color code), yet still have significant effects on the energy use of the vehicle.





3. COMMUNICATING THE TRAINING

LEARNING IX
Make sure the senior management embraces and promotes a learning culture in your organization that includes both internal as well as external communication!

Internal communication:
The Leipzig partners introduced the communication concept of a “green” driving licence. This licence was handed over to drivers after participating in the safe eco-driving trainings for trams and hybrid buses. Each licence has an individual number code and shall be used for follow-up activities to refresh the learnt skills and knowledge about eco-driving and to increase or sustain motivation to apply eco-driving in daily driving operation. In order to achieve a positive and long-lasting impact from the eco-driving training sessions, a small „online quiz” will soon be available and it is planned

that 3 months after the completion of the training sessions an additional „postcard quiz” will take place. These quizzes will also offer the participants a chance to win small prizes.

Once a year, a follow-up event on the general theme of energy savings will take place, where the ongoing results from the process will be analyzed, achievements highlighted and larger prizes handed out to successful contributors.



The green driving license from our project partner LVB, Leipzig

Michael Schoppe from LVB comments on the EBUS award:
„We are very grateful to have received the EBUS Award and also see it as a measure of obligation for the future. We were pleased to have received this prestigious distinction for a truly sustainable concept, which will have positive effects and far-reaching benefits, long beyond the timeline of the actual project. Now we are keen to prove that the energy savings and financial benefits generally associated with eco-driving can be implemented and maintained on a long-term basis.”

Good practice III: Leipzig – EBUS Award



The ACTUATE project managers from LAB, Michael Schoppe, LVB, Eberhard Nickel and Rupprecht Consult, Wolfgang Backhaus (from left to right)

In October 2014, our ACTUATE partner LVB was honoured with the prestigious EBUS Award. The EBUS Award, the German Environmental Award for public local transport, is given to successful projects and innovative products. The prize was awarded by Forum für Verkehr und Logistik, founded by the Association of German Transport Companies (VDV) and the insurance company DEVK. An expert panel under the patronage of German Federal Minister of Transport and Digital Infrastructure Alexander Dobrindt chose the ACTUATE application from numerous forward-thinking technical solutions and concepts for the operation of e-buses. The partners LVB and LAB from Leipzig were honoured for their sustainable concept of employee motivation and training for the safe eco-driving of e-buses.



10

Learning

LEARNING X

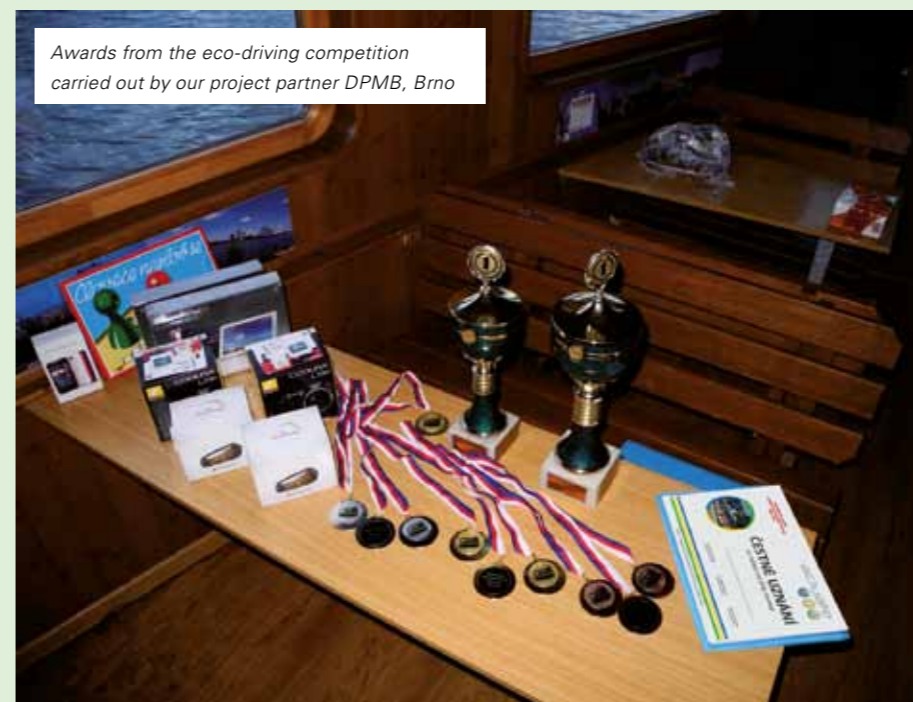
Make use of an in-house motivation campaign that supports your goals with visually appealing material, a rewarding system and incentives!

To sustain the beneficial training effect with regards to eco-friendly driving behaviour in the long-term, an in-house (motivation) campaign targeted at the drivers could be implemented as a complementary measure. This kind of senior management “engagement” is critical to the effective delivery of a safe eco-driving training programme. It also shows a positive and committed level of management involvement and successfully sets the tone for the goals of the training initiative, by helping raise in-house awareness and appreciation concurrently. An organization-wide programme launch, coinciding with an attractive in-house or even public advertisement campaign can get all employees involved as caring stakeholders in such a process. The ACTUATE partners actually developed and successfully implemented different concepts for such campaigns, ranging from poster displays and driver championships, to the launch of a green licence with a bonus point system (see the following examples).

Good Practice IV: Brno – Eco-driving competition

Brno’s public transport operator DPMB developed an in-house campaign to motivate the trained drivers to practice safe eco-driving in daily operations as much as possible. Due to the circumstance that periodical trainings often only have short-term effects (and changing the driving behaviour needs a long-term impact), DPMB developed a driver competition scheme to increase motivation and to sustain the safe eco-driving skills.

DPMB made two checks taking into consideration certain conditions that drivers cannot influence (e.g. traffic and weather situation). Energy efficiency was monitored daily through the on-board computer in trolleybuses and in some chosen trams. All drivers that were involved got a special remuneration for their extra activity in the ACTUATE project. The prizes ranged from special gifts (e.g. tram and trolleybus models) to extra bonuses for the best eco-drivers of the year. The competition idea was accepted very well and became very popular among DPMB’s drivers. The competition scheme will be continued in 2015.



Awards from the eco-driving competition carried out by our project partner DPMB, Brno

Furthermore, informal, self-managed and self-paced on-the-job e-learning options could be offered as part of the training programme and in-house campaign concept for the topic of safe eco-driving. The ACTUATE partners developed simple e-learning 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 e-learning resources have an “edutainment” (as mixture of education and entertainment) character and are provided via web-based access on both computers, e.g. in the break rooms of the drivers, or on mobile devices like smart phones. The ACTUATE partners evaluated the use (via the possibility to track learners access to the web-based e-learning resources) and acceptance of these simple e-learning resources.

Good Practice V: ACTUATE e-learning

Even though 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 – 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. Unfortunately, the drivers had to test the modules from their own computers or mobile devices and – even more importantly – the majority of drivers had to test the modules in their free time.

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, e-learning cannot replace practical eco-driving courses and should be integrated into regular (Directive-specific) compulsory trainings to ensure at least annual refreshes of the drivers’ knowledge.



Wolfgang Backhaus, ACTUATE project coordinator, Rupprecht Consult GmbH

„The feedback from all the drivers that participated in the training sessions has been very positive. Many stated that the emphasis on “looking ahead” and pro-actively anticipating traffic situations helps them to reduce stress on the job. The added value of this health benefit cannot be underestimated, as traditionally public transport operators are faced with high sick leave rates of their drivers. Eco-driving just might be one way to counter or reverse such circumstances.”



In conclusion, there are a couple of things to keep in mind regarding the image campaign, before you actually implement eco-driving in your organization:

- Due to varying interests (financial goals, schedule-efficiency, courses), clarify the communication and incentives before the trainings start!
- Create flyers and posters before you start the trainings to raise awareness for this topic!
- Involve the drivers in communication and give public relevance to the image campaign!
- Organize a kick-off event for the eco-driving initiative!

Different examples of the internal poster campaign designed by our project partners



**VORURTEIL
„Runter vom
Gas?
Das bringt
eh nichts!?“**

- Tatsächlich soll man möglichst den Schwung des O-Busses ausnutzen und das „Gaspedal“ nicht betätigen - das hilft sehr wohl den Energieverbrauch zu senken und erhöht gleichzeitig den Komfort durch gleichmäßigere Fahrt!
- Auch die Nebenverbraucher werden von der „Schwung“-Energie versorgt und es wird keine Energie aus der Fahrleitung verbraucht.
- Rollen ist der effizienteste Fahrstil, um möglichst viel Energie einzusparen!

**Good Practice VI:
ACTUATE internal poster campaign**

In order to further promote the ACTUATE eco-driving goals and sustain the effects of the trainings, the ACTUATE project partners developed an internal poster campaign. When carrying out the training sessions, the ACTUATE project partners listened carefully to the concerns that were expressed by the drivers about adapting an eco-driving style. Among others, these were related to an increase in journey times, the

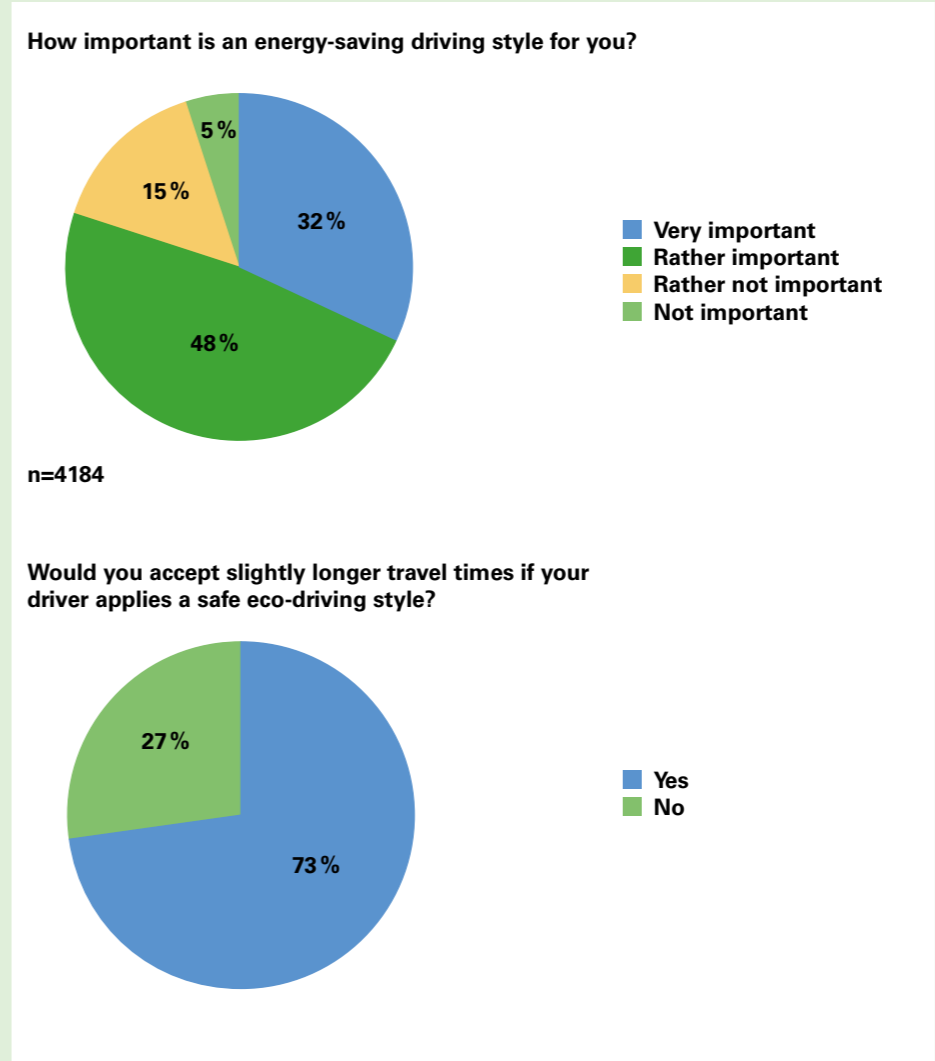
assumption that green vehicles were already sustainable enough, or the aspect that the passenger would not really notice the energy savings associated with an eco-friendly driving style. In order to “debunk” these most common prejudices to eco-driving, the project partners created posters that highlighted some empirical data and answers to these stereotypes.



LEARNING XI
Promote your eco-driving related goals with a creative advertisement campaign to gain support from your passengers!

EXTERNAL COMMUNICATION:
Passengers appreciate eco-friendly driving on public transport vehicles!
The ACTUATE partners carried out a passenger survey on the safe eco-driving topic. 80% of the more than 4.000 passengers asked, replied that eco-driving is "rather" or "very important" to them. Only 5% answered that eco-driving is not at all important to them. Passengers appreciate the safe eco-driving initiative of the ACTUATE project partners and are probably keen on seeing more local sustainability initiatives and campaigns being carried out by their public transport operators.

Most passengers would accept a slightly longer travel time in order to make it easier fo drivers to apply an eco-friendly and safe driving style!
This decisive level of public support for the concept and practice of safe eco-driving, about 3/4s of all people said they would accept slightly longer travel times, was quite a positive surprise for the public transport companies that were querying their customers. Travel time is one of the very crucial factors for passengers when deciding on the mode of transport, however people would be willing to go slightly slower if this has a positive environmental impact. When doing cross-benefit analyses, public transport operators should bear these results in mind and not base their decisions solely on travel time optimisation, which often leads to more stress for drivers and an uneconomic driving style consequently.





Good Practice VII: Parma – Our drivers have an environmentally-friendly foot!

The trolleybus company TEP from Parma developed an image campaign in order to promote the education programme and training sessions for safe eco-driving. Drivers were trained on the concepts and actual techniques of energy-efficient driving, the reduction of energy consumption in public transportation and the enhancement of passenger comfort.

Based on customer surveys and operational observations in Parma, it looked as though both measures proved extremely successful. 84% of passengers stated that they would accept a slightly longer journey time in order to ensure an energy-efficient ride, while 74% of travellers generally found energy savings and environmental sustainability important. These results indicate that the image campaign had a considerably positive effect and gave TEP a real public relations boost.

Furthermore, the campaign put a positive focus on the drivers, making them the friendly face and genuine ambassadors of eco-driving in Parma. This kind of personalised image campaign helped increase the public appreciation of local bus drivers as well as boost personal and professional self esteem amongst the TEP employees.

rispettiamo l'ambiente con una guida virtuosa



TEP INVESTE IN FORMAZIONE PER UNA GUIDA CHE RISPETTA L'AMBIENTE. Roberto, conducente TEP da 25 anni, ha partecipato ai corsi di formazione per l'ecoguida. Un viaggio più confortevole per i suoi passeggeri e un'aria più pulita per tutti. **Vi portiamo verso un futuro sempre più ecosostenibile.**



Examples from the image campaign deployed by our project partner TEP in Parma

i nostri autisti hanno il piede ecologico



TEP INVESTE IN FORMAZIONE PER UNA GUIDA CHE RISPETTA L'AMBIENTE. Una guida corretta può ridurre i consumi energetici e le emissioni gassose nocive per l'ambiente. Gli autisti TEP frequentano corsi di formazione per migliorare lo stile di guida. **Vi portiamo verso un futuro sempre più ecosostenibile.**



rispettiamo l'ambiente con una guida virtuosa



TEP INVESTE IN FORMAZIONE PER UNA GUIDA CHE RISPETTA L'AMBIENTE. Cinzia, conducente TEP da 18 anni, ha partecipato ai corsi di formazione per l'ecoguida. Un viaggio più confortevole per i suoi passeggeri e un'aria più pulita per tutti. **Vi portiamo verso un futuro sempre più ecosostenibile.**





5 GOLDEN RULES

- *acceleration should be quick*
- *the “steady state” on the throttle / accelerator should be avoided*
- *the rolling ratio should be as high as possible, while ensuring compliance with the schedule*
- *unnecessary braking should be avoided and usage of wear-free electric brakes for energy recuperation should be optimised*
- *conscious use of the heating, air-conditioning and ventilation system*

A balanced, foresighted and customer-friendly driving style saves energy and calms your nerves!



Trolley bus in motion in Salzburg

FACILITATION CHECKLIST

If you would like to implement eco-driving in your organization, we have the following tips!

- Be well organized and plan ahead when introducing safe eco-driving training programmes!
- Understand the existing levels of energy-consumption in your fleet of different public transport vehicles, so that you know what the established benchmark is and how much energy can be saved by introducing eco-driving!
- Higher energy savings can be reached through the use of measurement devices. In order to optimize drivers' learning effects, install these easy-to-understand and highly-illustrative tools.

- Make sure the senior-level management is committed to the eco-driving training programmes!
- Don't misuse the data resulting from the monitoring of energy consumption for the purpose of controlling individual driving performances!
- Organize the practical parts of trainings in small groups of not more than 4 to 6 people, so that you can engage all drivers sufficiently in the training session. Dedicate a substantial amount of time to the application of what was learnt in theory!
- Make use of illustrative training material such as brochures, color codes or short driving instruction movies!

- Make sure the senior management embraces and promotes a learning culture in your organization, which includes both internal as well as external communication!
- Make use of an in-house motivation campaign that supports your goals with visually appealing material, a fun rewards system and – if agreed – financial incentives for the drivers!
- Promote your eco-driving related goals with a creative advertisement campaign to gain support from the public!



PROJECT PARTNERS



Rupprecht Consult (RC) coordinated the project and is an independent, private research and consulting company based in Cologne, Germany. The company works in the field of sustainable development of cities and regions in Europe and around the world, covering topics such as sustainable urban mobility planning, clean public transport systems, or training and dissemination for European projects.

For more information visit: www.rupprecht-consult.eu



Leipziger Verkehrsbetriebe (LVB) was responsible for the development of the safe eco-driving training programmes for the tram and hybrid bus vehicle types as well as for the coordination of evaluation activities in terms of energy measurements. LVB operates the tramway and bus transport services in the city of Leipzig. On 14 tram lines and 60 bus lines, about 130 million passengers are carried annually.

For more information visit: www.lvb.de



In the LVB-Group, **LAB** is the service provider for knowledge and skills. LAB was responsible for coordinating and moderating the definition process for minimum quality criteria and the definition of learning outcomes. LAB operates in the four business areas vocational training and staff development, recruitment and training, operation of a driving school and mobility services for LVB.

For more information visit: www.lab-bildung.de



Salzburg AG (SAG) is among the largest trolleybus operators in Europe. About 41 million passengers use the trolleybus system in Salzburg every year. Salzburg is internationally renowned as a leading trolleybus city and was responsible for the development of the safe eco-driving training programme for trolleybus drivers.

For more information visit: www.salzburg-ag.at

Trasporti Pubblici Parma (TEP) is the public transport company that serves the city and the province of Parma. TEP (trolley-)buses run 11 million km and carry 37,5 million passengers per year. Services are provided by nearly 400 buses and trolleybuses driven by 450 drivers.

For more information visit: www.tep.pr.it



Brno's public transport Operator (DPMB) is the primary public transport operator in the city of Brno and also in the Integrated Public Transport System of the South Moravian Region. On 13 tram lines it operates 310 vehicles that transport 190,000,000 passengers per year. DPMB employs about 3,000 employees, most of them being drivers.

For more information www.dpmb.cz



Eberswalde has the oldest trolleybus system in Germany (set up in 1901). Since its establishment in 1953, the **Barnim Bus Operator** (BBG) has worked on the technical development of environmental-friendly vehicles. BBG operates the first trolley-hybrid-bus equipped with a lithium-ion battery and supercaps in Europe.

For more information visit: www.bbg-eberswalde.de



trolley:motion is the leading European trolleybus interest group. It constitutes part of a wide trolleybus community and has well established contacts to relevant e-bus actors, such as trolleybus cities, industry manufacturers and transport operators. trolley:motion was responsible for ACTUATE's dissemination and networking activities.

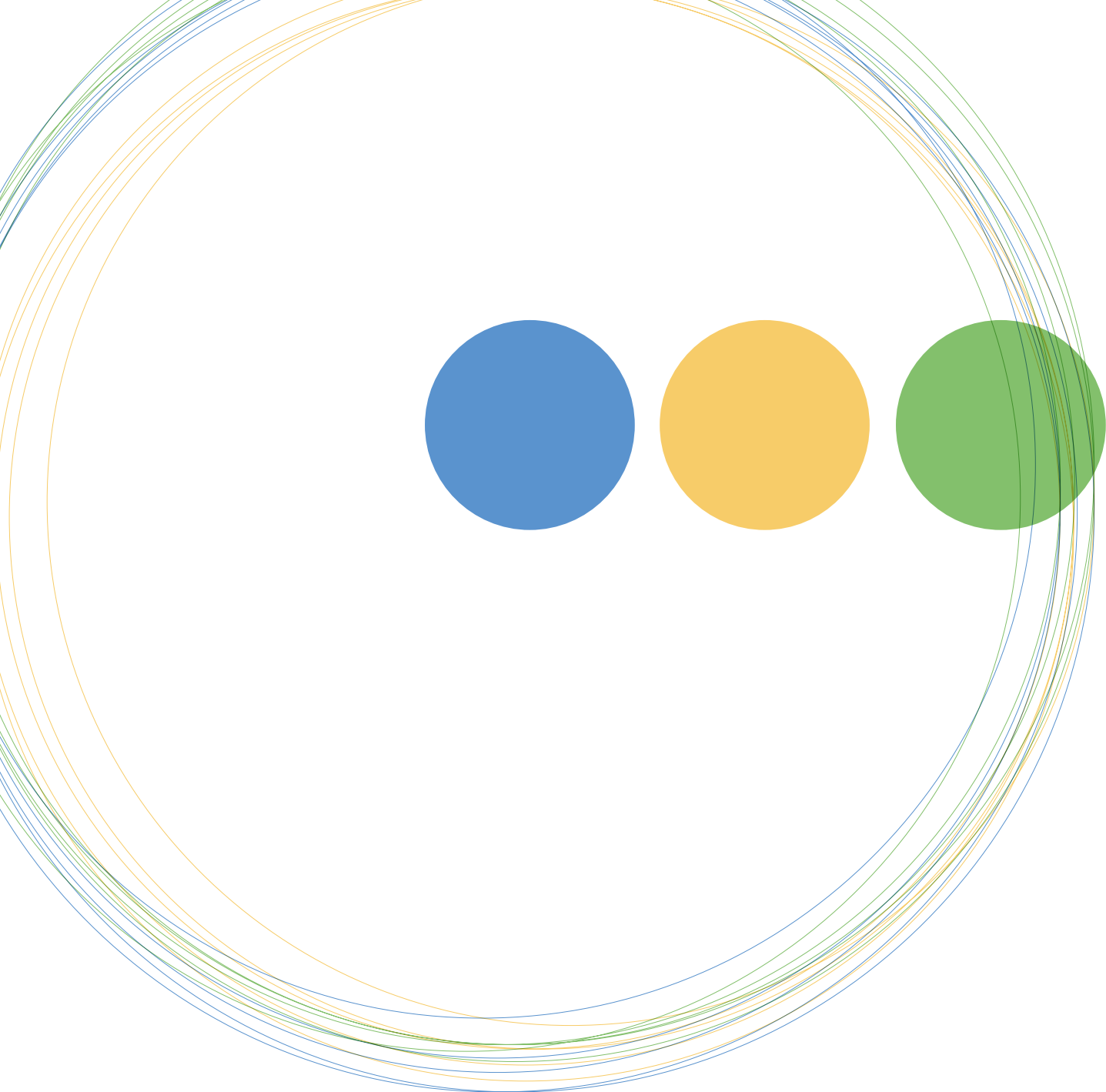
For more information visit: www.trolleyemotion.eu



VAN HOOL N.V. was founded in 1947 and is based in Lier-Koningshooikt near Antwerp, Belgium. The company is one of the largest independent manufacturers of integral buses and coaches in Western Europe. Approximately 1.600 buses and coaches are produced each year and commercialised through the VAN HOOL network. The company currently employs about 4,000 people in Koningshooikt.

For more information visit: www.vanhool.be





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