

A Introduction

UMAS is the abbreviation for the University Hospital, Malmö General Hospital and the abbreviation will be used throughout this report.

In 2002, UMAS conducted a pilot study about eco-driving. In total about 40 people took part in the training and as a result of this eco-driving training fuel consumption decreased by 7-10% in the period directly after the training sessions. While the results of this training were encouraging, it is well-known that such training must be repeated for the driver's habits to change during the longer-term. If refreshing training is not possible there must be an incentive to retain fuel-efficient driving behaviour. Ideally refresher courses and an incentive should both be possible.

Since 2002 the effect of the pilot study has decreased to the point that by 2006 it can be questioned whether there was any measurable effect retained by the drivers. Furthermore, some of the 40 people from the study in 2002 no longer work at UMAS or have perhaps changed jobs where they drive, while at work, less frequently. This suggested that the pilot study would have to be repeated in some way.

In this measure, all staff members who drive more than 5,000 km a year on business, i.e. as part of their work at UMAS, were informed about and offered a course in economical driving, traffic safety and driver ergonomics. The goal was that an estimated 5% of the staff at UMAS should receive training in eco-driving during a three-year period.

A1 Objectives

The measure objectives are:

- **Objective 1** The impact on the environment from transport shall be reduced. An estimated 5% of the staff at UMAS are to be trained in eco-driving during a three-year period which means 100 courses a year or a total of 300 people taking the course.

A2 Description

All members of staff who drive more than 5,000 km a year on business were informed about the project and offered a course in economical driving, traffic safety and driver ergonomics. An estimated 5% of the staff at UMAS meet the criteria because of their need to drive 5 000 km or more per year as part of their work and all of these staff were offered training in economical driving and traffic safety. However, because of delays in implementation training only occurred in the final year of SMILE, with during a three-year period, with over 100 people actually taking an eco-driving course. The functions performed by these drivers included non-emergency patient transfers and moving equipment between medical facilities.

B Measure implementation

B1 Innovative aspects

- **New conceptual approach, locally** – Educating the staff in eco driving will lead to reduced fuel consumption both when driving in the duty and as a private person.

B2 Situation before CIVITAS

Forty staff at UMAS received eco-driving training during 2002. The initial impact was documented but the positive effects reduced during the following years. Given that UMAS has about 6000 employees, the 40 staff who received eco-driving training in 2002 represent less than 1% of the workforce.

B3 Actual implementation of the measure

The measure was implemented in the following stages:

Stage 1: Delay (*Summer 2006- Spring 2008*) – *During this period of time no staff received eco-driving training. Negotiations with driving schools took place, information about the possibility of taking eco-driving was disseminated within UMAS. Given that the original plans for the measure involved about 100 people per year taking eco-driving it is clear that this is a delay that will have reduced the chances of meeting the initial target.*

Stage 2: Training (*Spring 2008 – January 2009*) – *During this period of time more than 100 staff received training in eco-driving.*

B4 Deviations from the original plan

The deviations from the original plan comprised:

- **Budget constraint** – The amount of trained staff will have to be decreased because the courses have also become more expensive than previously thought. According to the measure leader “The management” has considered trying to find resources for the investment of 300 driving sessions, but only found room for 200.
- **Significant delay in start of training** – Because of the budget constraint and other factors (see barriers discussion in section D), training sessions did not commence until the Spring of 2008 which can be considered to be at least 18 months behind schedule.

B5 Inter-relationships with other measures

The measure is related to other measures as follows:

- **Measures 5.3 (sub-measure concerning heavy eco-driving on the part of Skånemejerier), 11.2 (eco-driving for municipal employees) & 11.9 (heavy eco-driving)** – These measures and sub-measures can be considered to be in a cluster for Eco-driving

Relations among the eco-driving measures in SMILE Malmö:

In Malmö there are four measures – 5.3, 11.2, 11.8, 11.9 -- that deal solely or in part with what is called “eco-driving” which is a driver technique, approach and strategy to reduce fuel consumption without reducing driving speed. While all four measures include eco-driving, the results are not always easily compared and some of the assumptions or factors used in calculations differ between these measures. The reasons for this are as follows:

The target staff or drivers have varying degrees of incentive or motivation to continue to apply the eco-driving technique in the weeks, months and years following their training. The primary incentive comes from a reward, often in the form of financial gains – directly or indirectly – corresponding to the costs of saved fuel that has resulted from eco-driving.

The target staff or drivers have different relations to the vehicles and their work situation. Some of the drivers in some of the measures are professional drivers: that means driving is their occupation. Such drivers may have regular routes that they take where they may be able to perfect their efforts to reduce fuel. Others drive vehicles rather regularly as part of their work, but this is not the primary part of their occupation or profession. Still other drivers may irregularly and for shorter distances use vehicles as part of their work. This means that the results of the eco-driving measure will vary because of the frequency of driving and at the relative centrality of driving as part of the employees' occupation.

Some drivers almost always drive the same vehicle. Infrequent drivers are more likely to drive a different make of vehicle almost every time they need to use a vehicle.

Finally, there are different kinds of vehicles that are used by drivers in the four measures and the reasons for driving vary.

In comparison we can say:

5.3

That the drivers of heavy vehicles in 5.3 are employees of freight haulers and these employees may not be receiving a financial incentive. The supplier of the training, Skånemejerier, is not the employer. There are indications that the effects of eco-driving fell from about 13% to about 3% reduced fuel use when there was no refresher training but this may have then improved when refresher training was introduced much later in the measure.

11.2

For the municipal employees in 11.2 the initial reduction of fuel was about 13% but since the employees have no incentive to continue to drive this way (fuel savings do not accrue to them, they are not awarded in some other way), this savings tends to have approached nil within a year and we assume that it is zero after one year. There is no refresher training. Most managers or section heads do not see the relation between training staff in eco-driving and financial performance of their section.

There are some exceptions within 11.2 among individual drivers and managers who can see the benefit from eco-driving for their section's financial performance but these are truly the exception.

11.8

In the hospital, it proved difficult initially to get any medical or care staff to take the training. As a result we only have statistics from the regular transportation staff in the hospital. There may be some measure of incentive for the transportation staff since it is a small unit and cost savings can be more easily tracked and attributed to driver performance. For the other parts of the hospital where staff took the training fuel costs

are often small in comparison with the total budget and it is hard for either the managers or staff to see the advantage: again there is no incentive.

11.9

This last measure like 5.3 only involves heavy vehicles. However, unlike 5.3, most people who took the training were owner-operators of their own vehicles and as such have a financial incentive to maintain a high degree of eco-driving performance. From an initial savings of about 17% in terms of fuel consumption this falls to 10% or less in the longer-term. However, fuel savings accrue to the individual driver or, in some cases, the small firms that have joined the umbrella organisation Malmö LBC.

Thus we see that even if all measures attempt to reduce fuel consumption using the same basic techniques and methods, the context within which the measure is rolled-out has a clear impact on the long-term effects. More motivated drivers with a form of incentive tend to have driving habits similar to the ideal in eco-driving than drivers who have no form of incentive at all. Motivated drivers retain the positive effects of eco-driving.

This lengthy passage appears verbatim in the B5 section of 5.3, 11.2, 11.8, 11.9 to make it easier for readers who might want to compare these measures.

C Evaluation – methodology and results

C1 Measurement methodology

C1.0 Note on Methodology used in the Evaluation of this Measure

Ideally this measure would have been evaluated exactly according to the GUARD methodology. However, because of the great uncertainty on the part of both the measure leader at times and the evaluator when the measure would actually commence, it proved very difficult to establish a baseline among all staff at the UMAS hospital. Furthermore, because of the uncertainty during 2006 and 2007 whether this measure would be conducted at all, it was deemed to be an unnecessary spending of money to establish a baseline for this measure should the measure not actually be completed within the framework of SMILE.

Instead the methodology used was as follows:

- A. 6 drivers at the local UMAS transport department were chosen for closer scrutiny and given the task of recording distance travelled, fuel used etc. These drivers tended to drive vans and small trucks.
- B. The results of their records of their driving before they had eco-driving training were aggregated and likewise the results of their driving after the training were aggregated.
- C. The assumption is made that the baseline is the “before” period. The “before” period is also equivalent to the business-as-usual situation. Fuel consumption during the “after” period, following eco-driving, is the result of the SMILE measure. The change between after and before is the result to be reported in the “C2 Measure results” section of this report.
- D. Based on these numbers from the 6 drivers, estimates are extrapolated.

C1.1 Impacts and Indicators

Table 1: Indicator Table

Nr.	Relates to GUARD Nr.	INDICATOR Name	Possible DESCRIPTION	DATA /UNITS
1	1	Operating Revenues		SEK
2	2	Operating Costs		SEK
3		Vehicle Fuel Efficiency	Fuel used per three month period or change based on driver study	Litres
8		CO ₂ Emissions	CO ₂ per entire pool of drivers	kg
10		NOx Emissions	NOx per entire pool of drivers	g
11		Particulate Emissions	PM10 per entire pool of drivers	g
13		Awareness Level of Measure	Degree to which the awareness of the policies/measures has changed	Index, qualitative, collected, survey
14		Acceptance Level of Measure	Measure usage of scheme	Index, qualitative, collected, survey

Detailed description of the indicator methodologies:

- **Indicator 1** (*Operating Revenues*) – The revenues from carrying out this measure.
- **Indicator 2** (*Operating Costs*) – The change in costs from carrying out this measure.
- **Indicator 3** (*Vehicle Fuel Efficiency*) – The change in fuel used per vkm: the change resulting from taking training.
- **Indicator 4** (*CO₂ emissions*) – The change in CO₂ emissions as the result of the training.
- **Indicator 10** (*NOx emissions*) -- The change in NOx emissions as the result of the training.
- **Indicator 11** (*PM10 emissions*) -- The change in PM10 emissions as the result of the training.
- **Indicator 13** (*Awareness*) and **Indicator 14** (*Acceptance*) **combined** – Measured by proxy in terms of the take-up of the measure and a qualitative assessment of management and staff opinions.

C1.2 Establishing a baseline

See discussion in section C1.0

C1.3 Building the business-as-usual scenario

See discussion in section C1.0

C2 Measure results

The results are presented under several sub-headings. See also the discussion in section C1.0.

The following data/assumptions lie behind the figures in sections C2.1-C2.5:

- A. 100 employees took part in the training (this is not the exact figure.)
- B. Changes in the driving habits of these employees' led to a measured reduction in fuel consumption by 0.009 litres/km and that this reduction was maintained for one year.
- C. That the vehicles used were overwhelmingly driven using petrol and therefore petrol is assumed for be the sole fuel in this measure.
- D. The cost per litre of petrol was fluctuated widely during 2008. For more exact data see the enclosed Excel sheets.

C2.1 Economy

This measure entailed the following costs: 200000 SEK

This measure led to the following reduction of costs in terms of reduced fuel consumption: 24 453 SEK in the first year. This is based on the first year fuel reduction of 1950 litres multiplied by 12.54 SEK which was the average fuel price during 2008. Clearly this cost reduction figure would be different depending on the price of petrol.

C2.2 Energy

There are two ways to judge the effects of greater fuel efficiency because of the measure concerning eco-driving. One, called Driver Study, is to follow the distance driven and the fuel consumed by carefully studied drivers. The other, called Total Fleet, is to look at fuel consumption by all vehicles used by UMAS (perhaps also broken down into the transport department and the rest of UMAS).

C2.2a Driver Study

Figure 1 below shows fuel usage on the part of the 6 studied drivers before and after receiving training in eco-driving. Figure 2 shows the same drivers and their change in fuel usage per kilometre before and after the training.

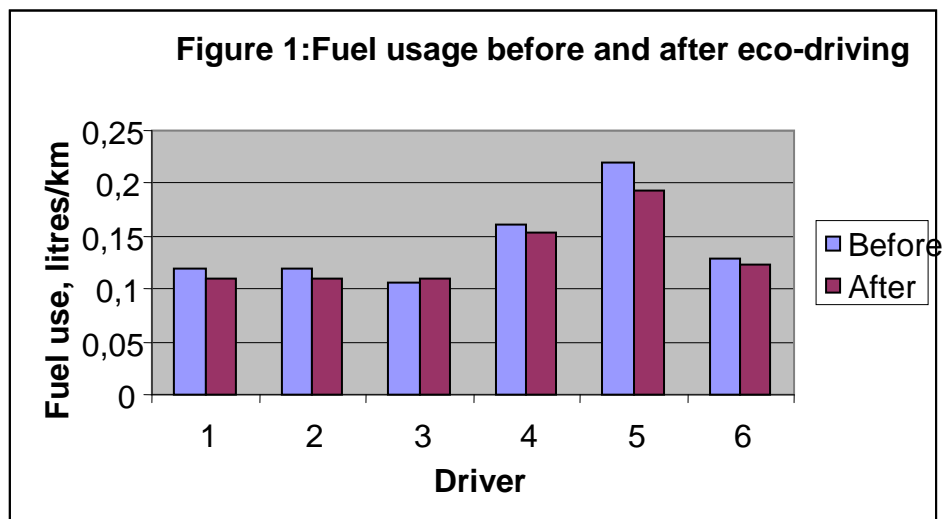
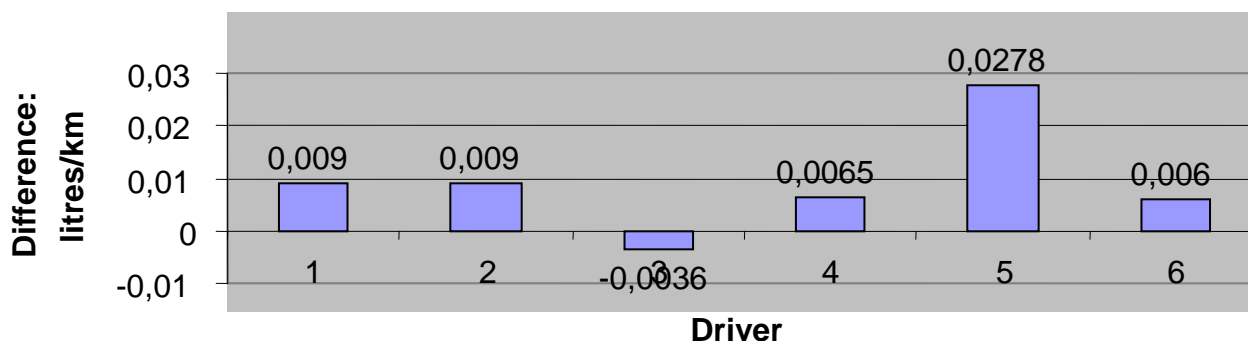


Figure 2: Difference in fuel consumption: before-after training

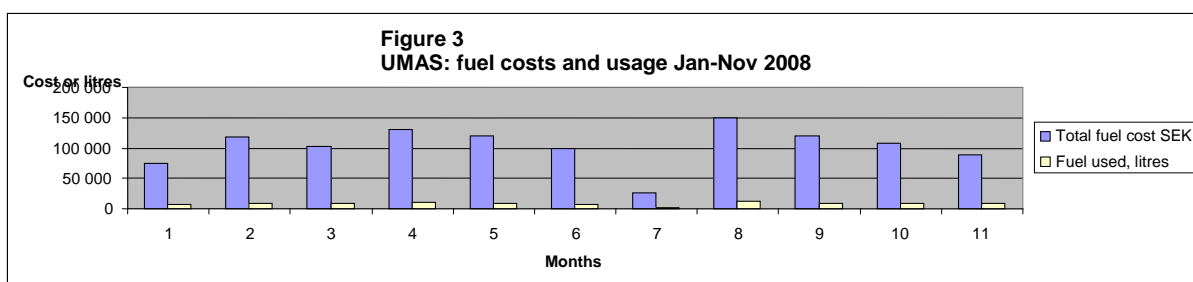


In terms of a percentage reduction in fuel usage, the effects of eco-driving training on the drivers is an average reduction of 0,009117 litres/kilometre which is a reduction by about 5.51%. These studied drivers all work at the transportation department.

C2.2b Total Fleet

Here we look at the aggregate figures for fuel consumption on the part of the entire fleet of vehicles used at UMAS. Since those people who drive the most at UMAS have been the target of the measure, this would suggest that these people are responsible for a large part of the total number of kilometres driven. In this study of the total fleet we are primarily interested in a comparison between the first half of 2008 when very few people had taken eco-driving and the second half of 2008 when the majority of people that had taken eco-driving training at UMAS as part of 11.8 had completed their training. The summer months of June and July have drastically lower use of fuel. August has one of the highest uses of fuel per month but this may reflect some fuelling of vehicles during the latter part of July.

The data received from the measure leader concerned FUEL COSTS and can be seen in figure 3 below. This is then converted into fuel use by dividing the average fuel cost each month to determine FUEL CONSUMPTION.



With regard to the reduction of fuel use by the transport department at UMAS, the reduction was 126 litres during September-November 2008 versus February-April 2008 and this was approximately a 4.7% reduction.

Looking at the rest of UMAS, where non-transport employees drive, the change was a reduction by 464 litres during the same time period. This was a reduction of about 7%.

It is curious to see a smaller percentage reduction at the transport department than the other staff. This is curious since a much greater percentage of the transport department staff took eco-driving training than the percentage of the other staff that should have taken eco-driving

according to the original proposal of some 300 staff in total to take eco-driving. This may mean that the effects of eco-driving training for regular, care-giving staff at UMAS was much greater than had been anticipated. Or this may mean that transportation department staff drove relatively efficiently in the past and the effects of training on each driver were, therefore, rather small. We cannot know since we lack travel diaries from UMAS staff who did not work at the transportation department.

That the documented effects from C2.2a were higher than from the effects in aggregate at the transportation department shown in C2.2b (5.51% versus 4.7%) shows that the trained drivers had a greater change than the transportation department as a whole. There is nothing unsurprising about these results.

We should not extrapolate 590 litres of saved fuel during three months of the fall of 2008 into an entire year since the summer months of June and July have rather low usage of vehicles. Therefore instead of multiplying the saved fuel by four (4 quarters in a year) we will multiply by 3.33 to approximate the yearly potential fuel savings from this measure. This results in savings of approximately 1950 litres petrol per year (rounded to nearest 50 litres.)

C2.3 Environment

Given the assumption of reduced use of 1950 litres petrol per year from C2.2, this leads to the following potential reductions of emissions.

Table 2: Environmental Improvements

Reduced fuel	Leading to reductions in:	CO ₂	NO _x	PM10
1950 litres	→	4290 kg	89.7 g	8.97 g

These figures are estimates based on the assumptions of:
 2.2 kg CO₂ emitted per litre, 0.046 g NO_x per litre and 0.0046 g PM10 per litre.

C2.4 Transport

There are no indicators associated with this category.

C2.5 Society

That this measure has been carried out appears to be essentially unknown on the part of patients at UMAS and the general public.

The take-up of this measure on the part of hospital staff and their most immediate supervisors appears to be relatively limited and somewhat below the expectations that were part of the original intentions of this measure. Staff awareness of the measure *per se* has been gauged as being rather high, at least based on the contacts that the evaluator has had with UMAS. Acceptance has been much lower, based on take-up rates and the inability for those the measure leader refers to as “the management” to find sufficient resources to train 300 staff as was originally intended.

In sum, combining awareness and acceptance together and based on the qualitative assessment of the measure leader combined with actual take-up, this indicates an underperformance of this measure.

C3 Achievement of quantifiable targets

No.	Target	Rating
1	300 employees having taking eco-driving during the duration of the measure.	0
NA = Not Assessed 0 = Not achieved * = Substantially achieved (> 50%) ** = Achieved in full *** = Exceeded A – No T = Assessed but no target to compare with		

C4 Up-scaling of results

Up-scaling would involve fulfilling the original measure intentions of 11.8 which was a total of 300 staff trained in eco-driving during SMILE. This would also require refresher training or other ways to maintain the positive effects of this measure during future years.

C5 Appraisal of evaluation approach

As previously discussed in C1.0, because of the great uncertainties whether this measure would actually be carried out, it was considered – during 2006, 2007, and into 2008 – to be a poor allocation of scarce evaluation resources to establish a baseline involving all drivers of vehicles at UMAS. It is also difficult to select *a priori* those drivers who would come to take eco-driving training as part of measure 11.8 to study as part of a baseline and business as usual scenario since it cannot be known prior to the start of the measure training which drivers would actually take the training.

Because of this, a selection of easily accessible drivers was taken among those drivers who would be taking eco-driving to study their fuel consumption when driving before and after the eco-driving training. In hindsight it is difficult to see to what extent another way of conducting the evaluation would have been possible, barring of course the spending of much money. The problem with this approach is knowing how representative the drivers under study are of all drivers at UMAS. Since only drivers that were easy to study were selected and these drivers all work in the transportation department, we lack information concerning those who drive on a daily basis as part of their work as nurses etc and we lack information about those who drive as part of work less frequently, for example some of the administrators as well as health-care staff that need to drive to meet patients but do so irregularly.

Given this it would have been useful to change the approach to include more focus on understanding the behavioural aspects associated with those included in the evaluation. However, by the time this was realised it was too late to make the change.

C6 Summary of evaluation results

The key results are as follows:

- **Key result 1** – This measure failed to train as many staff as had been originally intended. Approximately 100 employees received training compared with the original goal of 300.
- **Key result 2** – This measure may have led to the reduction of fuel consumption of up to 1950 litres petrol (or equivalent) and a reduction in emissions of 4290 kg of CO₂, 89.7g of NO_x and 8.97g of PM₁₀ on a yearly basis. This result cannot be maintained without procedures to ensure that the positive effects of eco-driving are maintained in future years. These effects can be maintained by refresher courses or other methods.

D Lessons learned

D1 Barriers and drivers

D1.1 Barriers

- **Barrier 1** – Difficulty to get staff to take eco-driving training. This barrier stems from two problems: A. That since staffing of health-care professionals is so “tight” there is little slack time available for staff to take extra training and in particular training which managers view as not being a central part of staff work. B. Managers do not actively assist in informing their employees about this possibility for driver training. Also, it is suggested that training must be optional which means the number of participants may be lower than expected. This can be further reduced by stipulating that only employees who drive 5000km or more are eligible for training, which is 5% of all staff.
- **Barrier 2** – Perception of the low potential for savings. Managers of clinics etc appear to have the perception that cost savings in fuel consumption would be so low compared to a wide range of staff and medical costs associated with the clinical activities that other avenues for cost-savings are more worthwhile to pursue.
- **Barrier 3** – To maintain the benefits of eco-driving it is suggested that refresher courses are offered to participants which, however, can prove costly not only from the point of financing these courses but also because employees are absent from work during training sessions.
- **Barrier 4** – Studies have apparently shown that the benefits of eco-driving diminish in the weeks after the training which defies the purpose of the measure objective for reducing the impact of transport on environment and may not represent value for money.

D1.2 Drivers

- **Driver 1** – UMAS is part of Region Skåne and the region has a number of policy decisions in the area of transport and employee travels that support the delivery of eco-driving training to employees in the hospital sector.
- **Driver 2** – UMAS environmental policy and other documents should be a driver for this measure.
- **Driver 3** – Eco-driving is generally considered a cost-effective and effective way of reducing fuel consumption and emissions and improving the environmental performance of the municipal car fleet.
- **Driver 4** – The measure results estimated that there has been a reduction in fuel use and reduction of emissions, which is a positive message for marketing and promotion of this measure.

D2 Participation of stakeholders

- **Stakeholder 1** – Employees took the eco-driver training courses. They were members of staff who drive more than 5 000 km a year on business.
- **Stakeholder 2** – The driving instruction school held the courses for UMAS as part of a procurement arrangement initiated centrally on the part of Region Skåne.
- **Stakeholder 3** – Local and regional administration had a driving role in this measure in terms of introducing the UMAS management to it.

D3 Recommendations

- **Recommendation 1** – Encourage participation through course design and integration with other human resource development initiatives. It is important to reduce the barrier for staff to participate because of lack of time to devote to training which arises from middle-level managers seeing eco-driving as an extra, un-related to the core work tasks for their staff. If it would be possible to “bundle” eco-driving with other continuing education or work-related training then it might be easier to increase participation. For example, eco-driving combined with fire-safety training is a possible bundle.
- **Recommendation 2** – More publicity on the part of UMAS in internal newsletters etc. about the experiences and benefits of eco-driving.
- **Recommendation 3** – It is recommended that to achieve wider benefits of this measure eco-driving is encouraged and promoted for personal use where the opportunities exist, i.e. people owning cars which are technologically equipped to allow for eco-driving and maintaining and enhancing the associated environmental benefits.
- **Recommendation 4** – It is recommended to co-ordinate eco-driving efforts with other large organisations in Malmö to show to participants that eco-driving is part of a city-wide initiative.
- **Recommendation 5** – To achieve a wider application of this measure driving tests centres could offer eco-driving techniques. Driver education schools, because of a national policy decision, have begun to integrate “eco-driving” concepts and methodology into the regular curriculum.
- **Recommendation 6** – it might be considered to install vehicle computers in order to create the most efficient feedback system on fuel consumption, as per measure 10.1, Freight driver support.

D4 Future activities relating to the measure

Some eco-driving training will probably occur during the first half of 2009 after SMILE has concluded. The evaluator has received no indication that continued eco-driving training on the part of UMAS is a prioritised area.