



BUY SMART

Green Procurement for Smart Purchasing

Procurement and Climate Protection

**Guideline for procurement of vehicles
with criteria of energy efficiency and environment**

Vehicles

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This guideline is provided within the framework of the European Union project “Buy smart – Green procurement for Smart Purchasing” funded by the program “Intelligent Energy – Europe”.

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Date: April 2011

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1. Introduction



Picture: AboutPixel.de

Transport is an indispensable component of our society and of our life. It constitutes an important pillar of our economic wealth. But it should not be ignored that the road traffic in particular contributes significantly to the emission of air pollutants and climate change gases. In spite of constant technical progress, the need for action for more environmental friendly products in the field of freight and passenger transport still remains.

Challenge N°. 1: Climate protection

Since the 1990s, the beginning of the climate protection efforts around the Kyoto Protocol, the EU has registered an increase of more than 20 % in transport-related CO₂ emissions. Successful reductions in other sectors are all but swallowed up by transport. About half of these transport-related CO₂-emissions are caused by passenger cars, light utility vehicles, and buses. In Europe every year more than 15 million vehicles are newly registered, 92 % of them in the older EU-15. Improvements in the efficiency of vehicles, as achieved by the car industry in the past, have as yet been neutralised by a higher traffic volume and vehicles' (in some cases substantial) extra equipment and higher motorisation. It is of the utmost importance that the "climate-friendly" technologies available on the market will be taken into consideration during vehicle procurement.

Challenge N°. 2: Air Pollutants

Furthermore, the transport - being the locally most significant cause of pollutant emissions (such as particulate matter) - has a central role to play in the prevention of air pollution. When evaluating the pollutant emissions of vehicles, it has to be taken into consideration that they are emitted at face level – and therefore is not thinned. The traffic in cities causes up to 50 % of the particulate matter emission, although it just reaches 20 % of the total particulate matter emissions. The need for action is also visible in the EU legal frameworks: in the past, the threshold value for particulate matter, according to the European Air Quality Framework Directive 96/62/EC, has frequently been exceeded in many cities in Europe, so that the emissions load shall be reduced by further Clean Air Plans and Action Plans in the future. One important measure in the transport sector is therefore a traffic ban for vehicles with extremely high pollutant emissions in the city centres.

Challenge N°. 3: Noise

Noise is another of the local problems in health and environmental protection. It is disturbing and also poses a risk to health. The main cause for noise in cities is traffic: in Berlin, for example, 61 % of inhabitants at main roads have to deal with a noise level above 65 dB(A) at day-time; at night-time even more than 78 % are affected by noise levels of 55 dB(A). In research about the effects of noise, these values are already on the threshold of where noise can lead to health problems, which are hearing damages and stress leading to cardiovascular diseases.

These numbers prove the necessity for traffic noise reduction. Besides measures in transport planning, such as speed limits at least at night-time, traffic ban for trucks, etc., noise emission reduction at the vehicle itself, e. g. by using low-noise and fuel-saving tyres, can contribute to environmental protection. Heavy utility vehicles definitely cause more noise; therefore they should be considered as a target for noise reduction.

Accepting the challenge – Options for fleet operators

In order to achieve the targets of the European Air Quality Framework, a wide range of technical and user-related measures are necessary. Fortunately, clean propulsion technologies and fuels for vehicles in vehicle fleets already exist. Fleet operators will play an important role in the implementation of these technologies.



Picture: AboutPixel.de

With their choice, procurers of fleets can give the market a significant positive stimulus if they decide on the environmental friendly alternative, because their choice of vehicle also affects the used vehicle sector. Also financially, they often have an advantage over the private customer due to the lower specific costs by procuring large numbers of vehicles.

On 23rd April 2009 the European Community enacted the Directive 2009/33/EC on the promotion of clean and energy-efficient road vehicles, which commits purchasers of public authorities to consider environmental and efficiency criteria when purchasing vehicles. Apart from the energy consumption, CO₂ emissions, nitrogen oxides, and particulate matter caused by the use of the vehicles during the entire life cycle have to be considered in the purchasing decision since 04th December 2010.

The procurement of a "clean vehicle fleet" is a decision for:

- Protection of environment and climate
- Less dependency on fuel prices
- Protection against driving restrictions in city centre air pollution control areas
- A possible step towards setting up an environment-friendly company image
- Economic efficiency.

However, it is evident that the uncertainty of vehicle fleet operators in particular with regard to the ecological advantages, the economic feasibility, and the future viability of "clean" procurement alternatives often prevents a more environmentally sound procurement.

The intention of this guideline is to provide procurers with a product-neutral, manufacturer-neutral decision aid, which enables the environmental and economically sound selection of propulsion technologies and fuels.

The guideline includes:

- Information on available technology for the "clean vehicle fleet"
- Information on financial feasibility
- General tips on procurement and vehicle operation
- Introduction of environmental marks and labels as procurement tools
- A proposed procedure for tenders for the "clean vehicle fleet"

1.1 Demands on the "Clean Vehicle Fleet"

The recommendations for the "clean vehicle fleet" consider the following aspects in procuring and using vehicles:

- Climate protection by lower greenhouse gas emissions
- Low consumption of non-renewable resources
- Prevention of local air pollutant emissions
- Reduction of noise exposure
- Contribution to the diversification of fuel supply.

The guideline gives a higher priority to the principle of an economical procurement; its goal is to show – taking into consideration the total life cycle costs – that the economic and environmental choice of vehicles can coincide.

Following these preliminary remarks, the considerations and recommendations within this guideline focus on efficient vehicles with conventional technology as well as on the propulsion alternatives and fuel alternatives, which can already be implemented in vehicle fleets today:

- Efficient vehicles with Otto engines (gasoline engine) and diesel engines
- Natural gas and liquid gas vehicles
- Vehicles with hybrid propulsion
- Biofuels (biodiesel, bio ethanol and biogas)

Future technological alternatives, which cannot yet be economically implemented in vehicle fleets, are briefly presented as future perspectives.

The addressed vehicle groups are: passenger cars, minibuses, vans, light utility vehicles, buses, and trucks – but without any details about specific requirements and vehicles for special purpose. In addition, equipment and materials for vehicles, such as tires, air conditioning systems, and motor oils are taken into consideration as well as tips on economical driving.

2. Considered products and related criteria

2.1 Products

2.1.1 Available Propulsion Types and Fuel Alternatives

2.1.1.1 Conventional Vehicles

Conventional vehicles in this guideline are those using common fuels like petrol or diesel. Both kinds of propulsion are based on a combustion engine. Since the energy density of diesel fuel is higher than that of petrol and the efficiency factor of diesel engines is superior to the ones of gasoline engines, diesel vehicles consume less fuel than comparable gasoline vehicles. Thus CO₂ emissions are lower. However, when comparing current EURO4-passenger cars, it becomes clear that diesel vehicles still have higher particle and nitrogen oxide emissions than petrol vehicles, since the latter are equipped with regular catalytic converters. This problem is met by the introduction of particulate filters for diesel vehicles. After all, a significant disadvantage for diesel vehicles remains, in respect to nitrogen oxide emissions – they are higher than in petrol vehicles.

Energy Consumption

Transport accounts for 25.5 % of the energy consumption and 21 % of green house gas emissions in Europe – an increase of 23 % since 1990. [EUROPEAN COMMISSION, 2006]

Since CO₂ emissions are directly related to vehicles fuel consumption, the energy demand of conventional vehicles constitutes an essential criterion for the road traffic effects on the climate. In principle, vehicles should be selected



Picture: H. Huppertz

by the lowest possible CO₂ emissions within the car segment and configuration, i.e. the vehicles should be equipped to be as efficient as possible. Thereby the climate can be protected and the fuel expenses lowered. Depending on the annual kilometrage, fuel expenses can have a share of up to 50 % of the total life cycle costs of the vehicle.

Consumption increases considerably with the size of the vehicle, but can vary greatly within a single vehicle model, as well. Thus, the CO₂ emissions of a common medium-sized passenger car can vary by more than 50 % between the various versions of the model, due to differing performance and components. Significant factors for the consumption of a vehicle are size, power and equipment, like air conditioning, independent vehicle and seat heaters, which increase the consumption of fuel significantly.

Since 2005 information regarding fuel consumption and CO₂ emissions of passenger cars are provided in the showrooms.

A report by the European Federation for Transport and Environment about CO₂ emissions of different brands can be found here:

http://www.transportenvironment.org/docs/Publications/2006/2006-10_how_clean_is_your_car_brand.pdf

If passenger cars are classified accordingly to the segments of the German Kraftfahrtbundesamt (www.kba.de/EN/), the maximum CO₂ emissions of the vehicle should be the must-criteria for each segment in the following table. About half the available automobiles reach these established criteria.

However, in terms of climate protection these minimum requirements are not ambitious enough. According to EU directive 2009/33/EC, CO₂ and other emissions are financially assessed and added to the total automotive cost. In this way vehicles emitting a large amount of CO₂ are becoming more expensive.

The classification of the vehicles is done by the manufacturers.

	CO ₂ emissions in g/km	
	Must-criteria	Vehicle with least CO ₂ emissions
Mini	110	SMART FORTWO (88 g/km)
Small cars	120	FORD FIESTE ECONECTIC (98 g/km)
Compact cars	130	TOYOTA PRIUS (104 g/km)
Middle class	150	VOLVO S40 1.6DDRIVE (118 g/km)
Upper Middle class	170	BMW 520d (136 g/km)
Upper class	270	BMW 6ER (183 g/km)
SUVs	210	FORD KUGA (159 g/km)
Vans	150	RENAULT MODUS (119 g/km)

Unfortunately there are no similar regulations for the publication of consumption values and CO₂ emission for transporters and small vans. Hence some of these vehicles are licensed as light utility vehicles. Some transporters below with a limited gross vehicle weight of 3.5 t are licensed as passenger cars. For those vehicles consumption and CO₂ emissions are given in the vehicle description. If no data is published, it should be available from the manufacturer. For transporters and small vans the following CO₂-criteria should be underlain for environmental-friendly vehicle procurement:

CO ₂ emissions in g/km		
	Must-criteria	Vehicle with least CO ₂ emissions
Transporters up to 3,5 t GVW	220	PEUGEOT BIPPER (119 g/km)

A decline of CO₂ emissions during the last years occurred for small cars. But lots of new products came along in the segments upper class, SUVs, and vans. The variety of models in these segments grew. And the average CO₂ emissions in these segments increased as well.

For transporters and vans the minimum mandatory criteria for an environment friendly procurement could be lowered compared to the criteria given in 2007.

The Regulation (EC) No 443/2009 bounds car manufacturers to lower the average CO₂ emission towards 95 g/km in 2020.

Pollutant Emissions

Urban air quality requirements have been considerably higher since 2005 due to the EU Air Quality Directive. Hence traffic is one of the main sources of local pollutants. Many cities have established measures to comply with the air quality threshold refer to traffic. Thus vehicles with relatively high pollutant emissions are kept away from city. Regarding these driving restrictions it should be kept in mind to purchase vehicles which correspond to the state-of-the-art concerning low emissions.



Picture: H.-G. Oed

Passenger cars and light utility vehicles

The currently applicable exhaust emission standard for passenger cars and light utility vehicles is EURO 5. Generally, new vehicles are also equipped with a particulate filter. A further emission level, EURO 6, which provides stricter values for particulate and NOx emissions, is currently under preparation at EU level and will come into effect in 2014.

For environmentally sound vehicle procurement, passenger cars and light utility vehicles should comply with the most severe requirements. Currently, this is the exhaust emission standard EURO 5. Diesel vehicles should also be equipped with a particulate filter.

The target value for nitrogen oxide (NOx) emissions is the EURO 6-standard of 80 mg/km NOx. In the USA a threshold value for nitrogen dioxide of 43 mg/km has been applied to diesel vehicles since October 2006.

Heavy goods vehicles and buses

The emission level EURO 5 is the current standard for all new bus and heavy goods vehicle models. This exhaust emission standard will also be further developed in Brussels to a EURO 6 level. Most manufacturers have implemented the standard EURO 4 and 5 concerning the NOx emissions by using the so-called SCR technology (Selective Catalytic Reduction). Here, a urea solution is fed into the flue gas stream, reducing the nitrogen oxide emissions. Another benefit of this technology is the reduction of fuel consumption by this in-engine optimisation.

At present, the strictest European environmental standard for heavy goods vehicles and buses is the EEV (Enhanced Environmentally Friendly Vehicle), which is even stricter than the EURO 5-standard. Some manufacturers offer buses which comply with this standard. This is realised by means of diesel buses with exhaust gas recirculation systems, or optimised natural gas buses.

Retrofitting of particulate filters

Depending on the age of the vehicle, it may be worth retrofitting it with a particulate filter. Here, a distinction is made between closed systems, which reduce the particulate emissions by more than 90 %, and so-called open systems, which allow reductions of between 20 % and 50 %. Particulate filter manufacturers offer retrofit systems for almost all prevalent passenger car models, and for several types of light utility vehicles.



Picture: BMU / Rupert Oberhäuser

The costs vary between 600€ and 800€ for passenger cars, and between 5.000€ and 7.000€ for trucks, depending on the size of the motor. Exhaust treatment systems which reduce NOx emissions as well as particulate emissions are also being developed. For buses, these are currently tested under the name SCRT (Selective Catalytic Reduction Technology).

Summary of conventional vehicles

Gasoline

- + low particle and NOx-emissions (due to catalytic converter)
- consumption/CO2-emissions generally higher than for comparable diesel vehicles
- no ban on driving for **vehicles** with controlled catalytic converter in environmental zones

Diesel

- + consumption/CO2-emissions lower than for comparable gasoline vehicles
- +/- with particle filter low particle emissions (filter required because of unhealthy particle emission)
- higher NOx-emissions than gasoline vehicles (therefore additional exhaust treatment strongly recommended/required)
- ban on driving for heavy emitting vehicles in environmental zones

2.1.1.2 Natural Gas Vehicles



Picture: BMU / Brigitte Hiss

natural gas tanks are placed underneath the car so the shipping volume is not reduced.

Many automobile manufacturers now mass-produce passenger cars and light utility vehicles which run on natural gas.

Natural gas vehicles are operated by a gasoline engine like a petrol vehicle. The only difference is the natural gas instead of petrol, which is stored at a pressure of 200 bar, and injected into the combustion engine. In mass-produced vehicles the

The range for passenger cars alternates between 200 and 450 km per tank of natural gas. A distinction is made between bivalent vehicles, which can be powered by either natural gas (CNG) or petrol, and monovalent/mono-fuel vehicles. The advantage of the latter is that these have engines which are optimised for the use of natural gas. Therefore they have a higher efficiency, and correspondingly lower fuel consumption and CO₂-emissions.

As far as the emission control is concerned, natural gas vehicles have an environmental advantage over diesel vehicles due to their low NO_x-emissions and no particulate emissions.

Regarding climate protection, there is only a slight advantage, with a maximum of 10 % carbon dioxide savings in comparison to diesel vehicles and 20 % compared to petrol-driven vehicles.

Natural gas is often hindered by the filling station infrastructure, which however is being continuously expanded. Information regarding the filling station network and natural gas vehicles which are available, can be found at: <http://engva.org>

In terms of security aspects natural gas vehicles do not differ from petrol driven vehicles. The tank of the natural gas vehicle is constructed for a cracking pressure of 600 bar. Moreover security valves provide a selective blow off in case of damage or in the case of an impact of heat – e. g. when the vehicle is on fire – a controlled burn down of the gas prevents the danger of an explosion. An important aspect though for the secure handling of the new technology is to comply with inspection intervals and guidelines (inspection intervals match the ones for petrol vehicles).

The ban on parking of natural gas vehicles in underground car parks, which at some places still exist, applies also to LPG vehicles

Summary natural gas vehicles

- + no particle emissions
- + lower NOx-emissions compared to diesel vehicles
- + biogas usable without restrictions
- +/- CO₂-emission savings compared to diesel vehicles are low
- +/- fuelling stations infrastructure differs regionally
- limited offer of new vehicles

2.1.1.3 Liquid Gas Vehicles

Liquefied petroleum gas (LPG or auto gas) is a mixture of propane and butane, and can basically be used in the same engines as natural gas. Unlike natural gas, which is stored at high pressures (200 bar), LPG can be stored at much lower pressures (maximum 10 bar) and in smaller pressure tanks. LPG systems for petrol-powered passenger cars are generally fitted for bivalent operation. This means it is possible to switch from petrol to gas and vice versa while driving.

For fuel tanks special gas tanks are applied which are also available for spare wheel recesses. With the same tank volume a liquid gas vehicle achieves an up to three times higher range compared to a natural gas vehicle. To fuel the vehicle a specific filling support is connected with the vehicles tank alignment. It should be noted that the gas tank can only be filled up to maximum 80 %, and then the fuelling process is automatically stopped by means of a filling stop valve.

LPG vehicles have considerably lower NO_x and particulate emissions than corresponding diesel vehicles; however the CO₂ emissions are similar to those of the corresponding diesel vehicles; the advantage compared to petrol-driven vehicles is up to 15 %.

Only a few new vehicles are released from the factory with built-in LPG systems. It is still more common to convert petrol vehicles for LPG. It is important to ensure that the installation work is performed by qualified specialist companies. More information can be found at: www.worldlpgas.com

Since LPG is heavier than air, vehicles with an auto gas tank are allowed to be parked in closed rooms only if there are appropriate measures to aerate, such as exhaust systems. The ban on parking LPG vehicles in underground car parks, which at some places still exist, applies to LPG vehicles as well as natural gas vehicles.

Summary liquid gas vehicles

- + no particle emissions
- + lower NO_x-emissions compared to diesel vehicles
- +/- CO₂-emission savings compared to diesel vehicles are minimal
- limited offer of new vehicles

2.1.1.4 Hybrid Vehicles

In recent years, hybrid propulsion has become the focus of the debate on fuel savings. With this technology, part of the braking energy is fed back into a battery. This energy is then used for propulsion of the vehicle via an electric motor, to supplement the conventional combustion engine. With this technology, primarily in city traffic, it is possible to achieve significant potential savings which may well amount to 30 %. Another advantage of these vehicles is that in electric mode they have almost zero noise emissions. The range of passenger car models with hybrid propulsion is still limited. However, the automobile manufacturers have announced that they will be offering more models.



Picture: Mobility CarSharing Schweiz

The models currently available can be found at:

<http://www.hybridcar.com/index.php>

This type of vehicle propulsion is of particular interest for passenger cars in city traffic, and for urban distribution of goods, which both involve a considerable amount of braking. Yet there is no corresponding light utility vehicle available on the European market, but already been heralded.

Summary Hybrid Vehicles

- + high saving potential for fuel consumption in city traffic
- + CO₂-advantage up to 30 % compared to conventional vehicles in city traffic
- low saving potential for interurban driving
- limited offer of new vehicles

2.1.1.5 Biofuels

The future role of biofuels in climate protection has been discussed with some controversy. The EU has set the target up to 2010 to sell a quota of 5.75 % biofuels.

The European Commission published an EU strategy for biofuels and a Biofuels Progress Report where it is stated



Bild: AboutPixel.de

that the biofuels directive target for 2010 is not likely to be achieved (http://ec.europa.eu/energy/renewables/biofuels/biofuels_en.htm).

The so-called first generation of biofuels which are currently utilised includes biodiesel and bio ethanol, predominantly produced from rapeseed, wheat and sugar beet. The consideration of their respective greenhouse gas balances, i.e. all emissions which harm the climate, reveals an advantage with regard to greenhouse gas emissions of around 40 % in comparison to fossil fuels. This is primarily due to the fact that for this type of bio fuel, it is necessary to cultivate the corresponding energy crops, such as rapeseed. When using fertilisers, in particular nitrous oxide is produced; this has a significant greenhouse effect. Depending on how the crops are cultivated, how much of fertiliser is used, and whether, for example in the production of biodiesel, possible by-products can be further utilised, the climate advantage of current biofuels can vary greatly. With biodiesel, for example, the impact on the climate, when compared to that of fossil diesel fuel, ranges from 20 % to 80 %. Basically, it must be said that on the basis of climate efficiency and the specific crop biomasses, these biofuels are only seen as an intermediate solution.

When evaluating the use of biofuels the land consumption for cultivating the necessary crops has to be taken into (ecological) considerations. This problem of the competition on the use of existing areas is currently discussed. Food prices have already risen and tropical rainforests are destroyed to plant palm trees for palm oil. Besides growing food plants are needed as resources for a variety of products.

It should also be taken into account that it is more efficient to use biomass in combined heat and power plants than use it as fuel for vehicles.

Biodiesel

Biodiesel is already being added to the conventional fuel. Using 100 % biodiesel in diesel vehicles is only possible upon manufacturer's approval. The first particulate filters for retrofitting have been approved for biodiesel. Information regarding vehicle manufacturers' approvals and regard-

ing the filling station infrastructure can be found at http://www.ufop.de/english_news.php. It must be noted that fuel consumption of biodiesel can be up to 10 % higher, and the oil-change intervals can become shorter.

It is also possible to fuel pure vegetable oil but only when retrofitting the vehicle. Vegetable oils are considered critically from environmental aspect since they have a worse greenhouse gas balance than biodiesel, and using them often leads to exceeding the emission threshold.

Bio ethanol

Bio ethanol, in its pure form, or in a blend (> 5 percent), can only be used in special vehicles. These vehicles bear the name FFV (Flexible Fuel Vehicle) and can be operated with pure petrol as well as with various ethanol-petrol blends. E85, for example, is in common use. This consists of 85 % anhydrous bio ethanol and 15 % normal petrol. In Germany there are recently only a few manufacturers who offer FFV. When it comes to ethanol blending, Sweden is leading the way in Europe (www.e85.biz). In Germany this kind of fuel is not common, the first fuelling station of E85 opened in Berlin in November 2006 (www.e85.biz).

Biogas

Biogas – also known as bio methane – is a good alternative to natural gas. A major advantage is that it can easily be used in conventional natural gas vehicles, and can be blended with natural gas at any ratio. In comparison to biodiesel, its climate balance is considerably more positive. Depending on the feedstock – such as



Picture: www.wendland-elbtal.de

manure or sewage – it is possible to reduce greenhouse emission between 65 % and

90%. Basically, biogas fuel could be drawn upon in the future as a blend with natural gas fuel or as pure biogas at a separate filling. For large fleet operators in close proximity to a source of biogas or sewage gas, investment in a self-owned biogas filling station may be worthwhile.

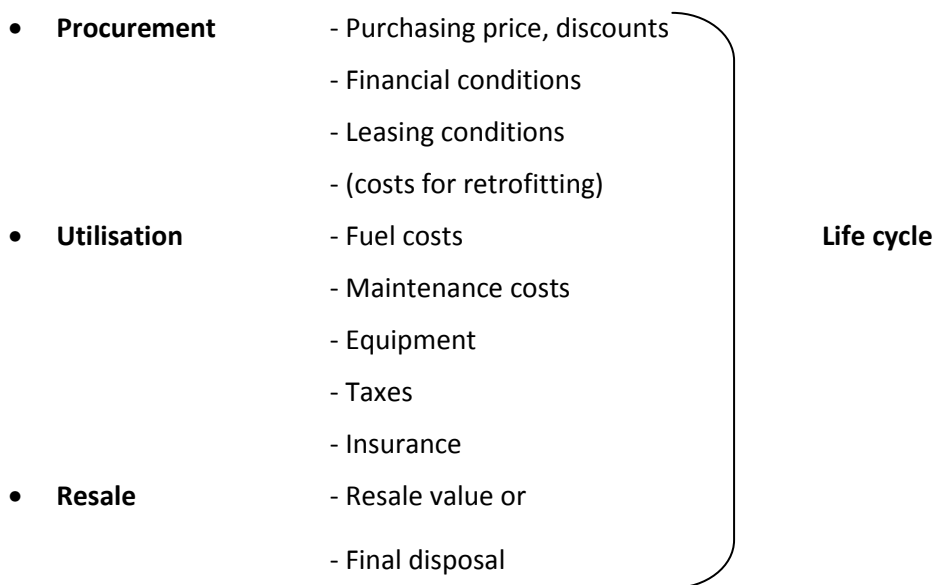
Summary Biofuels

- +** advantage in climate protection compared to fossil fuels
- +/-** no advantages regarding pollutant emissions
- use of pure biofuels is partially possible in vehicles

2.1.2 Economical aspects

To evaluate the economic efficiency of procurement alternatives, besides the purchase, utilisation and the resale value of the vehicle – that is to say the whole utilisation and life cycle of the vehicle – have to be considered.

Concretely, following shares play a role:



The relations of costs vary – depending on different vehicles types and particularly on different vehicle utilisations. Thereby the decisive criterion is the driving performance: the more kilometres travelled per year, the more significant is the share of utilisation costs, primarily the fuel costs. The life-cycle of purchased vehicles varies greatly: passenger cars are often only hold up to five years or less in the fleet –whereas it is up to 15 years for buses and commercial vehicles. The estimated service life is an important indication for the amortisation of additional expenditures, e.g. higher initial costs for different propulsion types. The longer the expected service life, the more important is a clean and environmental-friendly procurement, considering the fact that the demands for the air quality in cities and climate protection constantly increase. Those who want to drive without any emission-related bans in the long term should invest as soon as possible in the best technologies reducing pollutant emissions and fuel consumption.

Procurement

For the procurement process the petrol-powered models are commonly the lowest priced ones among comparable alternatives. Comparable models of diesel vehicles commonly have a surcharge of about 10 %. The difference between initial costs of natural-gas vehicles and comparable conventional propulsion ones varies depending on manufacturer and model – going from minor differences below 5 % when compared to a diesel-vehicle up to 15 % of additional costs.

For the procurement of vehicles it should be noted, that comparisons of catalogue prices are not always helpful for purchasers – particularly for the procurement of a greater number of vehicles discounts play a big role. The evaluation of procurement decisions concerning economical criteria should therefore be based on precise offers.

It is also possible to lease environmental friendly cars, e. g. at

<http://greenplan.graymatter.co.uk/default.htm>.

Retrofitting

It does not always have to be a new vehicle. Depending on age, extra equipment, and expected service life, retrofitting can be useful, i.e. to continue driving in low-emission zones.

- Diesel particulate filter

A diesel particulate filter, sometimes called a DPF, is a device designed to remove diesel particulate matter or soot from the exhaust gas of a diesel engine. The costs for retrofitting vary between 600 and 800 Euro for a car and between 5.000 and 7.000 Euro for a truck.

- Natural Gas Vehicles

All petrol vehicles can be retrofitted for the alternative operation with natural gas. The retrofitting costs between 3.200 and 4.500 Euro depending on the vehicle model and amortises due to savings of utilisation costs. However, in most cases the procurement of new mass-production vehicles is more cost-efficient and also preferable in respect to technical aspects, because by retrofitting the gas tank and the feed pipe system have to be integrated and adjusted. Furthermore it will lead to reduced space in the boot, as the tanks are rarely added underneath the car, which is the case for mass-production vehicles. In any case the retrofitting should be carried out by a specialised firm.

Fuel costs

Generally the relevance of fuel costs in the macroeconomic consideration of the vehicle's life cycle increases with higher fuel prices. Important for the comparison: same volumes of different fuels contain different energy quantities - for that reason fuel costs have to be regarded in relation to the consumption data of the respective vehicle types for the different propulsion kinds.

	Fuel	Consumption per 100 km	Driving performance year	Fuel price (example)	Fuel price per year
Diesel engine	Diesel	5,1 l	Each 20.000km	1,07 €	1.091 €
Gasoline engine	Petrol	6,9 l		1,23 €	1.697 €
Gasoline engine	Natural gas (H)	4,3 kg		0,75 €	645 €

As fuel prices might change within the time the vehicle is used, it is worthwhile to organise the economical comparison dynamically – i.e. to consider a possible price increase – especially when the vehicle is kept over a long period of time. Prices may vary due to tax exemptions.

As ethanol has an energy amount about 35 % lower than petrol an additional consumption of up to one third has to be expected. The fuel bio ethanol consists of 85 % bio ethanol to which 15 % petrol is added.

Maintenance costs

Modern natural gas vehicles do not differ technically from petrol vehicles. The effort for services and maintenance costs are approximately comparable. Similar is true for hybrid vehicles: manufacturers guarantee the same maintenance needs as for comparable conventional passenger cars.

The use of biodiesel may result in increased maintenance costs: in fact many manufacturers suggest shorter intervals for oil change because of security reasons. The additional costs are more than compensated for by the fuel's cost decrease.

Taxes

The vehicle exercise duty (also known as road tax) may differ depending on the car model.

Resale value

A number of factors influence the resale value (preferences for various brands, models, kinds of propulsion, equipment). The residual value is based on the factors in this guideline. The residual value of diesel vehicles is in general higher than of comparable petrol vehicles – there is a higher demand for used economic vehicles, in contrast highly motorised vehicles have higher loss in values. The retrofitting with a particulate filter has also some relevance for the terminal value: the estimated average resale value differs 2 % – 10 % (depending on the vehicles` age) for vehicles with filter respective vehicles without filter - according to Eurotax Schwacke .

The development of the resale value for natural gas vehicles adjusts to the lively market for this propulsion type, so that no disadvantages consist compared to conventional vehicles.

2.1.3 Outlook towards Future Technologies

2.1.3.1 Second Generation Biofuels

Beside the biodiesel and bio ethanol, previously described, a number of techniques for the generation of biofuels are under way due to the uprising interest and the special support for renewable energies. Those techniques particularly focus on the use of various biomasses as a resource. Particularly two of those techniques just being developed are very promising in the middle and long term:

1. The generation of synthetic fuels, the so called BtL (Biomass to Liquid), and sunfuel especially, which is produced from synthetic gas made by the gasification of biomass.
2. The generation of bio ethanol by decomposition of hemicellulose or cellulose containing materials and the subsequent fermentation of the (hemi) cellulose fraction.

However, it cannot yet be expected that these synthetic fuels will make any notable penetration of the fuel market within the next 10 to 15 years. But they do offer considerable potential for the future due to the unspecific nature of the source material in comparison to conventional biofuels.

2.1.3.2 Hydrogen Vehicles



Another fuel will be interesting in the future: hydrogen. It can be used in conventional combustion engines, but also in fuel cells, which enable higher efficiency factors. In fuel cells, the hydrogen is chemically converted to water, which simultaneously releases electrical energy that powers an electric motor. Thus, apart from water, no emissions leave the vehicle's exhaust pipe.

Various automobile manufacturers already have prototypes for passenger cars and buses in trial operation on the road, but mass-produced vehicles are likely to be some years away yet. The optimal storage of hydrogen in the vehicle is also still object of research. Whether hydrogen is environmentally friendly for fuelling vehicles depends largely on the product chain of the fuel. Hydrogen vehicles only present a real environmental advantage with regard to climate protection if the hydrogen is produced from renewable energy sourced: either from electricity generated from renewable energy sources, or from biomasses. Indeed, direct utilisation of renewable electricity will become ecologically and economically more efficient in the next decades, so widespread implementation of hydrogen vehicles cannot be expected in the immediate future.

<http://www.fuelcelleurope.org>

At present, there are already several projects, in which the energy source hydrogen is tested in road traffic for its suitability for daily use, as well as its system suitability. One example is the project HyFLEET:CUTE.

<http://www.global-hydrogen-bus-platform.com/>

3. Relevant European labels

In many fields, environmental marks and labels now provide the consumer or procurer with support in making an environmentally sound procurement decision. The idea is simple: the published, comparable product information support the procurer when making the procurement decision. The cumulative procurement decisions of all consumers then provide an incentive for the suppliers, for example to produce more environmentally sound products.

In the vehicle sector, an efficiency label similar to the well established for electrical appliances (e.g. A+ refrigerator) has not been introduced because too large differences do exist concerning the comparability between various vehicles. However, there are several other useful labels for the procurement of "clean vehicles".

3.1 Labels

EU Exhaust Emission Standards for Motor Vehicles

Website: <http://ec.europa.eu/environment/air/transport/road.htm>

Target:

The exhaust emission standards are not an environmental label in the strictest sense, but they require compliance with the established air pollutant threshold values for new vehicles.

Product/service group:

All passenger cars, heavy goods vehicles, buses, motorcycles and mopeds

Awarding Institution & criteria:

The threshold values according to the European exhaust emission standard apply to the air pollutants carbon monoxide (CO), nitrogen oxide (NO_x), all hydrocarbons (HC), and particulate matter (PM). The threshold values vary according to engine type and vehicle type, and are constantly revised. Since January 1st, 2005, the EURO 4 standard applies throughout Europe (EC directive 98/69/EC), and is mandatory for all newly purchased vehicles. As of 2008/2009, the emissions level EURO 5 will apply to all new bus and heavy goods vehicle models (99/69/EC).

To verify the compliance with the exhaust emission standard, the emissions of each new vehicle model are measured according to a standardised testing procedure.

Relevance on the market:

The current exhaust emission standard is statutory for new vehicles. The threshold values for EURO 6, which are discussed currently, can provide an indication as to which requirements regarding pollutant emissions will apply to motor vehicles in the future.

European Fuel Economy Label

Target:

The European fuel economy label provides the consumer with information about the fuel consumption of passenger cars.

Product/service group:

All passenger cars

Awarding Institution & criteria:

The European fuel economy label is based on the European directives 93/116/EC and 1999/94/EC. The directives state that the minimum of information which must be indicated for all passenger cars comprises the basic specifications (brand, model, cubic capacity, etc.), the fuel consumption in l/100 km for inner-city driving, extra-city driving, and for a combination of both, as well as the CO₂ emissions of the combined driving cycle. Car dealers must make this information available to the customer in an information table, which can be compiled individually. In addition, further information has to be made available to potential customers, such as comparison values for the indicated consumption values or recommendations for efficient driving practice.

Relevance on the market:

Although the efficiency of vehicles has improved by over 25 % in the past 30 years, real savings in consumption per vehicle have only been achieved to a limited extent. The trend towards higher motorisation, or towards more equipment for comfort and safety, more or less neutralises the increases in efficiency. The European fuel economy label should stem this trend, and by means of the consumers' market power, achieve the objective of an average of 120g/km CO₂ emissions for the European passenger car fleet.

4. Practical instructions for procurement and use of the group/product

4.1 Environmentally Sound Vehicle Use in the "Clean Vehicle Fleet"

4.1.1 Low Viscosity Oil (High lubricity Oil)

The most important function of low viscosity oil in an engine is the reduction of internal friction, i.e. its lubricating function. Motor oils are categorised according to their viscosity at cold start and at high motor temperature by means of the SAE (Society of Automotive Engineers) system. Oils with SAE viscosity grades 0W30 and 5W30 guarantee the best lubrication function due to their viscosity properties. For this reason, they are described as high lubricity oils. Conventional motor oils (15W40, 10W40) cannot achieve this level of viscosity, due to the blending properties of their mineral base oils. High lubricity oils are somewhat more expensive, but cause fuel consumption to decrease by around 3 %, so the investment is also financially rewarding after a period of time.

4.1.2 Low Rolling Resistance Tires

Low rolling resistance tires are vehicle tires which, due to optimised rolling resistances, have lower noise emissions and are characterised by fuel savings of around 3 %. There is already a broad range of so-called low rolling resistance tires, although they are offered in conjunction with somewhat confusing terminology. The German environmental label (Blue Angel) provides reliable criteria with regard to noise reduction and rolling resistance, but currently there are no products declared (http://www.blauer-engel.de/en/products_brands/vergabegrundlage.php?id=166).

A label similar to the energy information provided with household appliances will have to accompany tyres distributed from a factory to a shop or a garage from 1 November 2012. In addition to its impact on a vehicle's fuel efficiency, a tyre's performance in wet conditions and its rolling noise in decibels will also have to be indicated.

The label will classify tyres from the best-performing 'A' class to the worst 'G' class. In order to promote fuel-saving tyres, EU countries will be allowed to provide financial incentives only for tyres that reach at least 'C' class.

Prize comparisons between low rolling resistance tires and conventional tires show that there is either no or very little difference in price. But even at a higher price, low rolling resistance tires pay off after a period of time due to the reduced fuel consumption.

4.1.3 Tire Pressure

It is not only for reasons of safety that the tire pressure must be checked regularly. If pressure is too low, the rolling resistance of the tire increases, and fuel consumption can increase by some percentage points. Thus, regular tire pressure checks prevent unnecessary fuel consumption, and save costs.

4.1.4 Eco-Driving

The vehicle's fuel consumption cannot only be reduced by technical measures, but also depends on the individual use behaviour and the driving style. Thus, with fuel-saving driving practices, such as shifting into high gear early, and looking ahead, it is possible to achieve savings of up to 25 % per vehicle, compared to current consumption. The energy savings are accompanied by decreased accident numbers, and significant noise reductions. This driving style can be learnt in drive training courses. Drive training courses are available for passenger cars, buses, or heavy goods vehicles.

The success of the drive training course depends strongly on the existence of a display for monitoring the vehicle's fuel. Thus every vehicle should be equipped with a so-called "intelligent" consumption display, which provides readings for the average, maximum, and current consumption. Various vehicle models have already this type of consumption display as standard. Low-consumption driving practices can also be promoted by incentive systems for the drivers, such as premiums, or a share in the financial benefits, i.e. the cost savings incurred by the lower fuel consumption. On the long term, the potential consumption reduction which fuel-saving driving practices offer is on average of 12 % for inner-city traffic. For extra-city traffic, the potential savings per passenger car are around 6 %, and for heavy utility vehicles and buses 4 %.

4.1.5 Use of Air Conditioning Systems and Independent Vehicle Heaters

Nowadays almost all vehicles are equipped with an air conditioning system. Regarding driving comfort these systems are advantageous, but they consume additional fuel. The manufacturers themselves estimate the additional consumption to be 0.6 l/100 km. In city traffic, this figure can also be considerably higher. Thus, if it is impossible to avoid this equipment altogether, the air conditioning system should be used sparingly.

By retrofitting with an independent vehicle heater it is possible to save fuel when the temperature is low. Because the engine is already heated up when started, it consumes less fuel. The independent vehicle heater itself consumes about 0.3 litres of diesel or petrol. Further advantages are less wear out compared to starting cold, less environmental pollution because of less emis-

sions in the starting phase and comfort. However, these advantages do not play a role, when the vehicle is placed in closed parking spaces.

4.2 Practical procurement instructions

The website www.buy-smart.info provides procurers with free purchasing tools, including performance sheets and calculation tools. The performance sheets are available as Word documents and can be individually adapted if necessary.

There are two calculation tools available:

1. The calculation tool for the calculation of life cycle costs including costs for the emissions of CO₂, nitro oxides and particulate matter. The calculation tool was developed by the European Commission for the implementation of the Directive 2009/33/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of clean and energy-efficient road transport vehicles. The Directive had to be set into force from 4th December 2010 on. More information can be found at <http://www.cleanvehicle.eu/>
2. The second calculation tool had been developed in the previous project of Buy Smart and has been updated with the current data on the emissions of new vehicles (March 2008). With this tool, purchasers can calculate the life cycle costs, which consist of the initial cost and operating costs only. One version is targeted to light passenger and commercial vehicles and one for heavy road vehicles.

The procurement of vehicles are described by two different methods

- Alternative A: a comparably simple method for a life cycle analysis according to the EU-calculation tools. The result is the most efficient vehicle.
- Alternative B: a method including life cycle analysis as well as minimum requirements in terms of environmental protection.

4.2.1 Alternative A (calculation tool according to Guideline 2009/33/EG)

For application of this method the accordant environmental performance sheets are to be used:

- Integrate the environmental performance sheet with the must criteria into your specifications. Communicate this performance sheet as part of the procurement – bidders are asked to complete the bidding documents. The performance sheet only consists of mandatory minimum-criteria.

- Send the performance sheet as integral component of the call for tender, and indicate:
 - that products, which do not fulfil the criteria will be excluded
 - The supplier has to detail all requested information respectively to confirm the compliance with the must criteria
 - The offers, in which single must criteria are not fulfilled, will be excluded
- Use the EU calculation tool for a life cycle analysis:
 - Complete the calculation tools with the figures you got from the bidders.
 - Complete the calculation tools with your specific demands.
- The result is the most economic vehicle

4.2.2 Alternative B (comprehensive procedure)

The alternative B environmental performance sheet includes a life cycle analysis and minimum requirements.

- Integrate the environmental performance sheet with the must criteria and additional the target criteria into your specifications. Communicate this performance sheet as part of the procurement – bidders are asked to complete the bidding documents. The performance sheet only consists of mandatory minimum-criteria.
- Send the performance sheet as integral component of the call for tender, and indicate:
 - that products, which do not fulfil the criteria will be excluded
 - The supplier has to detail all requested information respectively to confirm the compliance with the must criteria
 - The offers, in which single must criteria are not fulfilled, will be excluded
- Use the Buy Smart calculation tools for a life cycle analysis:
 - Complete the calculation tools with the figures you got from the bidders.
- The result is the most economic vehicle

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6. List of Abbreviations

CNG	Compressen Natural Gas
EEV	Enhanced Environmentally Friendly Vehicle
EGR	Exhaust Gas Recirculation
ELR	European Load Response Test
ESC	European Stationary Cycle
ETC	European Transient Cycle
FFV	Flexible Fuel Vehicle
GVWR	Gross Vehicle Weight Rating
LPG	Liquified Petrol Gas
SCR(T)	Selective Catalytic Reduction (Technology)
SUV	Sport Utility Vehicle