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1 EXECUTIVE SUMMARY

CLEANER-DRIVE is a 3-year collaborative research project supported by the European Commission DG Transport and Energy. It aims to exploit the experiences, stakeholder contacts and market influence of national programmes to overcome barriers to the introduction of cleaner vehicles in Europe. One of the key objectives of CLEANER-DRIVE is to develop a robust European methodology for vehicle environmental rating that draws attention to cleaner vehicles and technologies, and to pilot its use in a web-based tool. This report describes the process of the development of the **vehicle environmental rating** and it's implementation in the **web-based vehicle decision support tool** and explains the background of the different choices made in this development process.

Cleaner Drive's rating methodology has been developed over the last three years by a consultative process involving a wide range of stakeholders from across Europe including: vehicle manufacturers; governments; the European Commission; engineering and emissions test centres; academia; environmental organisations; economists; and other national and international organisations. This approach has allowed the project to benefit from a wide range of knowledge and experience and to develop a methodology that is technically robust and supported by a wide range of stakeholders.

Main achievements in the task of the development of the vehicle decision support tool are:

- Identification and review of 20 clean vehicle information resources;
- Extensive research into the availability and reliability of vehicle data;
- Identification and characterisation of different national and international vehicle databases;
- Compilation of 7 national vehicle databases with environmental parameters and calculated environmental score and implementation of 6-monthly updating process;
- Consultation with a wide range of stakeholders, including vehicle manufacturers, national Government representatives, trade associations, vehicle and fuel experts, environmental economists and national cleaner vehicle programmes;
- Analysis of functional design of databases and vehicle decision support tool;
- Technical development of the vehicle decision support tool http://www.vito.be/CleanerDrive/asp/CDhome.asp ;
- Integration of the vehicle decision support tool in the UK pilot site http://www.cleaner-drive.co.uk/ ;
- Integration of the vehicle decision support tool in the 6 other national Cleaner Drive webportals (Belgium, Netherlands, Sweden, Switzerland, France, Austria);
- Organised stakeholder feedback on the functionalities of the DST;
- Improvements of version 1 of the vehicle decision support tool and development of version 2;

- Writing of maintenance plan with short and long term vision on further development of vehicle environmental rating and it's implementation in webbased information portals, of which a vehicle decision support tool is the major part.

Since the implementation of the second version of the vehicle decision support tool in the national Cleaner Drive websites, a maintenance plan for short and long term is foreseen. Partners are given the choice to support a central hosted version of the vehicle decision support tool or have received the necessary software to guarantee an efficient implementation of the vehicle decision support tool on their own servers. On the long term, the advantages of a centrally hosted vehicle decision support tool must not be underestimated. It ensures exchanges of existing information and vehicle data and an efficient tool to provide consumers environmental information on vehicles from a European perspective.

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3 INTRODUCTION

In Workpackage 4.3 of the Cleaner Drive project, the objective is to develop a decision support tool based on vehicle environmental rating to help vehicle operators, especially fleet operators, to identify cleaner vehicles.

The decision support tool will make the rating methodology, developed in Workpackage 4.2, visible to the user and is the core of the seven national websites on clean vehicles. Cleaner Drive's rating methodology has been developed over the last three years by a consultative process involving a wide range of stakeholders from across Europe including: vehicle manufacturers; governments; the European Commission; engineering and emissions test centres; academia; environmental organisations; economists; and other national and international organisations. This approach has allowed the project to benefit from a wide range of knowledge and experience and to develop a methodology that is technically robust and supported by a wide range of stakeholders. The

The decision support tool has been developed after intensive stakeholder consultations amongst users on the requirements for a rating methodology and a web-based information tool. In this stakeholder consultations, main objective was to find out how environmental performance of vehicles could be integrated in the purchase decision and how web-based information can support this objective.

Since the implementation of the decision support tool in the 7 nationally hosted Cleaner Drive websites that started in December 2002 and was completed by June 2003, a period of a year of stakeholder feedback was held. During this period, remarks from different stakeholders on a European and national level were gathered.

Based on the stakeholder feedback, important changes that were feasible in the budget of the WP4.3 task are implemented in the second version of the DST which is online since May 2004.

Main deliverable of WP 4.3 in the project is the web-based tool itself that can be consulted through the national websites. This report summarises the stakeholder feedback and changes implemented in the second version of the DST.

In a conclusive chapter, a long term view on the maintenance of the environmental rating methodology and the DST is given.

4 VEHICLE ENVIRONMENTAL RATING METHODOLOGY

Cleaner Drive's rating methodology has been developed over the last three years by a consultative process involving a wide range of stakeholders from across Europe including: vehicle manufacturers; governments; the European Commission; engineering and emissions test centres; academia; environmental organisations; economists; and other national and international organisations. This approach has allowed the project to benefit from a wide range of knowledge and experience and to develop a methodology that is technically robust and supported by a wide range of stakeholders.

4.1 Methodology Overview

4.1.1 Introduction

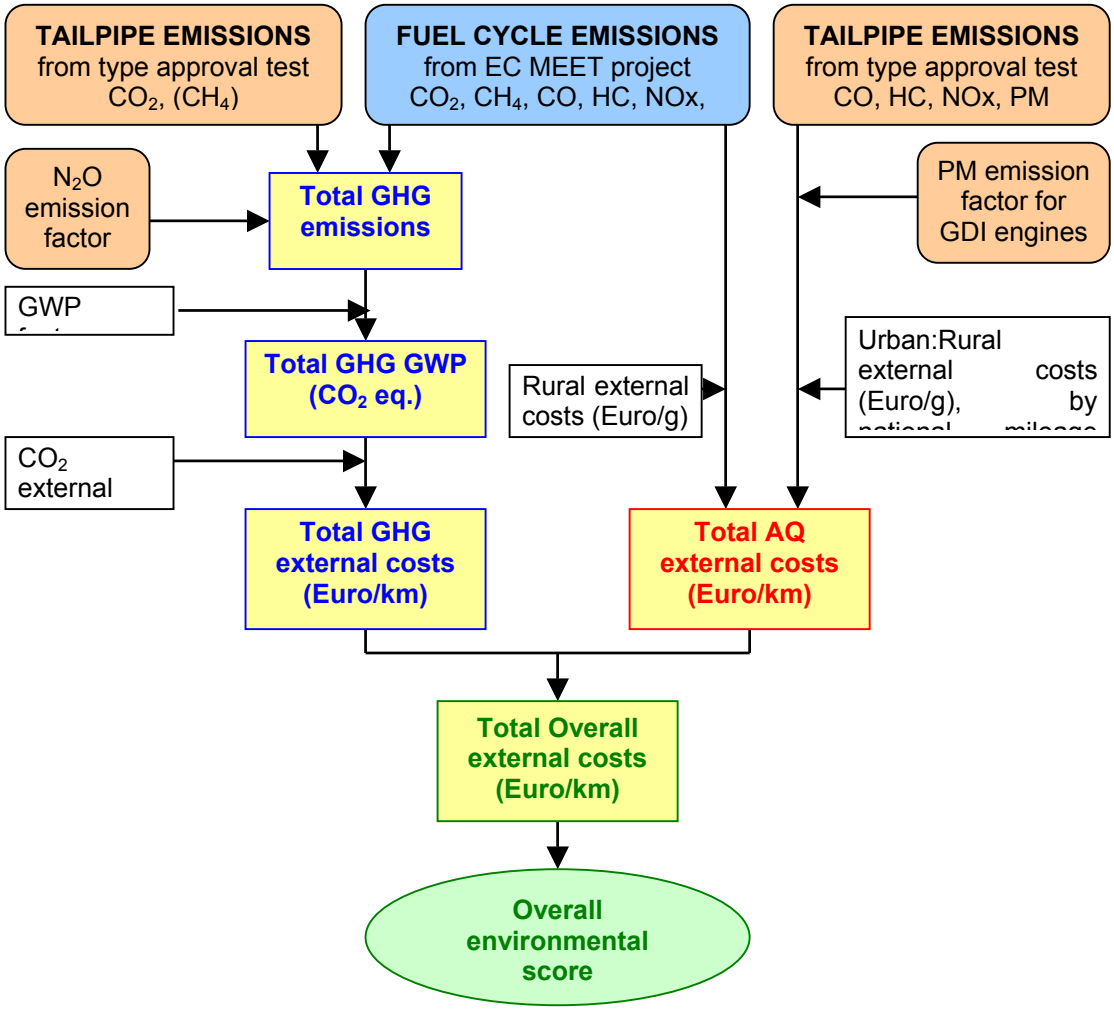
Cleaner Drive's car environmental rating system considers all the major emissions released from cars' exhausts (tailpipe emissions) and from fuel production and supply (fuel cycle emissions) and combines them to give each car a single overall environmental score. Environmental scores are shown as numbers between 1 and 100 – the higher the number the cleaner the car.

The rating system considers greenhouse gas emissions i.e. those that contribute to global warming, and 'air quality' emissions i.e. those that are detrimental to human health and ecosystems.

Wherever possible the rating system relies on actual emissions data. Data is not available for two categories of tailpipe emissions, however, so in these cases the most accurate method of approximation is used instead. [See 'Emissions Data - Tailpipe' below].

A flow diagram schematic of the methodology is provided in .Figure 1

Figure 1: Flow Diagram of Cleaner Drive Rating Methodology



4.1.2 Greenhouse Gas Emissions

The methodology assesses the following greenhouse gas emissions:

- Carbon dioxide (CO_2): Tailpipe and fuel cycle.
- Methane (CH_4): Fuel cycle only as tailpipe CH_4 emissions are low and data are not available. [For an exception to this rule see 'NMHC' below].
- Nitrous oxide (N_2O): Tailpipe only as fuel cycle N_2O emissions are of low significance.

'Global Warming Potentials' (GWPs) express the global warming effect of all greenhouse gases in CO_2-equivalent terms and are used to set the relative weighting of the different greenhouse gases. Cleaner Drive uses GWPs established by the UN's Intergovernmental Panel on Climate Change.

4.1.3 Air Quality Emissions

The methodology assesses the following air quality emissions:

- Carbon monoxide (CO): Tailpipe and fuel cycle.
- Hydrocarbons (HC): Tailpipe and fuel cycle.
- Oxides of nitrogen (NO_x): Tailpipe and fuel cycle.
- Particulate matter (PM): Tailpipe and fuel cycle.
- Sulphur dioxide (SO_2): Fuel cycle only, as today's low sulphur fuels mean tailpipe SO_2 emissions are now extremely low.

4.1.4 External Costs

The rating system uses recognised 'external costs' to establish the relative weight to attach to different emissions. External costs of emissions are values expressed in monetary terms, such as €/g, that reflect the overall damage to the environment and to human health caused by emissions.

The values are derived by extensive research involving environmental and health experts as well as economists. This approach allows the different emissions from vehicles to be compared on equivalent terms. It also allows for comparisons to be made between different impact categories, e.g. climate change vs. air pollution.

External costs measure impacts, so air quality emissions in urban areas have higher values than those in extra-urban areas. The Cleaner Drive rating methodology uses extra-urban values for fuel cycle emissions and a weighted average of urban and extra-urban values for tailpipe emissions (weighted to reflect the national average split between urban and extra urban mileage.) External costs also country-specific to reflect national differences in air quality.

Cleaner Drive's rating methodology uses external costs derived by 'ExternE', a European Commission programme that is widely recognised as the leading authority in its field.

4.1.5 Emissions Data - Tailpipe

European Type Approval data, which manufacturers are obliged to submit for every model and variant of car sold in the EU, are used for **tailpipe CO, HC, NO_x and diesel PM emissions.** This data is obtained from cars following a standard test cycle that includes sections that simulate both urban and extra-urban driving.

Given that Type Approval data is obtained from new, optimally calibrated cars there is some debate as to how accurately this data reflect in-use emissions from ageing, sometimes badly maintained cars. It is, however, the only objective and comparable set of emissions data available for all cars.

The other alternative would be to develop a methodology that required its own additional emissions tests. This is not considered viable, however, since emissions tests are expensive and time-consuming and would have to be undertaken for tens of thousands of models and variants. In practice, therefore, such a system would

either be limited to relatively few cars, or worse it would incorrectly assume that a wide range of models and variants produce the same levels of emissions.

Tailpipe N_2O emissions are not recorded during Type Approval but need to be included when calculating cars' overall environmental scores as N_2O is a powerful greenhouse gas. [Typical N_2O emissions are 5-8mg/km for Euro III, which equates to approximately 2-2.5g CO_2-equivalent/km given N_2O's GWP of 320.]. Tailpipe N_2O emissions do not correlate with CO_2, NO_x or any other emission but are dependent primarily on cars' fuel and catalyst type. Catalyst type correlates broadly with cars' Euro emissions standard, so as a best available approximation the methodology uses default values for N_2O emissions/km according to cars' fuel type and Euro standard.

European Type Approval only measures PM emissions for diesel cars as **petrol engine tailpipe PM emissions** are generally very low. However, direct injection (DI) petrol engines, which were first introduced by Mitsubishi in the late 1990s to bring greater fuel efficiency, do produce significant PM emissions. Typical values are around 0.006g/km so as an approximation the rating system assumes this value for PM emissions from all DI petrol engine cars. To put this in perspective the Euro IV limit value for PM from new diesel cars (mandatory from 2005) is 0.025 g/km. Further significant reductions are expected for the planned Euro V, expected to come into force at the start of 2009, to coincide with mandatory introduction of <10 ppm sulphur fuels.

Methane (CH_4) is a hydrocarbon (HC) but unlike most HCs it is not toxic or carcinogenic and does not contribute to low level ozone formation. The methodology therefore contains an option to include only the **non-methane hydro-carbon (NMHC)** fraction when calculating the air quality emissions score. In this case, however, the global warming potential of the CH_4 fraction is included toward a vehicle's greenhouse score.

4.1.6 Emissions Data – Fuel Cycle

Fuel cycle emissions include those produced during fuel extraction, refining, transport and distribution. Fuel cycle emissions are usually expressed in grams per gigajoule of fuel produced (g/GJ) and can easily translated into g/km travelled by relating the data to a car's fuel consumption.

The rating system considers fuel cycle emissions of CO_2, CO, NO_x, CH_4, NMHC, SO_2 and PM and uses data from an EC project entitled 'Methodologies for Estimating Air Pollutant Emissions from Transport' [MEET].

This option is available for all cars but is most likely to be appropriate for natural gas vehicles (NGVs), which typically produce considerable CH_4 emissions but less NMHC. Cleaner Drive will only distinguish between CH_4 and NMHC if requested by a vehicle manufacturer and only then if the manufacturer provides appropriate data stating CH_4 and NMHC separately.

4.1.7 Noise

Noise is an important environmental issue but is not included in the rating system because of the lack of data reflecting in-use noise levels. This is because above 40-50 kph tyre noise dominates over engine noise and is dependent upon the type of tyres fitted (as well as the road surface). Tyre type is not known because manufactures often fit several different types of tyre to the same variant and because tyres are a service item that are changed regularly throughout cars' lives.

4.1.8 Other Lifecycle Emissions

Other lifecycle emissions and environmental effects are not included in the methodology because data is not available to allow objective comparisons between makes and models.

4.2 Methodological Development since D2 (July 2002)

Since the original recommended Cleaner Drive methodology in Work Package 4.2 Deliverable 2 (July 2002), it was decided to use external costs to combine AQ and GHG criteria. There have also been a number of methodological changes made as a result of new information, internal discussions between project partners and external discussions with stakeholders/experts.

With regards to issues concerning remote fuel cycle emissions and biofuels, sensitivity analyses were carried out, and a workshop was held in December 2003 to discuss these issues, as well as other methodological issues. Workshop attendees included interested parties from the Cleaner Drive consortium, as well as some external experts in the field of vehicle environmental rating. Details of workshop attendees, agenda and minutes are shown in Appendix 10.

A later section ['Detailed Methodology Explanation'] provides a detailed description of the methodology currently in use. The changes made to the methodology since Deliverable 2, are as follows:

(1) Air Quality Tailpipe Emissions:

a) New emission factor is used for PM emissions from petrol GDI engines.
   [Based upon information provided by VTT, TNO Automotive and ADEME].
b) The maximum AQ emission limit is now based upon the Euro III car (not more than 2.5 tonnes laden), as opposed to the heavy car.
   [To increase the sensitivity of the methodology and spread out scores, enabling better distinction between similarly performing vehicles].

(2) Greenhouse Gas Tailpipe Emissions:

a) The maximum limit was reduced from 350 gCO2/km (98% year 2000 vehicles) to 300 gCO2/km (95% year 2000 vehicles).
   [To increase the sensitivity of the methodology and spread out scores, enabling better distinction between similarly performing vehicles].
b) The tailpipe emission factor for N_2O was changed and is now dependent on fuel and vehicle Euro standard.
   [based on new material based on vehicle testing, from TNO Automotive].

(3) Fuel Cycle Emissions:

a) The maximum limit values for AQ fuel cycle emissions are now based upon a vehicle emitting 300 gCO2/km (350 gCO2/km previously);
b) The maximum limit values for GHG fuel cycle emissions are now based upon a vehicle emitting 300 gCO2/km (350 gCO2/km previously).

The following sections discuss work carried out to investigate the possibility of incorporating biofuels into the methodology, as well as analysis carried out to assess how sensitive the methodology is to assumptions about remote fuel cycle emissions.

4.2.1 Biofuels

There are many types of biofuels, including biodiesel and bio-ethanol, bio-methanol, biomass-derived Fischer Tropsch diesel, and bio-hydrogen.

Biofuels are derived from crops, and are therefore renewable. They reduce net CO_2 emissions (sometimes greatly) because all of the CO_2 emitted when a biofuel is burnt would have been previously absorbed from the atmosphere when the crop was grown. However in assessing biofuels' environmental performance it is important to consider the effect that biofuels will have on vehicle tailpipe emissions, and the biofuel 'fuel cycle' emissions, i.e. those associated with:

- Growing crops, (manufacture of fertiliser, tilling, planting, harvesting etc).
- Processing crops into biofuel.
- Transporting the biofuel to its point of use.

Three biofuels are of particular interest:

- Biodiesel, which is available in many European countries, including France, where 5% biodiesel is blended into mineral diesel by suppliers as standard.
- Bio-ethanol, which is blended at 5% with petrol by suppliers in Sweden.
- Bio-methane, which brings the additional advantage that CH_4 (a potent greenhouse gas) is captured and used rather than escaping to atmosphere.

In assessing the possibility of inclusion of biofuels in the rating methodology, there are therefore several issues to consider:

- Tailpipe & Fuel Cycle data availability;
- Dealing with mixtures with conventional fuels;
- How to deal with different production & distribution routes (Fuel Cycle).

In order to investigate the possibility of including biofuels in the rating methodology and in the Decision Support Tool (DST) and partner websites, an investigation into data availability was carried out, and subsequently a sensitivity analysis using the excel demonstration model to understand the potential effects of adding biofuels. The results of these are detailed in the following sections.

4.2.1.1 Data Availability

We started by researching what biofuel emissions data was available. If full sets of appropriate tailpipe and fuel cycle emissions data were available then it would have been possible to insert them in to the model and the problem would be solved. However, this was not the case.

Tailpipe data:

Model-specific tailpipe data is not available for vehicles running on biofuels, at least not for the wide range of car models that we need to cover.

Various reports give generalised comparisons for vehicle tailpipe emissions for biodiesel vs. mineral diesel and for ethanol vs. petrol. This meant we could have made general assumptions such as: for vehicles running on biodiesel assume PM

emissions reduce by X% compared to when running on mineral diesel, HC emissions reduce by Y% and NOx emissions increase by Z%.

Fuel cycle data – greenhouse gases
Several reports give CO_2 fuel cycle estimates for biofuels, and between them cover most of the required fuel paths. However, we were unable to find biofuel fuel cycle data for other greenhouse gasses. This is a problem because some reports indicate that N_2O emissions from nitrogen fertilisers are likely to be significant.

Fuel cycle data – air quality emissions
There is very little data on fuel cycle air quality emissions data for biofuels. MEET has some data in this area too, however only covers a selection of the required fuel paths. For example, ethanol from wheat was included but not ethanol from sugar beet.

Selecting Appropriate Fuel Path
Even if the necessary fuel cycle data had been available for each fuel path there was the further problem of not knowing which fuel path, or what weighted average of fuel paths to use for each country. For example, biodiesel in Austria could be 90% rape methyl ester and 10% sunflower methyl ester. To calculate fuel cycle emissions accurately we would have had to know these weighted averages for each fuel for each country. (This is what the MEET data gives us for conventional fuels.)

4.2.1.2 Biofuels Sensitivity Analysis

Despite these data limitations we decided to carry out a sensitivity analysis with the best data we had available to look at the potential impact of including biofuels in the current DST and websites. In this view there were two possibilities:

1. Full inclusion of biofuels in the methodology and DST;
2. Partial inclusion by in giving an indication of the potential improvement to the overall score resulting from using a biofuel.

Given the absence of tailpipe emissions data for biofuel use, equivalent to the type approval data, it was agreed early on that the first option for full inclusion was not possible. Therefore the sensitivity analysis focused on testing the second option. The data in Table 1 (AQ) and Table 2 (GHG) were used in the calculations of the sensitivity analysis.

Table 1: Air Quality data used in biofuels sensitivity analysis

Production route and Biofuel	**g[pollutant]/MJ**				
	CO	**HC**	**NOx**	**SO2**	**PM**
Ethanol fuel cycle (straw process)	0.11410	0.10980	0.18330	0.15910	0.02930
RME fuel cycle	0.13700	0.07790	0.24220	0.06820	0.01850

Biogas (1)	0.0014	0.0275	0.0106	0.0169	0.0008

Source: 'Fuel and energy Production Emission Factors', MEET Project, Deliverable 20, AEA Technology, ETSU (1997)
Notes: (1) In the absence of biogas fuel cycle data from MEET, regular CNG fuel cycle data were used.

Table 2: Greenhouse Gas data used in biofuels sensitivity analysis

Production route and Biofuel	**Total GHG (CO_2 equivalent), gCO2eq/MJ**		
	Fuel Cycle	**Fuel**	**Net**
E100: enzymic hydrolysis of sugar beet (variant 2b)	-15.1	71.3	56.2
RME: bio-ester from rape seed (variant 2b)	-48.0	76.7	28.7
CMG: biogas derived compressed methane gas	-56.7	56.9	0.2

Source: 'GM Well-To-Wheel Analysis of Energy Use and Greenhouse Gas Emissions of Advanced Fuel/Vehicle Systems - A European Study', September 2002.

The following cases were examined when carrying out the sensitivity analysis:

1. ***Fuel efficiency:***
   The effects of using biofuels with vehicles of varying efficiencies from 120-350 gCO2/km (labelled supermini, small family, large family, luxury, and sports as an indication of the types of vehicles that might exhibit such fuel consumptions).
2. ***Proportion of biofuel mix:***
   The effects of using either a high proportion of biofuels, or low proportion of biofuel on the overall score relative to conventional fuels.
3. ***Biofuel AQ fuel cycle emissions***:
   The effect of using conventional fuel cycle air quality emissions, relative to biofuel fuel cycle air quality emissions (in conjunction with biofuel fuel cycle greenhouse gas emissions in both cases).

The results of the analysis are shown in Table 3 and Table 4. From this analysis a number of conclusions can be reached:

a) ***Fuel efficiency***:
   The more fuel a vehicle consumes (i.e. the less fuel efficient it is) the greater the benefit derived from switching to biofuels.
b) ***Proportion of biofuel mix:***
   Whilst a high or 100% proportion of biofuels can lead to significant increase in score using the Cleaner Drive methodology, low proportions of biofuels mixed into conventional fuel can have little effect on the overall score.
c) ***Biofuel AQ fuel cycle emissions:***
   The data available suggests that biofuels do not perform as well as conventional fuels in terms of the air quality emissions from the fuel cycle, therefore if they are used the result is a reduction in the overall score.

Table 3: Biofuel sensitivity analysis results - using conventional fuel cycle AQ emissions

						Conventional		High Proportion		Low Proportion	
Vehicle	Body Type	Fuel	Fuel Cons., mpg *	gCO2 /km	Biofuel	Overall Score	%Bio	Score Increase	%Bio	Score Increase	%Bio
Car 1	Supermini	Gasoline	53.0	120	Ethanol	79.8	0%	3.8	85%	0.2	5%
Car 2	Small Family	Gasoline	35.3	180	Ethanol	70.2	0%	5.8	85%	0.3	5%
Car 3	Large Family	Gasoline	26.5	240	Ethanol	60.7	0%	7.7	85%	0.5	5%
Car 4	Luxury	Gasoline	21.2	300	Ethanol	51.1	0%	9.6	85%	0.6	5%
Car 5	Sports	Gasoline	18.2	350	Ethanol	43.1	0%	11.2	85%	0.7	5%
Car 6	Supermini	Diesel	62.3	120	Biodiesel	77.5	0%	9.6	100%	0.5	5%
Car 7	Small Family	Diesel	41.6	180	Biodiesel	69.1	0%	14.3	100%	0.7	5%
Car 8	Large Family	Diesel	31.2	240	Biodiesel	60.7	0%	19.1	100%	1.0	5%
Car 9	Luxury	Diesel	24.9	300	Biodiesel	52.3	0%	23.9	100%	1.2	5%
Car 10	Sports	Diesel	21.4	350	Biodiesel	45.3	0%	27.9	100%	1.4	5%
Car 11	Supermini	CNG	43.7	120	Biogas	82.6	0%	15.4	100%	0.8	5%
Car 12	Small Family	CNG	29.1	180	Biogas	74.5	0%	23.1	100%	1.2	5%
Car 13	Large Family	CNG	21.8	240	Biogas	66.3	0%	30.8	100%	1.5	5%
Car 14	Luxury	CNG	17.5	300	Biogas	58.2	0%	38.5	100%	1.9	5%

Table 4: Biofuel sensitivity analysis results - using biofuel fuel cycle AQ emissions

						Conventional		High Proportion		Low Proportion	
Vehicle	Body Type	Fuel	Fuel Cons., mpg *	gCO2 /km	Biofuel	Overall Score	%Bio	Score Increase	%Bio	Score Increase	%Bio
Car 1	Supermini	Gasoline	53.0	120	Ethanol	79.8	0%	0.7	85%	0.0	5%
Car 2	Small Family	Gasoline	35.3	180	Ethanol	70.2	0%	1.1	85%	0.1	5%
Car 3	Large Family	Gasoline	26.5	240	Ethanol	60.7	0%	1.4	85%	0.1	5%
Car 4	Luxury	Gasoline	21.2	300	Ethanol	51.1	0%	1.8	85%	0.1	5%
Car 5	Sports	Gasoline	18.2	350	Ethanol	43.1	0%	2.1	85%	0.1	5%
Car 6	Supermini	Diesel	62.3	120	Biodiesel	77.5	0%	6.7	100%	0.3	5%
Car 7	Small Family	Diesel	41.6	180	Biodiesel	69.1	0%	10.1	100%	0.5	5%
Car 8	Large Family	Diesel	31.2	240	Biodiesel	60.7	0%	13.4	100%	0.7	5%
Car 9	Luxury	Diesel	24.9	300	Biodiesel	52.3	0%	16.8	100%	0.8	5%
Car 10	Sports	Diesel	21.4	350	Biodiesel	45.3	0%	19.6	100%	1.0	5%
Car 11	Supermini	CNG	43.7	120	Biogas	82.6	0%	15.4	100%	0.8	5%
Car 12	Small Family	CNG	29.1	180	Biogas	74.5	0%	23.1	100%	1.2	5%
Car 13	Large Family	CNG	21.8	240	Biogas	66.3	0%	30.8	100%	1.5	5%
Car 14	Luxury	CNG	17.5	300	Biogas	58.2	0%	38.5	100%	1.9	5%

Whilst these results are useful in identifying importance of biofuels and the effects on utilising them in rating, there are number of limitations. First and foremost of these is the biofuel fuel cycle data availability and quality issue - this has already been discussed in previous section. Second, the analysis only shows the results of data from one fuel cycle production route for each of the biofuels. Different production route can have quite significant differences in fuel cycle air quality and

greenhouse gas net emissions. Therefore it is important to identify the appropriate national mix of production routes for the fuels available in each country, but this information does not appear to be available. Lastly, as already mentioned, it has not been possible to analyse the effects of tailpipe emissions for vehicles running on biofuels, as this data is also unavailable.

4.2.1.3 Conclusions

Using generalised estimates for how tailpipe emissions vary on biofuels compared to conventional fuels would not be appropriate for Cleaner Drive given our emphasis on vehicle-specific emissions data.

An alternative would be using conventional fuel tailpipe emissions data and biofuel fuel cycle data. However, the only emission for which comprehensive (for all the required fuel paths) fuel cycle data is available is CO_2. Therefore, the only option for calculating separate biofuel scores would be to use biofuel fuel cycle CO_2 data (with tailpipe CO_2 assumed to be zero as it will all have been absorbed from atmosphere during the previous growing season) and use conventional fuel tailpipe data and conventional fuel air quality fuel cycle data.

It was decided that this would not be a good way to proceed because we would not be comfortable stating Cleaner Drive biofuel scores based on so many inaccuracies and assumptions as it could potentially undermine the rest of the methodological approach. Because of the importance of Biofuels, the following approach was agreed with project partners:

- To include general descriptive text as pop-up box on website;
- To include biofuels in the future if reliable data becomes available;
- To attempt to compile a list of manufacturers warranty details to include on the national websites, e.g. Ford warranty their vehicle at X% biofuel, etc

4.2.1.4 Summary

Cleaner Drive does not currently calculate separate environmental scores for vehicles running on biofuels because of the lack of suitable data for vehicle emissions when running on biofuels and for the emissions associated with the production and distribution of biofuels (fuel cycle emissions). However, because some biofuels bring significant CO_2 savings compared to conventional fuels, it is desirable to incorporate separate scores for vehicles using biofuels as and when suitable data becomes available.

4.2.2 Fuel Cycle and Remote Emissions Sensitivity Analysis

A number of concerns were raised by TNO Automotive with regards to the sensitivity of the methodology relating to petrol AQ tailpipe emissions and remote emissions from the fuel cycle. The issues raised can be summarised as follows:

(1) Tailpipe proportion of AQ score is small for petrol vehicles (a few %, compared to around 20-30% for diesel, see Table 5), leading to:
   a) Relative insensitivity of score to changes in petrol tailpipe emissions (particularly for CO);
   b) A high proportion of most petrol vehicles' overall score is directly related to the tailpipe CO_2 emissions;

(2) Treatment of remote emissions from the fuel cycle, where currently rural external costs are used $\Rightarrow$ suggested reduction of external cost factor.

Table 5: Score proportion build-up sensitivity analysis for a basket of vehicles

Option 1					Greenhouse Gas		Air Quality		GHG Total	AQ Total
					GHG_Tp	*GHG_FC*	*AQ_Tp*	*AQ_FC*	*GHG Total*	*AQ Total*
Vehicle	**Body Type**	**Fuel**	**Fuel Cons., mpg ***	**Emissions Standard**	**Combined External Cost,%**	**Combined External Cost, %**	**Combined External Cost, %**	**Combined External Cost, %**	**Combined External Cost, %**	**Combined External Cost, %**
Car 1	Supermini	Gasoline	41.5	Euro 4	69%	10%	1%	19%	79%	21%
Car 2	Supermini	Diesel	64.2	Euro 3	61%	6%	24%	9%	67%	33%
Car 3	Supermini	Electric	0.485	Euro 4	0%	49%	0%	51%	49%	51%
Car 4	Supermini	G. Hybrid	83.1	Euro 3	67%	10%	4%	18%	77%	23%
Car 5	Small Family	G. Hybrid	55.4	Euro 4	68%	10%	3%	19%	78%	22%
Car 6	Small Family	Gasoline	37.2	Euro 3	69%	10%	2%	19%	79%	21%
Car 7	Small Family	Diesel	52.3	Euro 3	54%	5%	32%	8%	60%	40%
Car 8	Small Family	LPG	25.8	Euro 4	79%	8%	2%	10%	88%	12%
Car 9	Large Family	Gasoline	30.7	Euro 3	69%	10%	2%	19%	79%	21%
Car 10	Large Family	Diesel	43.5	Euro 3	61%	6%	24%	9%	67%	33%
Car 11	Large Family	LPG	24.8	Euro 4	80%	8%	2%	10%	88%	12%
Car 12	Large Family	CNG	31.4	Euro 4	81%	12%	2%	5%	93%	7%
Car 13	MPV	Gasoline	31.7	Euro 3	69%	10%	1%	19%	79%	21%
Car 14	MPV	Diesel	39.8	Euro 3	54%	5%	32%	8%	60%	40%
Euro III G	Small Family	Gasoline	37.2	Euro 3	66%	10%	6%	18%	76%	24%
Euro III D	Small Family	Diesel	52.3	Euro 3	52%	5%	35%	8%	57%	43%
Euro IV G	Small Family	Gasoline	37.2	Euro 4	68%	10%	3.2%	19%	78%	22%
Euro IV D	Small Family	Diesel	52.3	Euro 4	63%	6%	21%	9%	69%	31%

* Electric vehicles consumption is in MJ/km, CNG & LPG vehicles are in mpg gasoline equivalent

Notes: GHG = greenhouse gas; AQ = air quality; FC = fuel cycle; Tp = tailpipe.

The first issue is explained in consideration of a number of factors. Pollutants are weighted according to external cost factors derived through specific transport modelling in the EC ExternE project framework (e.g. see Table 6 for UK, or Appendix 2 for values for all countries).

- The tailpipe proportion of AQ score is small for petrol vehicles, due to the relatively low emissions of the most harmful pollutants from petrol vehicles and high emissions from diesel vehicles, i.e. PM and NOx. Emissions of NOx from diesel vehicles are typically an order of magnitude larger than from petrol vehicles and petrol vehicles (with the exception of GDI engines) essentially emit zero particulates.
- Whilst tailpipe emissions of AQ criteria pollutants have decreased markedly since the introduction of the Euro standard emission limits, tailpipe emissions of CO_2 have not decreased significantly.

- With regards to the sensitivity to tailpipe emissions: the Euro standard limit values, petrol vehicles were generally well below the limits, whilst diesel vehicles were generally close due to the trade-off in reducing NO_x/PM emissions (actions to reduce PM $\Rightarrow$ increase in NO_x and visa-versa).

Table 6: External cost factors used in the rating methodology for the UK

		Urban	Rural
Criteria	**Pollutant**	**Euro/tonne**	**Euro/tonne**
Air Quality	**CO (Carbon Monoxide)**	3.47	0.32
	HC (Hydrocarbons)	1,900	1,900
	NO_x (Nitrogen oxides)	2,600	2,600
	SO_2 (Sulphur dioxide)	12,300	4,500
	PM (Particulate Matter)	122,130	8,730
Greenhouse Gases	**CO_2 equivalents**	46	46

Source: ExternE & extension 'BeTa Benefits Table database: Estimates of the marginal external costs of air pollution in Europe'; AEA Technology 2002

The second issue was explored in detail using a sensitivity analysis of the excel demonstration model.

In terms of reducing remote emissions impact/external cost it is important to consider that most shipping routes are close to land and transboundary AQ pollutants can be carried some distance to populated centres. There is also the need to consider effect on workers locally in extraction and transport. Therefore three scenarios were tested against each other in the sensitivity analysis:

(1) Continue to use the existing values;

(2) Reduce the effect of remote emissions by a factor of two;

(3) Set the remote emissions component to zero.

The results of the analysis showed that reducing (or even removing) the remote FC emissions therefore has little effect on the AQ or overall scores (maximum 1 point increase for petrol over diesel), and has little effect on the proportions of the scores (see Figure 2 and Figure 3). The reason for this is that the main fuel cycle emissions (cost wise) are SO_2 and Hydrocarbons and only a small percentage of these are from the more remote parts of the fuel cycle, namely shipping and distribution (see Table 7).

Table 7: Remote emissions sensitivity analysis

4.2.2.1.1.1.1 Gasoline FC Emissions	CO_2	CH_4	N_2O	CO	NMVOC	NO_x	SO_2	PM
Fuel Cycle Stages (1)	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*
Extraction and Shipping	**28%**	**100%**	**76%**	**64%**	**26%**	**64%**	**28%**	**32%**
Refining and Distribution	**72%**	**0%**	**24%**	**36%**	**74%**	**36%**	**72%**	**68%**
MEET Fuel Cycle Data (2)	*g/kgfuel*	*g/kgfuel*	*g/kgfuel*	*g/kgfuel*	*g/kgfuel*	*g/kgfuel*	*g/kgfuel*	*g/kgfuel*
Petrol	435	0.813		0.244	9.847	2.050	3.435	0.110
Diesel	312	0.713		0.215	3.978	1.718	2.432	0.052
LPG	303	0.812		0.208	2.765	1.647	1.742	0.073
External Cost (3)	*€/kgfuel*	*€/kgfuel*	*€/kgfuel*	*€/kgfuel*	*€/kgfuel*	*€/kgfuel*	*€/kgfuel*	*€/kgfuel*
Petrol	0.0200	0.0008		0.0000	0.0187	0.0053	0.0155	0.0010
Diesel	0.0144	0.0007		0.0000	0.0076	0.0045	0.0109	0.0005
LPG	0.0140	0.0008		0.0000	0.0053	0.0043	0.0078	0.0006
%Total External Cost (3)	*%*	*%*	*%*	*%*	*%*	*%*	*%*	*%*
Petrol	32.7%	1.3%		0.0%	30.6%	8.7%	25.2%	1.6%
Diesel	37.3%	1.8%		0.0%	19.6%	11.6%	28.4%	1.2%
LPG	42.6%	2.4%		0.0%	16.0%	13.1%	23.9%	1.9%

Source/Notes:

(1) Based on gasoline fuel cycle data from the project: 'CO2 Abatement by Gas to Liquid Transport Fuels', IEA Greenhouse Gas R&D programme, AEA Technology Environment (2002)
(2) 'Fuel and energy Production Emission Factors', MEET Project, Deliverable 20, AEA Technology, ETSU (1997)
(3) ExternE & extension 'BeTa Benefits Table database: Estimates of the marginal external costs of air pollution in Europe'; AEA Technology 2002

Figure 2: Remote emissions sensitivity analysis (AQ emissions, Euro III Gasoline vehicle, 181 gCO2/km)

Current external cost
(remote emission factor = 1)

Zero external cost
(remote emission factor = 0)

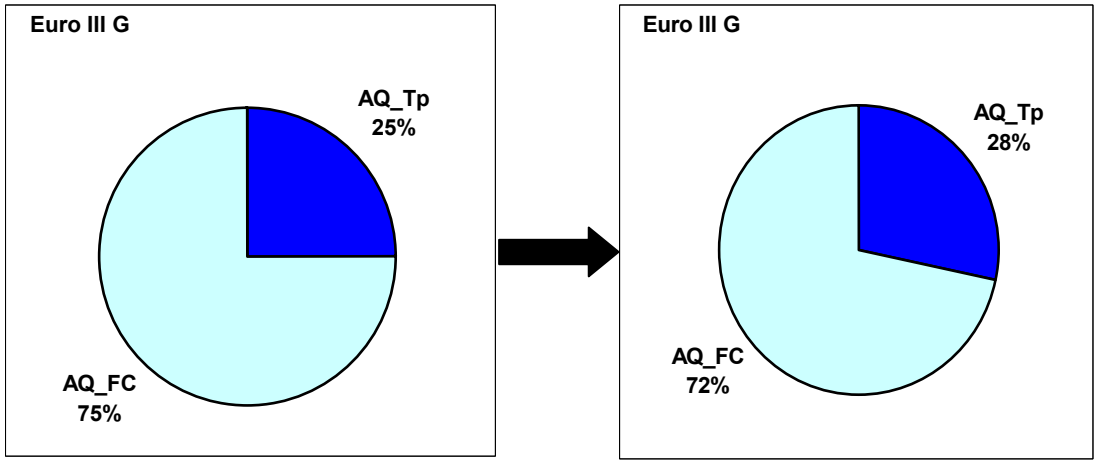
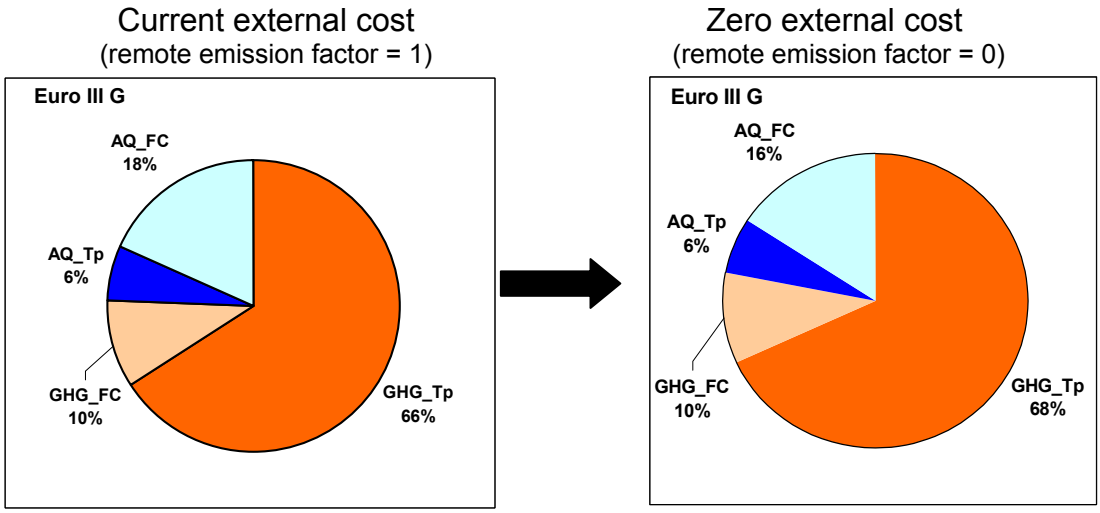


Figure 3: Remote emissions sensitivity analysis (all emissions, Euro III Gasoline vehicle, 181 gCO2/km)



4.2.2.2 Conclusions

The overall conclusions and recommendations from the analyses and discussions at an expert workshop in Brussels on 12 December for 2003 were as follows:

- No change to numerical methodology was needed;
- Sensitivity analyses should be included in the final reporting;
- An explanation should be provided on the websites as to why there are only small differences between similar petrol vehicle overall scores;
- The common scoring range should be broadened to enhance the methodology's ability to distinguish between different vehicles, by:
  - Changing the model to use regular passenger car limits (rather than heavy car limits);
  - Reduce the upper limit for tailpipe CO_2 emissions from 350g/km (98% of year 2000 vehicles) to 300g/km (95% of year 2000 vehicles).

An additional concern also raised was that local evaporative emissions reduced significantly in last 10 years; therefore MEET data may be an overestimate, however without new data available on this it is not possible to do anything about it at this time.

Following the workshop, a sensitivity analysis was carried out (again using the Excel demonstration model) to determine the effect of changing the limit values on the scoring range. The results (see Table 8) showed that reduction of the limit values was effective in increasing the scoring range and facilitating vehicle comparisons. These results and recommendations were presented to Cleaner Drive partners at the quarterly meeting in Utrecht, February 2004, where they were accepted in full.

Table 8: Methodology limit adjustment sensitivity analysis

						New Limit Values			Old Limit Values			Point Change Old => New		
	Body Type	Fuel	FCons., mpg *	gCO2 /km	Emissions Standard	Air Q Score	GHG Score	Overall Score	Air Q Score	GHG Score	Overall Score	Air Q Score	GHG Score	Overall Score
Car 1	Supermini	Gasoline	41.5	163	Euro 4	81	50	62	88	60	74	-8	-11	-11
Car 2	Supermini	Diesel	64.2	119	Euro 3	74	64	68	84	72	78	-10	-8	-10
Car 3	Supermini	Electric	0.5	0	Euro 4	65	77	72	79	82	81	-14	-5	-8
Car 4	Supermini	G. Hybrid	83.1	80	Euro 3	89	75	81	93	80	87	-4	-5	-6
Car 5	Small Family	G. Hybrid	55.4	120	Euro 4	85	63	72	91	71	80	-6	-8	-8
Car 6	Small Family	Gasoline	37.2	181	Euro 3	78	44	58	86	56	70	-9	-12	-13
Car 7	Small Family	Diesel	52.3	143	Euro 3	57	57	57	74	66	70	-17	-9	-13
Car 8	Small Family	LPG	25.8	178	Euro 4	89	47	64	94	58	75	-4	-11	-11
Car 9	Large Family	Gasoline	30.7	220	Euro 3	73	32	49	84	47	64	-11	-15	-15
Car 10	Large Family	Diesel	43.5	171	Euro 3	62	49	54	77	60	68	-15	-11	-14
Car 11	Large Family	LPG	24.8	185	Euro 4	89	45	63	93	57	74	-4	-12	-11
Car 12	Large Family	CNG	31.4	161	Euro 4	94	50	68	97	61	78	-2	-11	-10
Car 13	MPV	Gasoline	31.7	211	Euro 3	75	35	51	85	49	66	-10	-14	-15
Car 14	MPV	Diesel	39.8	189	Euro 3	44	44	44	66	56	61	-22	-12	-17
					Smallest	44	32	44	66	47	61	-22	-15	-17
					Largest	94	77	81	97	82	87	-2	-5	-6
					Range	50	45	37	30	35	26	20	10	11

4.2.3 Passenger Car Noise

Noise is an important environmental issue affecting people's health as well as their sense of well-being. Consequently, the maximum levels of noise that vehicles sold in the EU may produce are governed by European legislation: Directive 70/157/EEC introduced the first noise limits and several amendments, the latest by Directive 96/20/EC, have since tightened them. There are now eight different EC noise limit values for passenger and goods vehicles, ranging from 74 dB for petrol cars (75 dB for diesel cars) to 80 dB for some categories of heavy duty vehicles and motorbikes.

Vehicle noise consists primarily of powertrain noise, road/tyre noise and aerodynamic noise. Powertrain train noise is determined largely by engine speed, which itself is a function of vehicle speed and gear setting. Road/tyre noise depends on road surface and type of tyres fitted, but for a given combination of the two depends largely on vehicle speed. In addition, both powertrain noise and road/tyre noise are influenced to a lesser extent by load i.e. throttle position.

The European Type Approval passenger car noise test consists of driving into a test area with a specified road surface at 50 kph (31mph) and then accelerating at full throttle (known as wide open throttle, or WOT) through the full length of the area without changing gear. A microphone at a set distance from the line of travel measures the maximum level of noise that is produced and this single value is recorded as the test result. Critics of this test point out that it is not representative of real-life driving because it fails to take account of different vehicle speeds, engine speeds, engine loads, or type of tyres and road surface. Specific problems with the current Type Approval test include:

- Cars are only measured at WOT, or 100% load, whereas the majority of urban driving involves cruising (zero or close to zero acceleration) where load is typically around 5%. Consideration of the factors determining vehicle noise (see above) demonstrates that this will affect both powertrain and road/tyre noise.
- Results are determined by only one vehicle speed and one engine speed. This affects road/tyre noise and powertrain noise, respectively.

An additional problem is that tyre/road noise is dependent on the tyre type, and manufactures often fit several different types of tyre to one car variant. In addition, tyres are changed regularly throughout cars lives, which limits the extent to which any new car noise test will reflect lifetime in-use road/tyre noise levels.

ACEA, the European vehicle manufacturers' trade organisation, has proposed a new noise test that would improve upon many of the short-comings of the current Type Approval test. ACEA's methodology measures car noise at WOT to correspond with maximum acceleration and at 5% load to correspond with driving at constant speed in an urban area. Each test is repeated for two gears and then the resulting four test scores are combined to give one overall score.

Cleaner Drive's additional research into vehicle noise has therefore confirmed the decision reached by the majority of partners during the first year of the project: that although vehicle noise is an important environmental issue, the car noise data currently available do not accurately reflect in-use noise levels and are not appropriate to include in Cleaner Drive's rating methodology. A more comprehensive test, such as that proposed by ACEA, would improve upon the current test but would still not be able to address the problem that road noise levels are dependent upon tyres, which are service items. If a more comprehensive test were introduced, it would be necessary to decide whether the test provided a sufficiently accurate representation of real-life noise levels to warrant inclusion in the rating methodology.

4.3 Detailed Methodology Explanation

4.3.1 Air Quality Criterion

There are 5 pollutants included in the Air Quality (AQ) Criterion: CO (carbon monoxide), (Total) HC (hydrocarbons), NO_x (nitrogen oxides), SO_2 (sulphur dioxide) and PM (particulate matter). The methodology used to combine them is outlined in the following sections.

4.3.1.1 Tailpipe Emissions

As already indicated the AQ pollutant criterion is rated based on the actual EC type-approval test data for each of the regulated pollutants (CO, HC, NO_x and PM), rather than simply the Euro emissions standard that the vehicle qualifies for. Exceptions include:

(a) *Diesel vehicles:* HC emissions data are taken as the difference between the NO_x and the NO_x+HC emissions data;

(b) *Petrol vehicles:* Average PM emission factors (Table 1) are assumed for all GDI (gasoline direct injection) vehicles, as PM is not measured in their EC type approval test. It is also proposed to allow the inclusion of model specific petrol PM emission data where a reliable data source is available;

(c) *CNG vehicles:* Non-methane hydrocarbon (NMHC) data may be used in the place of total HC type approval data for specific vehicles, where reliable data sources are available. (In this case the remaining methane emissions are included in the GHG criteria.)

Table 9: Tailpipe Petrol PM Emission Factors

Indirect injection (IDI)	Direct injection (DI)
PM emission factor, g/km	PM emission factor, g/km (a)
0	0.006

Notes:
(a) Based on data from measurements carried out by VTT, TNO Automotive and ADEME.

The maximum tailpipe emission for each pollutant is set at the maximum legislated Euro III (2000) emission for cars (not exceeding 2.5 tonnes laden) and any fuel (see Appendix 8), the minimum emission is taken to be zero (e.g. electric vehicle). These limits are summarised in Table 10.

Table 10: Tailpipe AQ Emission Limits

Emission, g/km	CO	HC	NO_x	SO_2 [(c)]	PM
Minimum	0	0	0	-	0
Maximum	2.3 [(a)]	0.2 [(a)]	0.5 [(b)]	-	0.05 [(b)]

Notes:
(a) Euro III, Petrol, Car (not exceeding 2.5 tonnes laden)
(b) Euro III, Diesel, Car (not exceeding 2.5 tonnes laden)
(c) No limits for sulphur apply and tailpipe emissions are negligible compared to other sources.

4.3.1.2 Fuel Cycle Emissions

Fuel cycle emissions are based on country data from MEET Deliverable 20 (1997) (as outlined in Appendix 9). Minimum emissions are again taken to be zero (e.g. 100% renewable electricity). Maximum emissions are calculated as those resulting from the equivalent fuel consumption of a vehicle emitting 300 gCO_2/km (95% year 2000 vehicles emit at lower level than this). Using the current Fuel Cycle data set (MEET, 1997) the maximum emission limits for each pollutant (for the UK) are presented in Table 11:

Table 11: Fuel Cycle AQ Emission Limits (UK)

Emission, g/km	CO	HC	NO_x	SO_2	PM
Minimum	0	0	0	0	0
Maximum [(a)]	0.023	0.976	0.196	0.309	0.011

Notes:
(a) Gasoline fuel cycle.

4.3.1.3 Combined AQ Pollutant Score

External costs are used to provide relative weighting of the pollutants (also allowing weighting relative to the location type of the emission) before their combination to an overall AQ external cost per kilometre and then AQ criteria score. Three sets of values (based on an extension to the ExternE study, see Appendix 7) are presented in Table 12 urban and rural values and a vehicle (combined) average, derived from the UK proportion of urban to rural kilometres for passenger cars (46%:54%). This proportion is currently changed (along with the external costs) to reflect different conditions in different Member States (see Appendix 7 and Appendix 9). [However, it would also be easy to use EU average values if preferred as another option.]

Table 12: Indicative Values for UK Air Pollution Costs.

	Cost per tonne (Euro)				
	CO	HC	NO_x	SO_2	PM_{10}
UK Urban	3.5	1,900	2,600	12,300	122,130
UK Rural	0.3	1,900	2,600	4,500	8,730
Average UK use	**1.8**	**1,900**	**2,600**	**8,088**	**60,894**

The total AQ external cost is calculated from the direct sum of the costs associated with emissions of the individual AQ pollutants, according to the following formula:

$$Q_{AQ} = \sum_i p_i.c_i$$

Where:
Q_{AQ} = AQ External Cost in Euro/km;
p_i = emission of pollutant *i* in g/km;
c_i = external cost of emission of pollutant *i* in Euro/g.

Rural external cost factors are used to calculate the cost of fuel cycle AQ emissions to reflect the fact that the majority of these emissions occur away from urban areas. Currently the proportion of urban:rural external cost factors used to calculate the cost of tailpipe AQ emissions is fixed to the Member State average. However, it could also be varied according to the specified ratio of urban:rural driving for the vehicle, if desired; e.g. provide the user with 3 defaults (100% urban, 100% rural and average split for the Member State) as well as the option for them to provide their own ratio.

Minimum emission is taken as zero in both cases and so the external cost is also zero. Maximum emission limit external costs are calculated using:

(a) Urban external costs for tailpipe emissions;
(b) Rural external costs for fuel cycle emissions;

Using the previously specified emission limits this gives the values in Table 13:

Table 13: UK Maximum AQ Emission Limit External Costs

Euro/km	CO	HC	NO_x	SO_2	PM	TOTAL
Tailpipe max cost	0.000008	0.00038	0.00130	0.00000	0.00611	**0.00779**
Fuel cycle max cost	0.7E-7	0.00185	0.00051	0.00139	0.00010	**0.00385**
TOTAL max cost	**0.000008**	**0.00223**	**0.00181**	**0.00139**	**0.00621**	**0.01165**

The overall AQ criteria score (out of 100) is calculated using the specified emission limits for tailpipe and fuel cycle emissions, the external cost factors and the following formulas:

$$Q_{AQ}\text{ (total)} = Q_{AQ}\text{ (tailpipe)} + Q_{AQ}\text{ (fuel cycle)}$$

and

$$\text{AQ Score} = 100 - 100 \times Q_{AQ}\text{ (total)} / Q_{AQ}\text{ (max emission total)}$$

Where:

Q_{AQ} (total) = total AQ external cost in Euro/km;
Q_{AQ} (tailpipe) = tailpipe AQ external cost in Euro/km;
Q_{AQ} (fuel cycle) = fuel cycle AQ external cost in Euro/km;
Q_{AQ} (max emission total) = total AQ external cost for the max emission limits in Euro/km.

4.3.2 Greenhouse Gas Criterion

There are 3 pollutants included in the Greenhouse Gas (GHG) Criterion: CO_2 (carbon dioxide), CH_4 (methane) and N_2O (nitrous oxide). The methodology used to combine them is outlined in the following sections.

4.3.2.1 Tailpipe Emissions

As already indicated the GHG pollutant criterion is rated based on:

(a) *All vehicles:* The actual EC type-approval test data for gCO_2 emissions per kilometre;

(b) *All vehicles:* N_2O emissions do not correlate with CO_2, NO_x or any other emission but are dependent primarily on cars' fuel and catalyst type. Catalyst type correlates broadly with cars' Euro emissions standard, so as a best available approximation the methodology uses default values for N_2O emissions/km according to cars' fuel type and Euro standard. See Table 14;

(c) *CNG vehicles:* For the AQ criteria, NMHC data may be used in the place of HC type approval data for specific vehicles, where reliable data sources are available. In this case the remaining CH_4 emissions are included in the GHG criteria (typically around 80% of total HC emissions). Otherwise CH_4 emissions are assumed to be zero.

Table 14: Tailpipe N_2O Emission Factors

EF (a), gN_2O/km (a)	Petrol	Diesel	LPG	CNG (b)	Electric
Euro 1	0.027	0.002	-	-	N/A
Euro 2	0.013	0.005	0.012	0.012	N/A
Euro III	0.005	0.008	0.005 (c)	0.005	N/A
Euro IV (d)	0.005	0.008	0.005 (c)	0.005	N/A

Notes:
(a) Emission factors are based on tests carried out by TNO Automotive on a range of vehicles using the Euro III test procedure.
(b) in the absence of other data emissions are assumed to be approximately equal to LPG emissions
(c) assumed to be similar to petrol in the absence of the data
(d) assumed to be the same as Euro III in the absence of other data

The minimum tailpipe emission is taken to be zero (e.g. electric vehicles). The maximum tailpipe emissions are based on an emission rate of 300 gCO_2/km (95% year 2000 vehicles emit at lower level than this). These limits are summarised in Table 15.

Table 15: Tailpipe GHG Emission Limits

Emission, g/km	CO_2	CH_4	N_2O
Minimum	0	0	0
Maximum	300	0.16 (a)	0.008 (b)

Notes:
(a) 80% of HC emission limit Euro III, Petrol/CNG, Car (not exceeding 2.5 tonnes laden).
(b) For Euro III diesel.

4.3.2.2 Fuel Cycle Emissions

Fuel cycle emissions are currently based on country data from MEET Deliverable 20 (1997) (as outlined in Appendix 8). (However if more recent data was available this could be used instead). Minimum emissions are again taken to be zero (e.g. 100% renewable electricity). Maximum emissions are calculated as those resulting from the equivalent fuel consumption of a vehicle emitting 300 gCO_2/km (95% year 2000 vehicles emit at lower level than this). Using the current Fuel Cycle data set (MEET, 1997) the maximum emission limit for each pollutant (for the UK) are presented in Table 16. Emissions of N_2O from the fuel cycle are negligible in comparison to other GHG emissions and are not significantly different between different fuels (and also no data is available in MEET). For this reason they are excluded from the methodology.

Table 16: Fuel Cycle GHG Emission Limits (UK)

Emission, g/km	CO_2	CH_4	N_2O (a)
Minimum	0	0	-
Maximum	42.900 (b)	1.176 (c)	-

Notes:
(b) N_2O emissions from the fuel cycle are excluded from the methodology;

(c) Gasoline fuel cycle;
(d) CNG fuel cycle.

4.3.2.3 Combined GHG Pollutant Score

GWP (Global Warming Potential) factors are used to provide relative weighting of the pollutants in units of CO_2 emission before their combination to an overall GHG external cost per kilometre and then GHG criteria score. The total GHG external cost is calculated from the direct sum of the costs associated with emissions of the individual GHG pollutants, according to the following formula:

$$Q_{GHG} = \sum_j p_j.g_j.c_{CO2}$$

OR

$$Q_{GHG} = \sum_j p_j.c_j \qquad \text{and} \qquad c_j = g_j.c_{CO2}$$

Where:

Q_{GHG} = GHG External Cost in Euro/km

p_j = emission of GHG pollutant *j* in g/km;

g_j = GWP of GHG pollutant *j* (100 year time horizon);

c_{CO2} = external cost of emission of CO_2 in Euro/g;

c_j = external cost of emission of GHG pollutant *j* in Euro/g.

The values for the GWPs and external costs currently used in the methodology are listed in Table 17. The external cost for CO_2 emission is currently based on the upper value of €46/tonne from the ExternE study, see Appendix 6

Table 17: Global Warming Potential and External Costs for GHG Pollutants

	CO_2	CH_4	N_2O
GWP (100 year horizon)	1	21	310
External cost, Euro/tonne	46	966	14260

Using the previously specified emission limits with the formulae outlined gives the values for maximum cost in Table 18:

Table 18: Maximum GHG Emission Limit External Costs

Euro/km	CO_2	CH_4	N_2O	TOTAL
Tailpipe max cost	0.01380	0.00015	0.00011	**0.01407**
Fuel cycle max cost	0.00197	0.00114	0.00000	**0.00311**
TOTAL max cost	**0.01577**	**0.00129**	**0.00011**	**0.01718**

The overall GHG criteria score (out of 100) is calculated using the specified emission limits for tailpipe and fuel cycle emissions, the external cost factors and the following formulae:

$$Q_{GHG}\ (total) = Q_{GHG}\ (tailpipe) + Q_{GHG}\ (fuel\ cycle)$$

and

$$GHG\ Score = 100 - 100 \times Q_{GHG}\ (total) / Q_{GHG}\ (max\ emission\ total)$$

Where:

Q_{GHG} (total) = total GHG external cost in Euro/km;
Q_{GHG} (tailpipe) = tailpipe GHG external cost in Euro/km;
Q_{GHG} (fuel cycle) = fuel cycle GHG external cost in Euro/km;
Q_{GHG} (max emission total) = total GHG external cost for the max emission limits in Euro/km.

4.3.3 Overall Environmental Rating

The overall Environmental score (out of 100) is calculated by combining the external costs for the AQ and GHG criteria directly and then scaling according to the similarly combined emission limits as before:

$$Q_{Overall}\ (total) = Q_{AQ}\ (total) + Q_{GHG}\ (total)$$

and

$$Overall\ Score = 100 - 100 \times Q_{Overall}\ (total) / Q_{Overall}\ (max\ emission\ total)$$

Where:

$Q_{Overall}$ (total) = total overall environmental external cost in Euro/km;
Q_{AQ} (total) = total AQ criteria external cost in Euro/km;
Q_{GHG} (total) = total GHG criteria external cost in Euro/km;
$Q_{Overall}$ (max emission total) = total external cost for the AQ + GHG max emission limits in Euro/km.

4.3.3.1 Additional Option

As discussed in the AQ section, as an alternative to fixed ratio of urban and extra-urban driving the user, Could Alternatively be presented with 3 default overall rating the options and one customisable option:

1. 100% urban driving;
2. 100% rural driving;
3. Average driving (split varies with country, e.g. UK = 46% urban: 54% rural);
4. User defined split of urban: rural driving.

Moving between these options only effects the AQ component of the rating via the different external costs associated with urban and rural AQ pollutants (GHGs are global pollutants, so costs are independent of emission location). This would effectively change the balance between the AQ and GHG component criteria, reflecting the greater importance of AQ pollutant emissions in urban areas.

5 VEHICLE DECISION SUPPORT TOOL

5.1 Introduction

On the Cleaner Drive web-site general information on cleaner vehicles can be found. To access information about a particular vehicle, a database of conventional and alternative (cleaner) vehicles with environmental information is available. The decision support tool is a software-tool that allows the user to easily get the desired vehicle information from the vehicle database. The tool guides the user to the information about the vehicle he is looking for.

In the project, a first version of the decision support tool (DST) was implemented by June 2003 in all national websites. A period of stakeholder feedback in the second half of 2003 was foreseen, during which users and other experts were invited to give feedback on the websites in general and the DST more specific. Based on this stakeholder feedback, an improved version of the DST has been developed and is online since May 2004 in all national websites.

5.2 Version 1 DST

For a full description of version 1 of the DST, a reference is made to Deliverable 3 fo the Cleaner Drive project 'Decision Support Tool for vehicle purchasers' of June 2003.

Principal decisions on the database structure and the centrally hosted DST are motivated in that deliverable.

5.3 Stakeholder feedback DST

5.3.1 Review by EEA

Deliverable 3 with the online version 1 of the DST was peer reviewed by an expert of EEA (European Environmental Agency). The full report of the review can be found in Appendix 1.

Main conclusions can be summarized as follows:
The DST fills in a need for vehicle purchasers and policy makers in their search for the most environmental friendly solution for their needs. Most important problem is that the DST is not linked to the other information in the website. More financial information (that is provided in the rest of the website) could be a supplementary argument to use the DST. More interactivity with the user could be a useful tool as well, that the user can fill in user specific requirements (car use for example: division urban – rural traffic) and that custom made advice on the environmental

performance dependent on the vehicle use could be given. Other remarks on the complexity of retrieving the desired information were mentioned.

5.3.2 Feedback through national websites

Users that consulted the DST through the different national websites were invited to give their comments on the functioning and the content of the DST. By several partners, structured stakeholder feedback sessions (discussion groups) were organised to get an in depth evaluation of the websites and DST.

The main conclusions of received stakeholder feedback were in line with the expert review by the EEA (see previous chapter). Most received remarks specifically on the DST concerned the complexity of the user interface and the completeness of the databases. It appears that when visitors use the DST for the first time, it needs some time to fully understand the possibilities of it.

5.3.3 Input from partners in Cleaner Drive

The functional design of the DST that was implemented in the first version of the DST was based on a consensus amongst all partners.

Main decision was giving environmental performance priority in the search criteria and in the display of information of vehicle details. To make the websites a reference site for vehicle purchasers, the maximum information (technical, financial, environmental) should be integrated. The availability of this elaborate data was investigated. A detailed cost module seemed not achievable.

Starting from the implementation of the DST in the different national websites in June 2003, at regular moments during the stakeholder feedback period, a hands-on session on the DST was organised at the consortium meetings, to check the relevancy of received stakeholder feedback.

The complexity of the user interface was a major concern of the consortium. The principal decision of version 1 of the DST which had to be fit in a frame in the UK pilot website was reconsidered. When opening the DST in a full screen, it became possible to make a more user friendly interface without losing too much information.

5.3.4 Feedback Summary

A complete logbook of all remarks that were gathered during the period of stakeholder feedback is added in Appendix 2.

Most relevant stakeholder feedback that was gathered through consultation of different stakeholder groups in the different partner countries can be summarised in four categories:

- Complexity of user interface. When retrieving information from the DST for the first time, it is difficult to get an overview of all search possibilities and how they must be used.

- Completeness of databases. The databases of the DST have been updated three times during the year of stakeholder feedback. Nevertheless, it was not feasible to have fully up to date databases online because of the loss of time for gathering data through the national administrations for vehicle registration, processing data by the national partner (adding cost information, car segmentation) and the uploading by VITO who hosts the DST. Specific discussions rose on the alternatively fuelled databases: it was chosen to have most vehicles as possible for the different fuel/technology options in the alternatively fuelled database which was centrally compiled by NOVEM. Partners could decide which vehicles were appropriate to insert in the national database. This selection not always was found useful by the users. Some remarks were made that the database was not complete enough, other remarks were made that it was not useful to insert vehicles in the database when no complete data on the environmental performance were available.

- Completeness of information. When using the DST which is actually a search engine on a vehicle database, users sometimes lacked more background information on e.g. fuel and vehicle technology, the calculation methodology of the environmental rating etcetera. This information could be retrieved from the information on the website, but this was not easily found in some cases.

- Interactivity: due to the incompleteness of not being up to date of the DST databases, some users have more information available then in the DST database. For this reason, it is interesting to have an interactive module to allow users to fill in vehicle data and that the environmental rating would be calculated. Data that are interesting to be filled in by users are vehicle and environmental data (emissions, fuel consumption), cost data, specific urban/rural split to calculate the environmental score for urban/rural applications.

5.4 Changes implemented in version 2

5.4.1 Improvements to user interface

Most important changes that were implemented in the second version of the DST concerned the improvement of the user friendliness of the user interface. Most important decision of the consortium was to leave the frame in which the DST was opened in version 1 to fit it in the UK pilot site, but which had serious consequences of the surface of the screen that could be used by the DST.

Version 2 of the DST is opened in a second separate window which allows to use a full screen for the DST. It also has the advantage that the homepage of the Cleaner

Drive websites will stay available for the user (in the originally opened screen) so all information on fuels and vehicles can be retrieved during the use of the DST without having to leave the DST.

Other smaller changes which improved the user friendliness of the DST were implemented in version 2 of the DST. A summary of all remarks and following changes that were implemented in the second version of the DST can be found in Appendix 3.

5.4.2 Improvement to information & search possibilities

Market segment seemed to be a very important parameter that is used by users when looking up vehicles, which was possible in the combined criteria search but difficult to find. To resolve this, market segment was made a front end search criterion which can be used from the homepage of the DST.

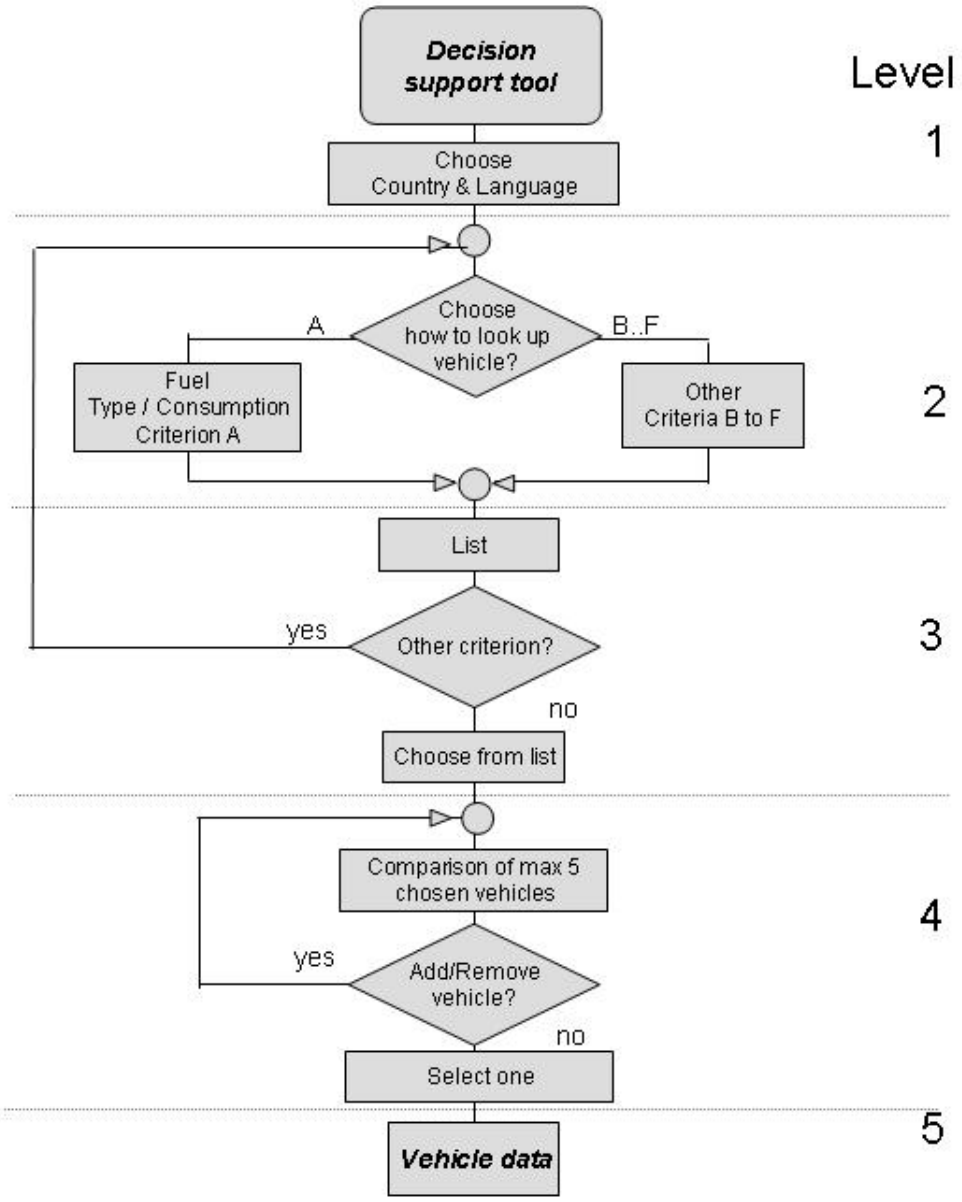
Changes were made to the detailed information page (vehicle sheet) so that most relevant information was on top of the page. Unnecessary information of incomplete parameters were removed from the vehicle sheet.

On the completeness of the datasets, a new compiling of alternatively fuelled vehicles was organised and the online database in the final version of the DST contains most updated information possible. All partners paid extra attention to the compiling of the conventionally fuelled databases for the last update which was done in this project.

5.5 DST – final version

5.5.1 Flow chart of the tool

The aim of the project is to encourage the use of clean vehicles. Therefore the emphasis in the use of the decision support tool is on clean vehicles. The user is preferably guided to this category of vehicles.



5.5.2 Description of the tool

In this chapter we describe how the decision tool has to be used, based on the different windows that can be opened in the programme. By choosing the right criteria the user is guided to the environmental information of a vehicle he is looking for.

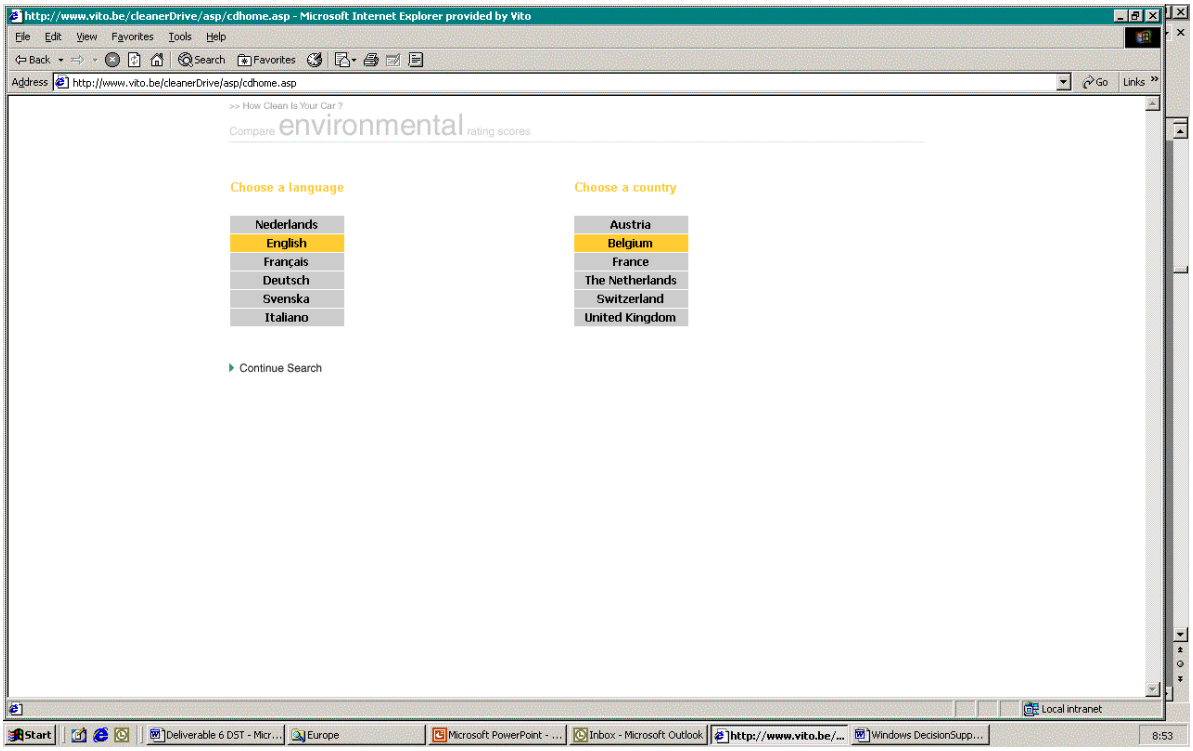
5.5.3 Opening window (level 1)

In a first stage the user has to choose a language and the country of the database. The languages and countries that can be chosen are given in the tables below.

Language
Dutch
English
French
German
Italian
Swedish

Country
Austria
Belgium
France
Switzerland
The Netherlands
United kingdom

A picture of the window is given below.



5.5.4 Selection criterion window (level 2)

Once the user has selected the language and the database, he is suggested to select a vehicle based on fuel and fuel consumption.
If this selection criterion does not fit, the user may choose one of the following:

- market segment
- technology
- top 10 (the 10 cleanest vehicles)
- vehicle make and model
- combined criteria (for the experienced user)

5.5.4.1 Fuel economy (Level 2A)

In this window the vehicle selection can be done based on the type of fuel and the fuel consumption.
The fuel types that may be chosen are given in the table below.

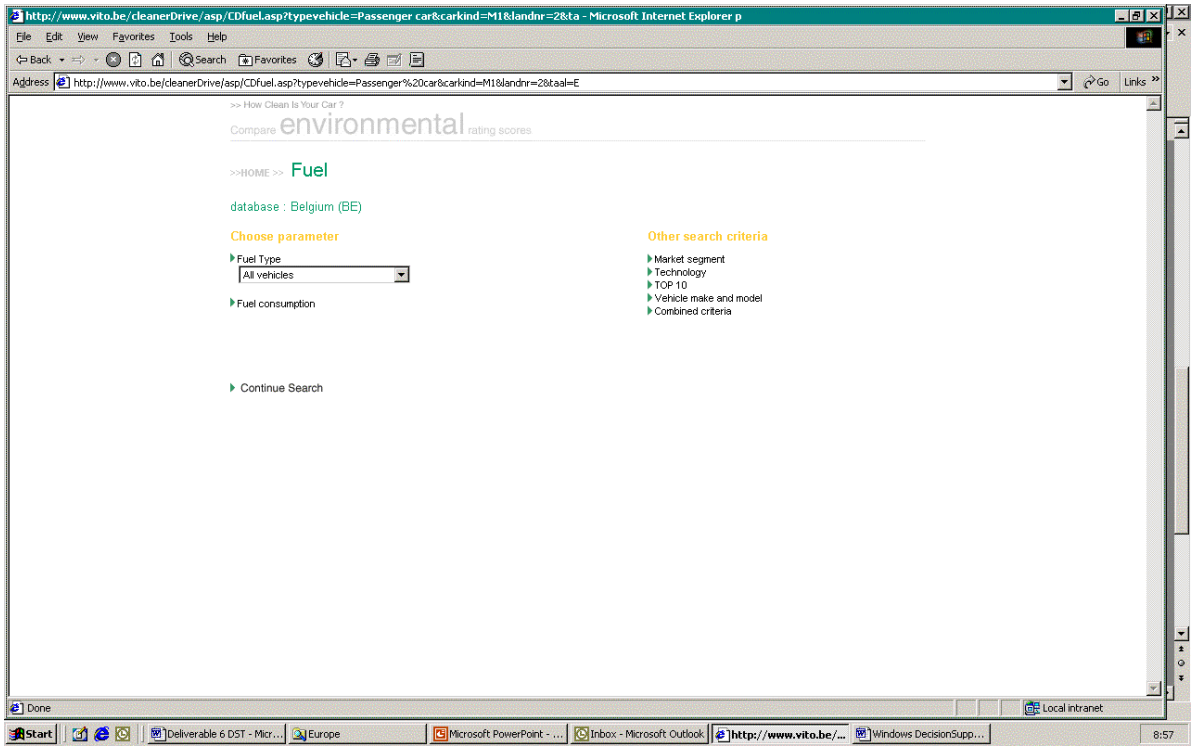
Fuel types

Petrol
Diesel
LPG
Natural Gas
Hydrogen
Biodiesel
Electricity
Methanol
Ethanol 85
Ethanol 10
DME
Synthetic petrol
Synthetic diesel

Fuel consumption is given in unit depending on whether it is liquid or gaseous and the country that was chosen.
Gasses are quantified in cubic meters (m^3), liquids in litres (l).
For the United Kingdom and The Netherlands, the fuel consumption is expressed in distance per quantity unit. For all other countries, the consumed fuel quantity in litre per 100 km is given.

If there are no vehicles in the database of a certain fuel type, this is indicated in the drop down list to avoid unnecessary actions by the users.

A picture of the window is given below.



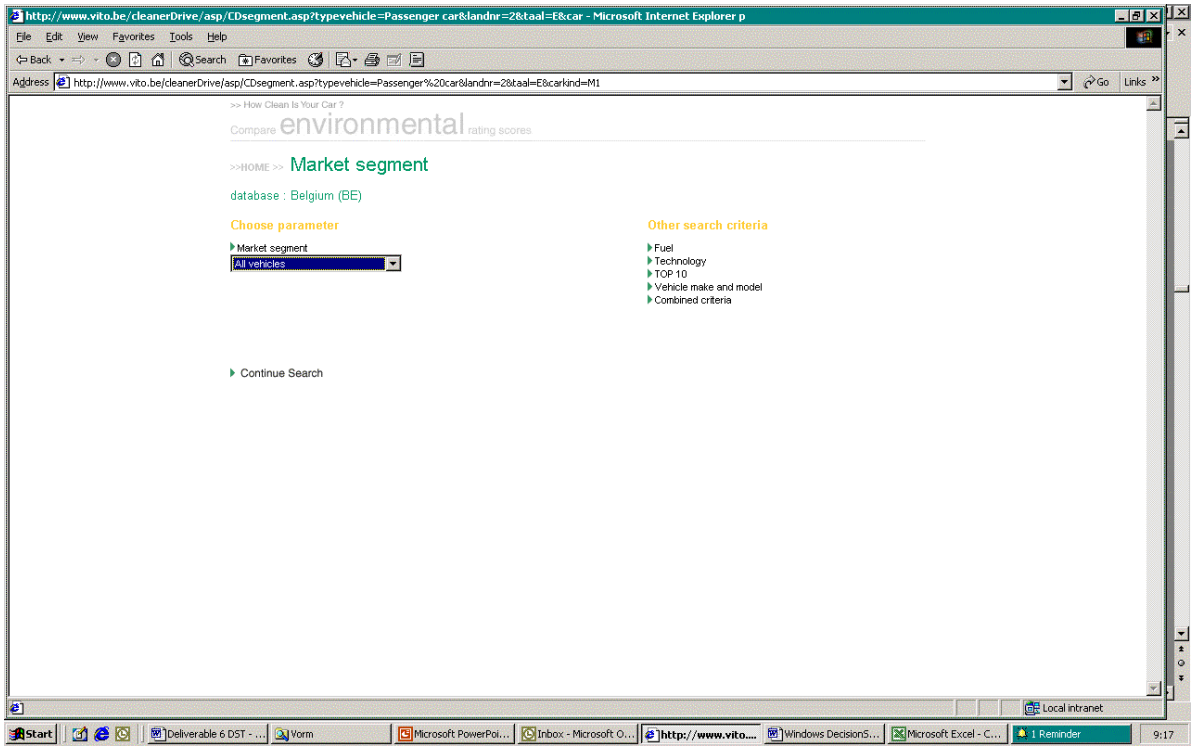
5.5.4.2 Market segment (Level 2B)

The market segment characterises the type of vehicle that has to be considered. As explained in chapter 5.4, market segment is made a front end search criterium in the second version of the DST.

The segmentation is based on the segmentation that is applied by Febiac (the federation of Belgian automotive and bike importers/manufacturers).

Market segment
Supermini
Small family car
Large family car
Mini multi purpose vehicles
Multi purpose vehicles (MPV)
Executive car
Roadster
Off roader

A picture of the window is given below.

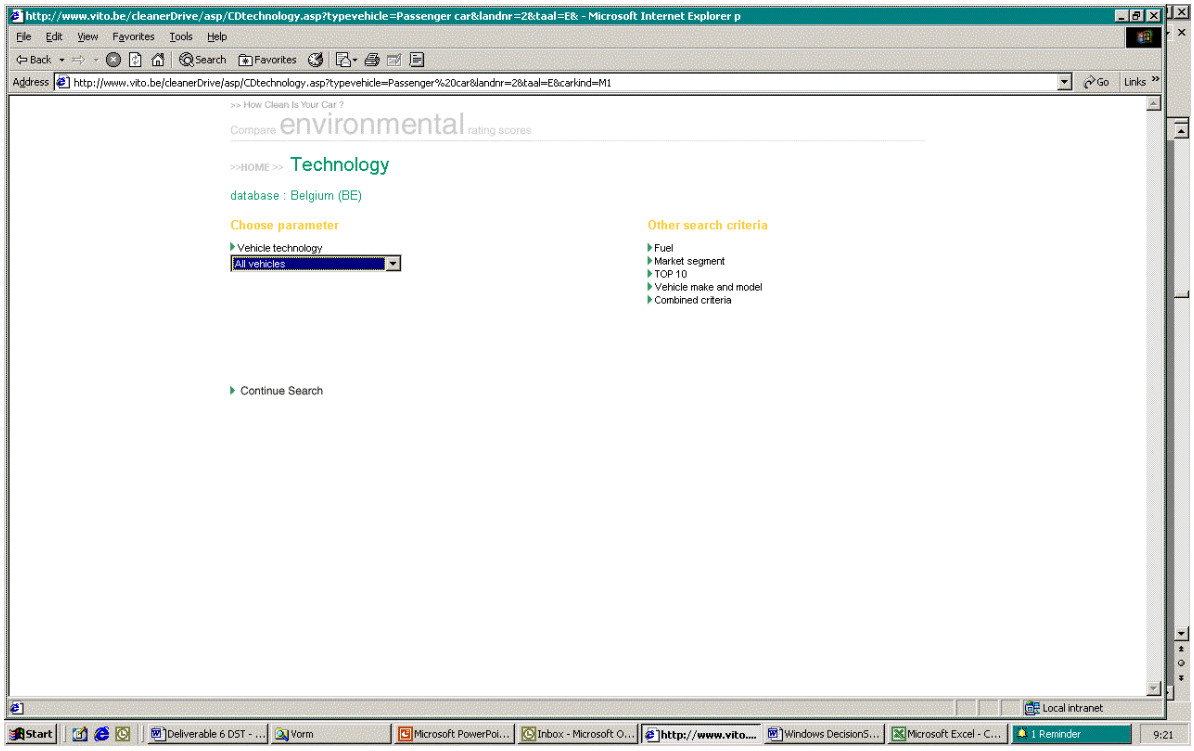


5.5.4.3 Technology (Level 2C)

In this window the vehicle selection can be done based on the driving technology of the vehicle. The technology options are given in the table below.

Technology
Combustion Engine Ignition
Combustion Engine Compression
Electric motor battery
Fuel Cell
Hybrid

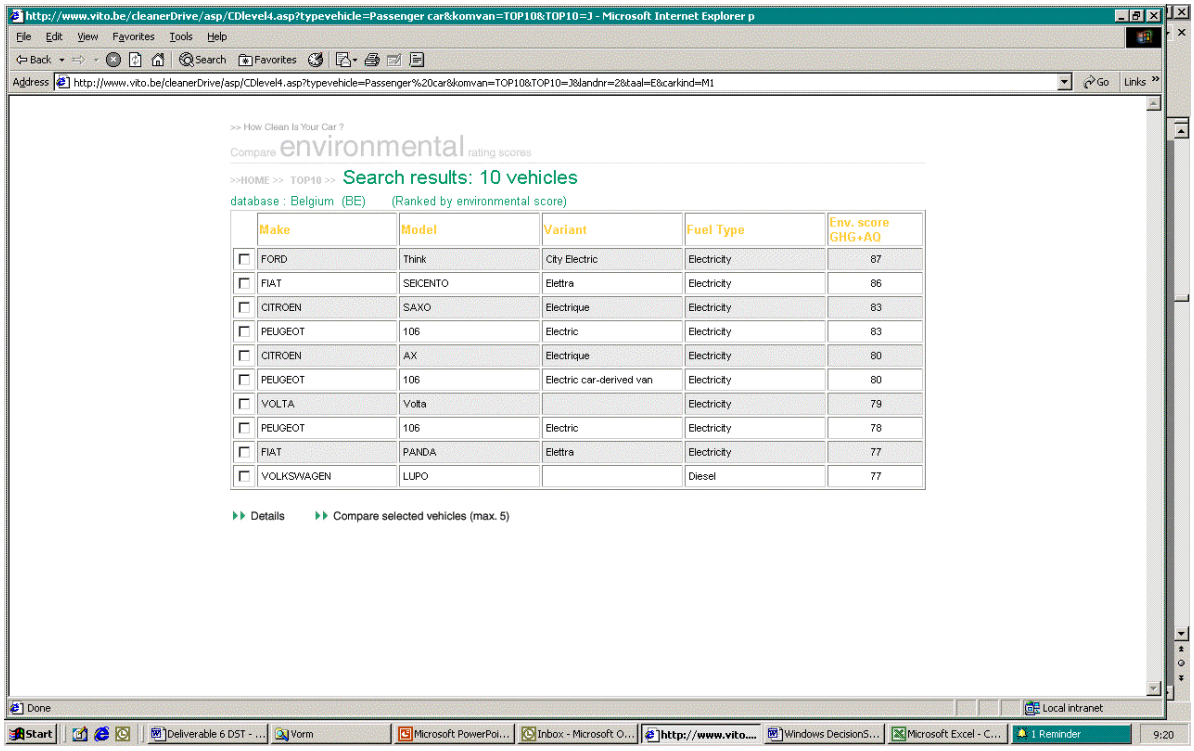
A picture of the window is given below.



5.5.4.4 Top 10 (Level 2D)

This gives a table with the 10 vehicles that have the best environmental rating (greenhouse gas and air quality) in the database. The table is different from one country to another, due to the fact that the databases are not the same..

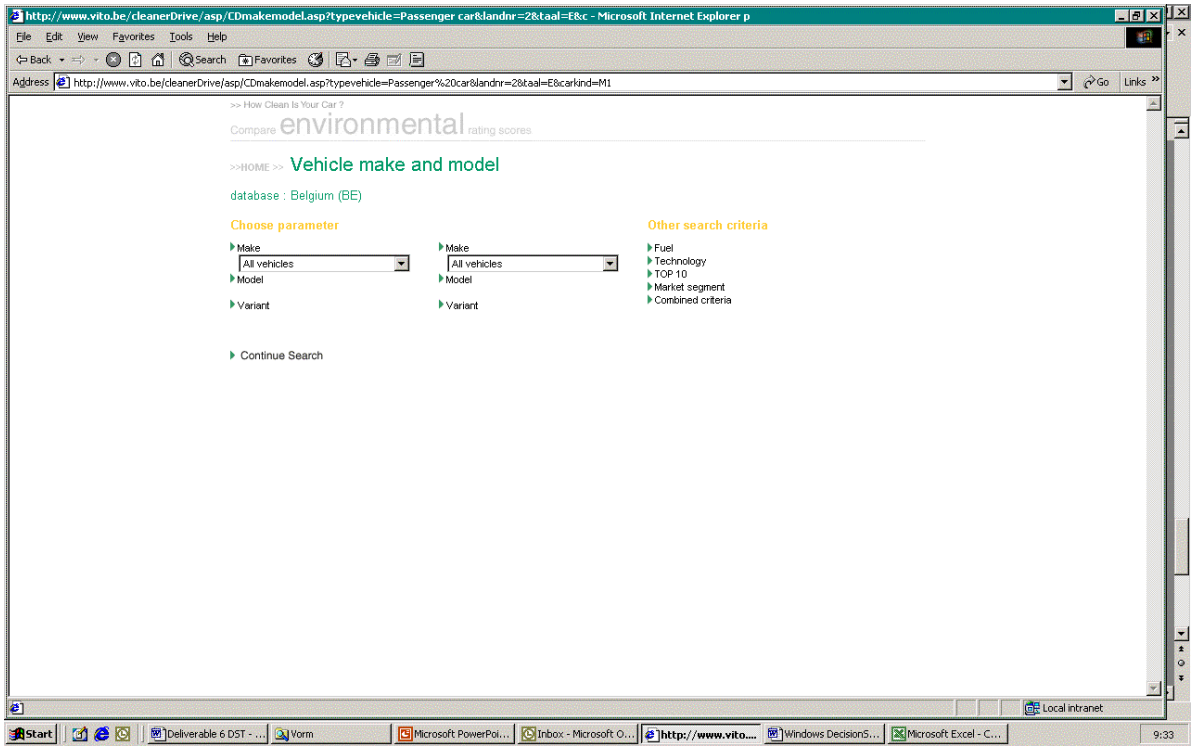
A picture of the window is given below.



5.5.4.5 Vehicle make Model (Level 2E)

In this window a vehicle can be selected based on make, model and variant. In the first version of the DST, the user had the possibility to search one vehicle characterised by make-model-variant. As the purchase decision of consumers is often made out of 2 choices characterised by make-model-variant, version 2 of the DST was adapted to support this decision process. Two vehicles (make-model-variant) can be chosen to make a comparison possible between different makes, models or variants.

A picture of the window is given below.

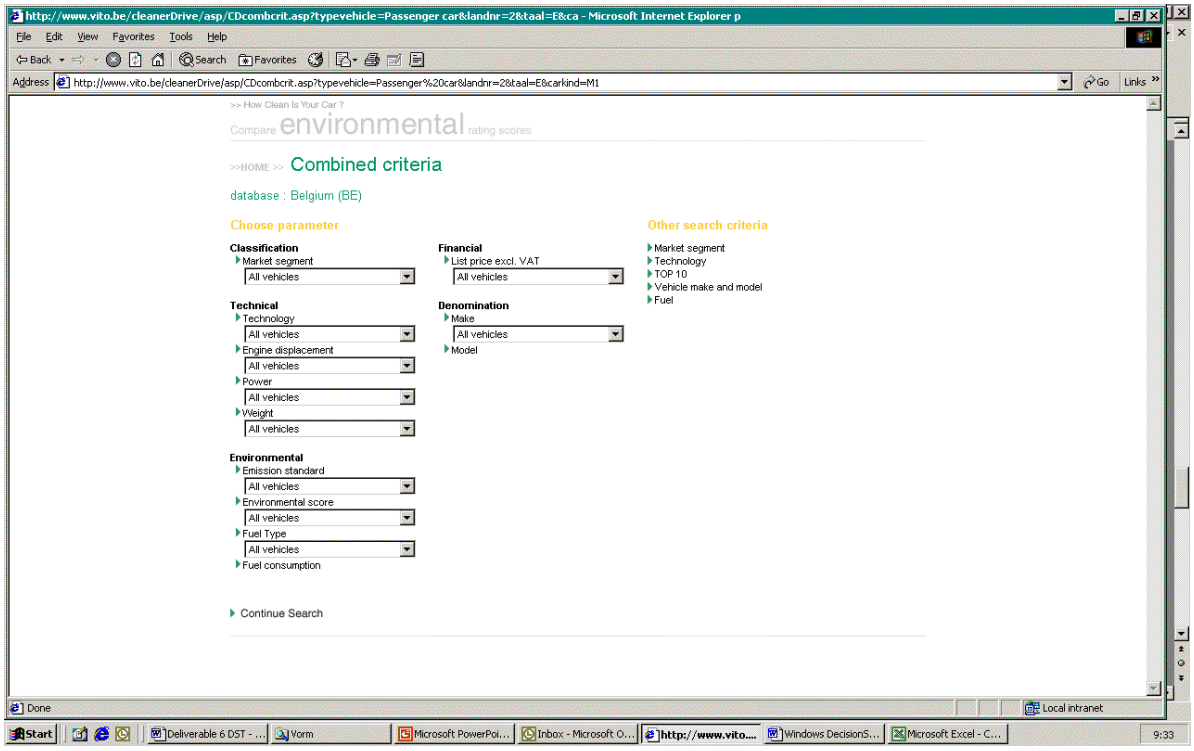


5.5.4.6 Combined criteria (Level 2F)

In this window a vehicle can be selected based on several criteria, given in the table below. This window is intended for experienced users familiar with who need to find quickly the desired information.

Combined criteria
Classification
Market segment
Technical
Technology
Engine displacement
Power
Weight
Environmental
Emission standard
Environmental score
Fuel type
Fuel consumption
Financial
List price excl. VAT
Denomination
Make
Model

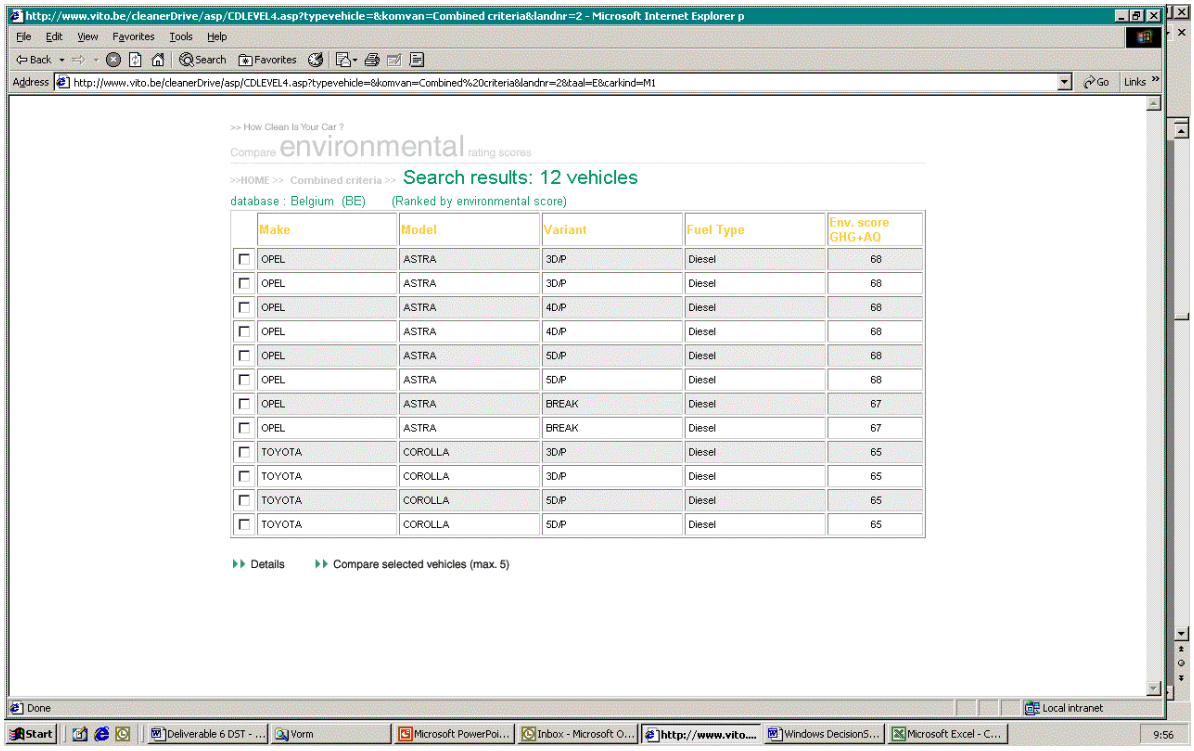
A picture of the window is given below.



5.5.5 Search results window (Level 3)

The vehicles are listed according to their environmental score (all emissions), so in the list of search results, the cleanest vehicles are on top.
Vehicles for which no emission data are available can be found at the bottom of this list. Due to the fact that emission data for some alternative vehicles are currently not available, these vehicles can be found at the end of the list.

A picture of the window is given below.



From this list one or more vehicles can be selected for comparison.
The user can choose whether he wants to compare up to 5 vehicles, based on a limited number of specifications (Level 4) or whether he wants to have detailed information of the selected vehicles (Level 5).

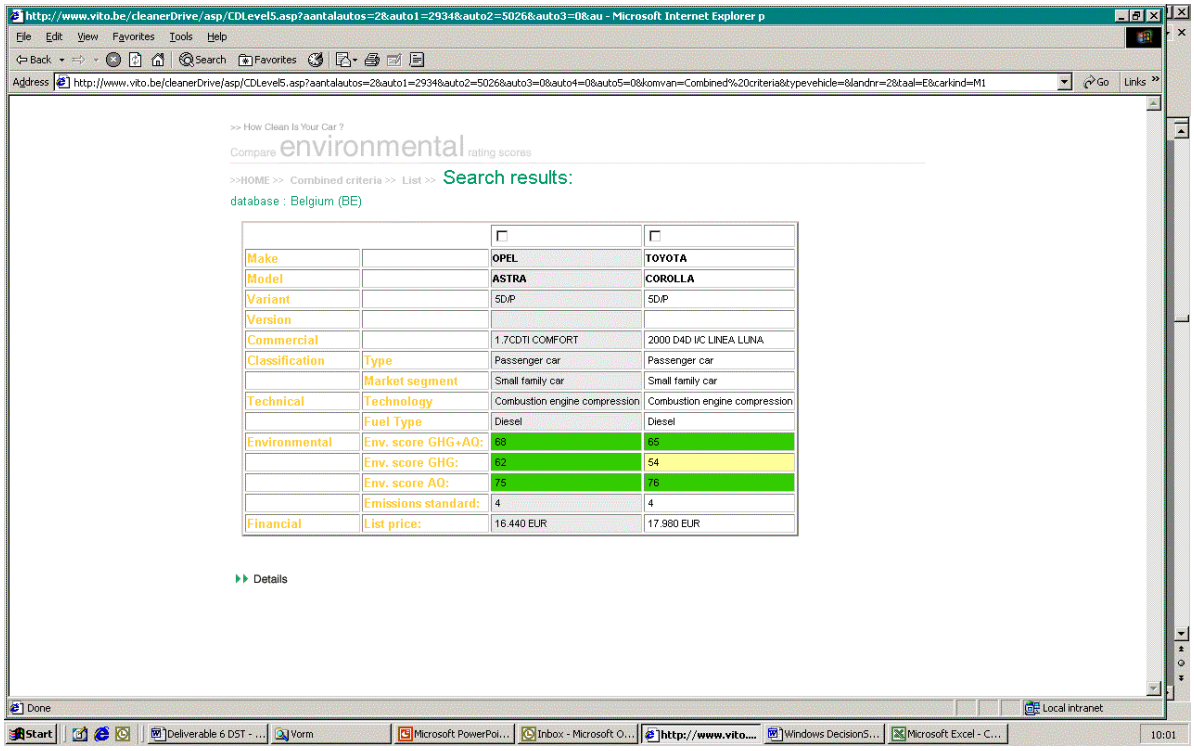
5.5.6 Search result of selection window (Level 4)

This window shows the result of the comparison that was asked for in the previous window. The vehicles to be compared are presented with a limited number of parameters.

Comparison parameters

Make
Model
Variant
Version
Commercial
Type
Market segment
Technology
Fuel type
Environmental score Air Quality + Greenhouse gas
Environmental score Greenhouse gas
Environmental score Air Quality
Emission standard
List price excl. VAT

A picture of the window is given below.



5.5.7 Vehicle sheet window (Level 5)

This window is opened within the previous window (Level 4). In this window all the technical details of the vehicle are given (general). In an additional window detailed information on environmental aspects can be found.

A picture of the windows is given below. Note: When vehicle parameters are not included in the database, the comment “not available” will be shown, like in this example.

5.5.7.1 Vehicle sheet general

The data presented in the vehicle sheet can be found in the table below:
The first part presents various technical data.

Identification

Make
Type
Variant
Version
Commercial

Classification

Car Type
Market segment

Engine

Technology
Fuel type
Displacement
Power

Environmental

Emission

Emission standard
Environmental score GHG (CO_2)
Environmental score AQ emissions
Environmental score combined (GHG & AQ)

Fuel economy

Fuel consumption Urban cycle
Fuel consumption Extra urban cycle
Fuel consumption Combined cycle

Noise

Noise – drive-by
Noise – stationary

Vehicle

Driven wheels
Number of axles
Driving Range
Maximum speed
Transmission type

Dimensions

Length
Width
Height
Wheelbase
Number of doors
Number of seats
Cargo/luggage space
Weight
Maximum rated weight
Load capacity

Financial

List price
Purchase tax
Vehicle tax
Tax class

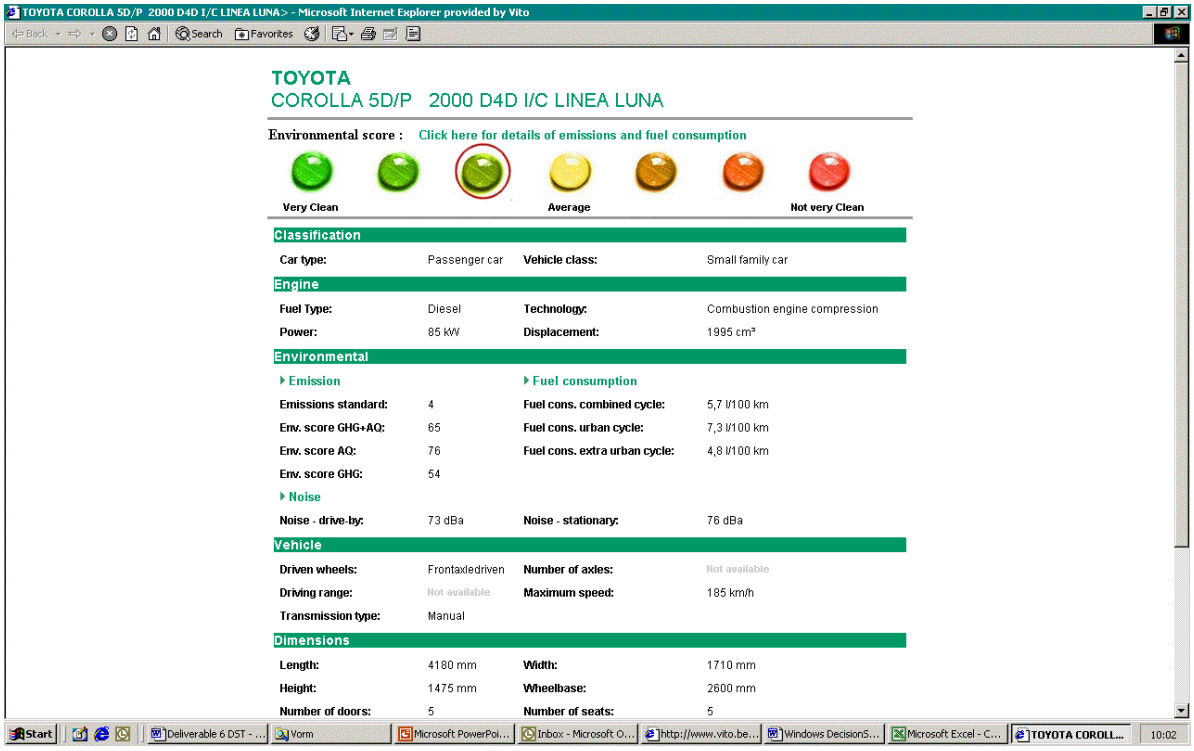
Miscellaneous

Date of introduction
Availability
Last updated on
Data source

Also a colour code for environmental score (all emissions) is given. The colour codes have been adapted in the second version of the DST with the implementation of the revised rating methodology which aims a larger range of environmental scores.

Environmental score	***Colour code (circle)***	
81-100	brightly green	Very clean
66-80	green	
56-65	dull green	
46-55	yellow	Average
36-45	dull red	
21-35	red	
0-20	brightly red	Not very clean

The window containing this information is shown below.



5.5.7.2 Vehicle sheet detailed (environmental)

The detailed emission data are listed in the table below.

Identification

Make
Type
Variant
Version
Commercial

Emissions

Environmental score
Environmental score total *vehicle*
Difference to average env score segment
Difference to average env cscore fuel type
Environmental score *air quality vehicle*
Difference to average AQ segment
Difference to average AQ fuel type
Environmental score *greenhouse gas vehicle*
Difference to average GHG segment
Difference to average GHG fuel type
Exhaust gas
CO_2
HC
NO_x
CO
CH_4
NMHC
PM

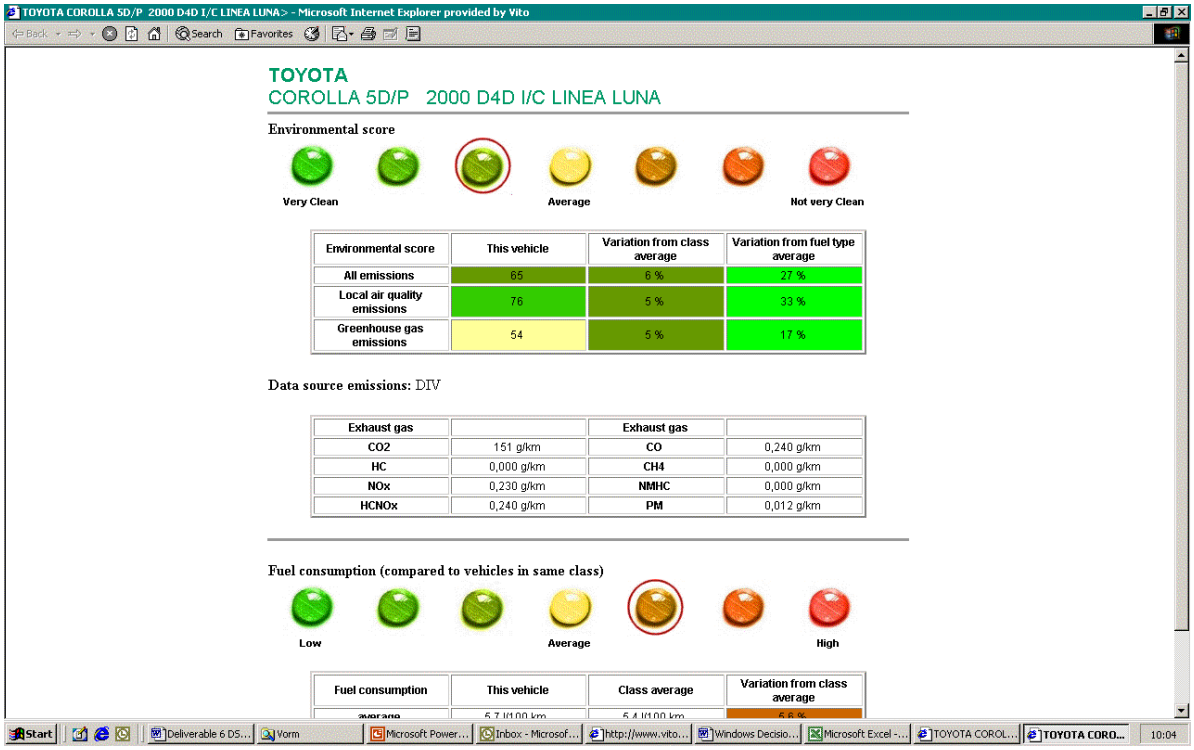
Fuel consumption

Average vehicle
Average segment
Difference to average segment
Urban vehicle
Urban segment
Difference to urban segment
Extra-urban vehicle
Extra-urban segment
Difference to Extra-urban segment

Colour codes from green to red are used to display the environmental score and fuel consumption. Their meaning is given in the table below.

Fuel consumption		***Environmental score***	
Circle/Table	*Colour code*	*Circle/ Table*	*Table*
Difference of segment average %		Value	Difference of segment/fuel type average %
Less than -25	brightly green	81-100	Less than -15
-25 tot -15	green	66-80	-15 tot -10
- 15 tot -5	dull green	56-65	- 10 tot -5
-5 tot 5	yellow	46-55	-5 tot 5
+5 tot +15	dull red	36-45	+5 tot +10
+15 tot +25	red	21-35	+10 tot +15
Over 25	brightly red	0-20	over 15

The window with the environmental details is shown below.

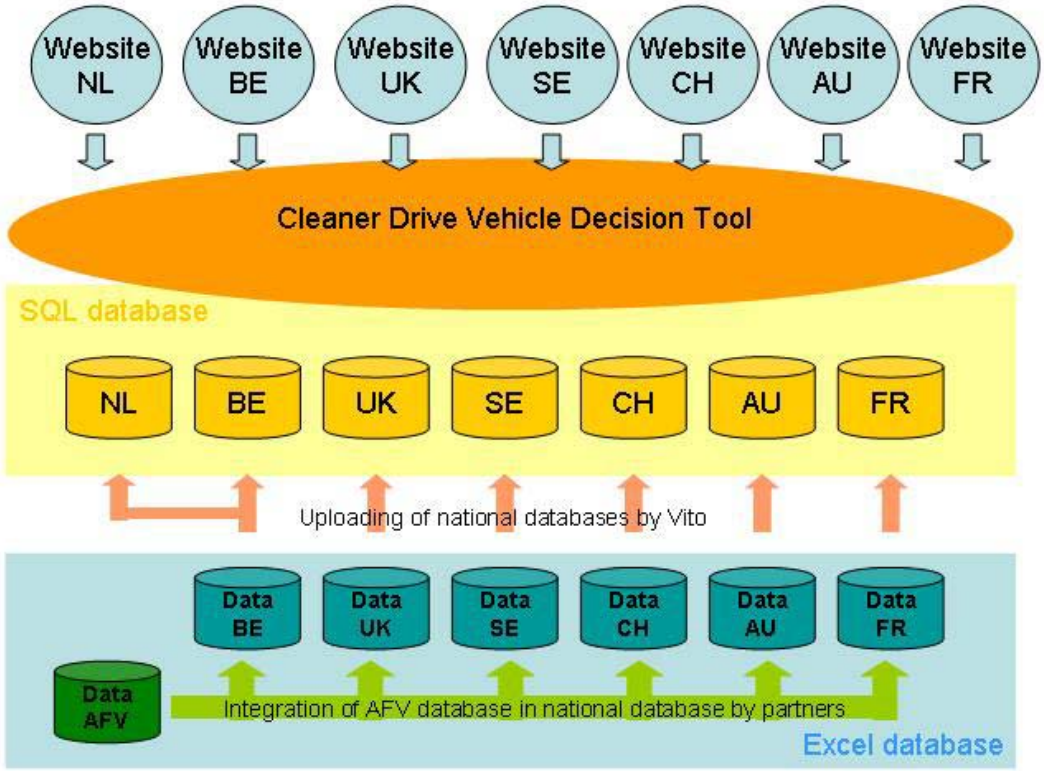


6 VEHICLE DATABASE

The vehicle database for Cleaner drive is built up from 7 national databases.
The project partners supplied the vehicle data from their national database in an Excel spreadsheet.

All the supplied spreadsheets were converted to an SQL-database, on which the decision tool operates. The data that are used by the vehicle decision tool are stored in a database. No calculations are done while using the vehicle decision tool.

In the figure below the structure of the database is given.



6.1 The definition of the database

From discussions with the partners the following aspects were considered to be important for the database:

- up to date information
- compatibility of this information with other databases
- information on different sorts of vehicles
- vehicle cost information should be included.

Further it was determined which vehicle information should be available to the user.

To store the information of an individual vehicle, it was decided to define a number of parameters. These parameters should be known or calculated for each particular vehicle.

6.1.1 Vehicle record

Each of the partners was asked to supply a national vehicle database in Excel.
To make the vehicle data accessible for the decision support tool, these data had to be in the same format for all the national databases.
The format of this database is described in the file vehicle record, that can be found in Appendix 5.
It is very important that each partner supplies the database in the prescribed format. Only databases in this format can be uploaded in the SQL-database.
In the vehicle record it is defined which vehicle parameters are in the database and in what format they have to be given.

6.1.2 Vehicle parameters

The vehicle parameters can be split up in parameters on which the user can select a particular vehicle and parameters that only provide information on the vehicle.
On the other hand some parameters are calculated (rating) from data in the national databases.

6.1.3 Selection parameters

These parameter are needed to make the selection of the vehicle by the decision tool.
If selection parameters are unknown, a vehicle will not be selected when the selection is done according to a criterion that uses these parameters.
A list of these parameters is presented in the table below.

Selection parameters

Make	Fuel type
Model or type	Weight
Variant	Emission standard
Version	Environmental score average
Car kind	Environmental score air quality
Segment	Environmental score greenhouse gas
Technology	Fuel consumption Average
Displacement	List price excl. VAT
Max. Power	Country(nationality database)

For the environmental score values the next parameters are required, and therefore they are indirectly selection parameters.

Parameters necessary for selection

HC-emission
NO_x-emission
HC + NO_x-emission
CO-emission
CH_4-emission
NMHC-emission
PM-emission

6.1.4 Information parameters

These parameters are in the database and can be presented in the vehicle sheet. The parameters in italics are calculated using other parameters.

Information parameters

Engine	*Environmental score average segment*	Energy consumption (urban cycle)
Commercial name	*Environmental score air quality segment*	Energy consumption (extra-urban cycle)
Country code TA	*Environmental score greenhouse gas segment*	Energy consumption Average
Make code TA	*Environmental score average fuel type*	Noise – drive-by
Number TA	*Environmental score air quality fuel type*	Noise – stationary
Power at nom. rpm	*Environmental score greenhouse gas fuel type*	Purchase tax
Fuel injection	CO_2-emission	Vehicle tax
Autonomy/Range	HC-emission	Tax class
Driven wheels	NO_x-emission	Incentives
Number of axles	HC + NO_x-emission	Used price 5 year
Transmission type	CO-emission	Maintenance costs
Maximum speed	CH_4-emission	Maintenance occurrence
Length	NMHC-emission	Insurance
Width	PM-emission	Leasing
Height	Fuel consumption (urban cycle)	Date of introduction
Wheelbase	Fuel consumption (extra-urban cycle)	Picture
Number of doors	Fuel consumption segment Average	Availability
Number of seats	Fuel consumption segment urban	Last updated on
Cargo/luggage space	Fuel consumption segment extra-urban	Data source
Maximum rated weight	Fuel consumption fuel type Average	Data source
Load capacity	Fuel consumption fuel type urban	
	Fuel consumption fuel type extra-urban	

The data that will be presented in the vehicle sheet are discussed in the next paragraph.

6.2 Source information for the database

6.2.1 National databases

An inventory was made by the involved partners of all available data in their country (Austria, Belgium, France, Sweden, Switzerland, The Netherlands). The report on the data availability is enclosed in Appendix 4.

6.2.2 Alternative vehicles database

For the database of alternative vehicles data was gathered from several sources by all the partners in the project. These data were put in the alternative database by Novem.
This database can be seen as a separate database that can be added to the different national databases.
The database contains some 90 vehicles with complete emissions data, so that these vehicles will show up in the decision support tool. These 90 vehicles are mostly LPG (bifuel) vehicles, but also several natural and biogas, electric and hybrid vehicles. Important sources for these data are the Powershift register (UK), tests in the Swiss large-scale field trial in Mendrisio, the German vehicle registration agency, a Swedish alternative fuel vehicles database, and finally various manufacturer websites. The source of the emissions data is given in the vehicle record.

6.2.3 European database RDW

The government organization RDW (Rijksdienst voor het Wegverkeer) in The Netherlands has set up a European database of vehicles. This database is used for type approval and licensing. It contains all vehicles which got type approval within any European country, so all vehicles sold in Europe. Alternative fuel vehicles (i.e. other than petrol, diesel, LPG) which have no type approval are not included.
It was considered if this database could be used for the Cleaner Drive project and several meetings between Novem, VITO and RDW took place to discuss this. After negotiations the price of the database was not acceptable in relation to the budget of the Cleaner Drive project. Moreover, as the RDW dataset does not give information about which vehicle can be purchased in what country, the partners would have had to add these specific data by hand.
For future projects, it will be considered to restart negotiations and reach an acceptable agreement for all partners.

6.3 The generating of the Cleaner Drive database

6.3.1 Setting up and gathering the national databases

All the partners set up a database of passenger cars that are available in their country. For the conventional vehicles existing sources were used. The database for alternative vehicles was set up by one partner (Novem), who provided the information to the others (see 6.2.2). Each partner decided on what information to implement in his national database.

6.3.2 Uploading the national databases

All the national databases were centralised at Vito. Here it was checked whether the information was in the correct format. After that the data were stored in an SQL database.

6.3.3 Calculation of additional parameters

After the conversion to the SQL-format, the vehicle data were completed by executing some calculations: the environmental scores and the averages of vehicle segment and fuel type.
Each of these parameters is given per vehicle, if the source information is available.
The decision support tool operates on this database, which is located at a server at Vito.

6.4 Technical Development and integration in pilot website

6.4.1 Database structure

The data are stored in a Microsoft SQL Server 2000 relational database, situated on one physical server at Vito. For each country a separate logical database is used with only data regarding this country. Reference data that are not country dependent are stored in one extra logical database. Vehicle data and reference tables are stored in a relational database structure. The choice for centrally stored data is made because of the uniformity of the data that is necessary for a uniform user interface.

6.4.2 User interface

The Decision Support Tool communicates with the databases through “stored procedures”. These are reusable sets of statements that achieve a consistent implementation of logic across applications and provide good performance.
The user interface consists of Active Server Pages using the “stored procedures” to meet the users’ request for information. The Decision Support Tool was tested for the latest versions of both Internet Explorer and Netscape.
The Decision Support Tool is centrally hosted by Vito.

6.4.3 Integration in national websites

The integration in the different national websites depends mostly on which level of integration is needed. The Decision Support Tool can be opened in a separate window, just having a link in the national website to the Vito server where the decision support tool is hosted, or can be opened in a internal frame of the national website looking to be part of it.

7 MAINTENANCE PLAN

7.1 Vehicle environmental rating

7.1.1 Feedback from stakeholders

Comments about Cleaner Drive's rating methodology, especially those concerning its technical merit, have generally been favourable. Most commentators have indicated that they believe the rating system gives a good representation of cars' relative environmental performance and that it compares favourably to alternatives that attempt to do the same.

A small minority of stakeholders have raised questions about the methodology's use of external costs, but in most cases these concerns have been allayed by explanations of how external costs are derived and of what effects they represent.

One or two stakeholders have also expressed reservations that the methodology uses Type Approval vehicle emissions data derived based on the New European Drive Cycle (NEDC) rather than 'real world' data. The reservations are either that 'cycle-beating' takes place, in which cars' ECUs (Engine Control Units) are programmed specifically to achieve low emissions on the NEDC rather than when in-use, or that new specially prepared vehicles will always perform better than those that are in-service and that may not have been maintained fully. However, upon consideration it is apparent that Type Approval data is the only data set available that covers all cars sold in Europe, and that in any case the objections to use of the NEDC would apply to any test cycle that became well established and influential.

In addition, as discussed previously, Cleaner Drive's Swiss and Belgian partners would prefer to have seen noise included in the methodology.

Despite the largely favourable comments about the rating methodology's technical merit, many manufacturers have made it clear that they do not desire to see any vehicle environmental rating methodology gain prominence and influence. This is because the production and marketing of cars is already a complicated and multi-faceted exercise, which manufacturers do not wish to see further complicated by an additional factor gaining prominence in buyers' decision making. This reaction from manufacturers was expected, however, and should not unduly influence future plans to use and promote the methodology.

A more detailed summary and analysis of stakeholder feedback on Cleaner Drive's environmental rating methodology is contained in Deliverable 4, submitted to DG TREN in October 2003.

7.1.2 Potential Areas for Further Development

The rating methodology will need to be periodically reviewed, and if necessary updated. In addition there are several areas in which further development could be beneficial:

1. The web-based Decision Support Tool (DST), which allows users to select cars according to various search criteria in order to view their environmental scores, should be expanded to encompass other European countries. At present, car environmental scores can only be seen online for the seven countries with Cleaner Drive websites: Austria, Belgium, France, Netherlands, Sweden, Switzerland, and the UK.

   To expand the scope of the DST to other countries would require vehicle emissions data in a specified format for the additional countries, but this should be relatively easy to obtain. The DST would have to be accessed through appropriate websites in each new country. These could be new or existing sites, but in either case the existence and availability of the DST would need to be appropriately marketed to the target audiences.

   One potential area of difficultly with expanding the DST to the 10 members of the EU that joined in May 2004 is that the model currently uses fuel cycle data from the EC MEET project, which did not cover the new members. Further research would be required to see how this problem could be overcome.

2. Moving to a single European vehicle emissions database. Each of the 7 countries that currently have websites linking to the DST obtain and prepare vehicle emissions databases independently. In 2002 Cleaner Drive engaged in talks with the Dutch organisation Rijks Dienst voorhet Wegverkeer (RDW) about purchasing a single database of Type Approval emissions data for all European countries. RDW already has such as database, but talks foundered over the cost of the data, largely because this would have been an unexpected cost that had not been budgeted for when the Cleaner Drive project was planned.

   The charges proposed by RDW may, however, be considered reasonable for a future project in which the costs were foreseen from the outset. Alternatively, there may be potential for a partnership approach with RDW, in which RDW would provide the necessary data and would receive a reciprocal benefit for its involvement with Cleaner Drive.

3. Noise. Noise is excluded from the rating methodology because the data available from the Type Approval test is not representative of in-use noise levels, partly because of the nature of the test itself. A new Type Approval noise test has been proposed, however, and if more representative data were to become available then the question of whether to include noise should be reconsidered.

   It should be noted that excluding noise from the methodology was a majority rather than unanimous decision; the consortium's Belgian and Swiss partners would have preferred noise to be included, partly because of the importance of vehicle noise to the Flemish Government and the Swiss Federal Roads Administration.

7.1.3 Future Uses of Cleaner Drive Rating Methodology

A major focus of any future work on Cleaner Drive's rating methodology and the DST should be in dissemination and encouraging more stakeholders to use the methodology.

Many policy makers believe that a car environmental label aimed at the mass-market should be based on CO_2 rather than on a composite indicator such as Cleaner Drive's. This is because environmental performance is not a key consideration for the majority of vehicle purchases but fuel cost is, so the direct relationship between CO_2 emissions and fuel costs should be stressed. There are, however, many other potential uses of Cleaner Drive's rating methodology:

1. The rating methodology provides an objective assessment of cars' relative environmental performance and as such is an ideal tool for policy makers to use as the basis for vehicle taxes, policies and subsidies.

2. The rating methodology should be promoted online and through other media to the significant minority of consumers that are interested in cars' environmental performance.

3. The rating methodology could be used as the basis of an endorsement, and perhaps a label, to be applied to cars that achieve a specified high environmental rating. NB: This would provide a different function from the CO_2 based label that is envisaged for all cars, and that will probably be mandatory in vehicle showrooms etc. An endorsement or label based on Cleaner Drive's rating methodology would apply only to a minority of vehicles, its use by manufacturers would be discretionary, and it is likely that it would be used by manufacturers to target consumer groups that are known to have a high level of environmental awareness.

7.1.4 Future Funding for Cleaner Drive

Additional funding will be required for any the tasks described above: updating the methodology; maintaining the DST; expanding the scope of the DST to other countries; expanding the scope of the methodology; or further work to promote and ensure widespread dissemination of the methodology.

The consortium has explored several possibilities for further funding, including seeking a partnership with a private-sector organisation, or the possibility of existing Cleaner Drive partners contributing to a centralised fund to undertake the above tasks. None of these options have proved fruitful, however, and it now appears that further work on the rating methodology and/or DST will only be possible if additional funding can be provided by the EC.

From Cleaner Drive's enquiries to date, it appears that the most likely route for EC funding would through an Intelligent Energy for Europe proposal under the 2004 call that will open in October 2004.

7.1.5 Practical Arrangements for Cleaner Drive Post-June 2004

Partners have agreed that no changes will be made to the rating methodology under the Cleaner Drive brand, as the existence of more than one “Cleaner Drive” vehicle rating methodology would undermine its authority.

The DST, which is based on VITO’s server, will continue to operate for all seven Cleaner Drive websites, barring any unforeseen technical problems. Should technical problems develop, partners would have to make financial arrangements directly with VITO to correct the problems. Alternatively, Cleaner Drive website partners have the option to replicate the DST on their own servers. To facilitate this, a disc containing the DST code has been circulated to all website partners.

7.2 Vehicle Decision support tool

7.2.1 Centralized version

In a centralized version of the decision support tool the database and the decision tool operates on one central server as it is hosted. Every user of the decision tool and the database has access to this server for running the decision tool via the internet.

7.2.1.1 Tasks for the hosting partner

The organisation hosting the server keeps the decision tool operational and updates the national databases, based on update information from the partners.
The decision support tool can be hosted on one place for all the partners. In this case the hosting organisation should be provided with a budget to do this, for all the partners that want to keep the DST operational.

<u>Database</u>
To keep the data up to date, regularly new data have to be provided. These data shall be supplied by the several partners in the project to the hosting partner.
The data are uploaded in a server which has to be kept free for this application.

<u>Decision support tool</u>
The software is installed on a server at the hosting organisation.
Also it has to be taken into account that the decision support tool shall be updated once in a predefined period, based on the experiences/remarks from users.

7.2.1.2 Tasks for the participating partners

Each partner has to provide the hosting organisation with the actual vehicle data. The update of the database should be done every half year. The database shall be in the prescribed format (vehicle record).

7.2.1.3 Pro's and con's

The decision tool is maintained by one partner, who is very well informed on the software programmes for running the tool. Adaptations can be done efficiently.
The database will stay uniform for all the participating countries. This makes an extension to other participating countries more easy.

With a centralized decision tool it is not possible to change the format to local/national requirements.

7.2.2 De-centralized version

In a de-centralized version of the decision tool each partner is running the software with the database on an own server. All the national vehicle databases with the tool to have access to it will be separated and operate autonomously.

7.2.2.1 Tasks for the participating partners

After the ending of the Cleaner Drive project when the DST will not be maintained centrally without funding, the participating partners will have to implement the DST and the databases behind on their own server.
It is the task for the participating partners to keep the decision tool operational and the database up to date. The software that is used in the decision tool is provided once by Vito to each partner in the Cleaner Drive project.

7.2.2.2 Pro's and con's

Each operator has to keep the database and tool operational.
Updating of the decision tool will be done by each of the partners; As a consequence of this the CD decision support tool will evolve different for each of the Cleaner Drive partners, which will end up in several versions of the decision tool.
Due to the de-centralized data base the missing information in a national database will not be filled up with data from other databases, as can be done when the database is centralized, by exchanging information between partners.

7.2.3 Software tools to make the decision tool operational

The attached CD-ROM contains all the necessary files to set up the decision tool hosted by interested partners in 4 folders.

7.2.3.1 Database

- The scripts to create all tables and stored procedures on an MS/SQL server 2000 are provided. Not MS/SQL server users, can use these scripts as a description of the database structure and functionality of the stored procedures.
- the logical database for the country dependent data = Cleanerdrive_XX
  script file : *database script Cleandrive_XX.sql*
  (XX can be replaced by your country code)
- logical database for the not country dependent reference data = Cleanerdrive_General.
  Script file : *database script Cleandrive_General.sql*
- more info in CD_databaseINFO.XLS
  - which stored procedures are used in which webpages and using which parameters
  - tables
- The most important table “Cdvehicle” has the same structure as the "vehicle record" (only make/model/variant are codes to be used with their reference tables)

7.2.3.2 Data

An excel-file in the “vehicle record” format can be loaded into the table XX (by using the MS/SQL server data transformation service)
Using table XX as a base, the reference tables cdmake, cdmodel and cdvariant can be filled with distinct values.
The table cdvehicle will be filled with the data from XX combined with the 3 reference tables.
Scripts for both actions are provided. Experience learned to first use test-tables for new data and perform all actions (as far as rating-calculation) on the cdvehicle test-table.
A third script is for updating the emissions and noise values if they are not between their boundaries.

7.2.3.3 Rating & other calculations

The software used for this calculations is Visual Basic (VB). The folders contain the VB-files. Not VB users can use the .frm files as a description of the functionality. The tables used in the calculation are the test-tables.

- fuel consumption by segment
  to calculate columns CDfuelcaversegm, CDfuelcurbsegm and CDfuelcexurbsegm
- environmental rating
  to calculate columns CDenvscairq, CDenvscghg and CDenvscav
- env. rating by segment & by fueltype
  to calculate columns CDenvscavseg, CDenvscairqseg, CDenvscghgseg, CDenvscavft , CDenvscairqft and CDenvscghgft

7.2.3.4 DST Website

The DST is based on Active Server Pages. All the pages (.ASP), the style sheet and images can be found on the folder.
The most important files are :

- Home page : CDhome
- "Search criteria" pages : CDfuel, CDcombcrit, CDsegment, Cdtechnology and CDmakemodel
- "Search result" page : CDLevel4
- Comparison of vehicles page : CDlevel5
- Vehicle detail page : CDlevel6 and CDlevel6_expert
- Dictionary : CDlanguages
- Style sheet : CDstylesheet.css
- Images : images folder

8 APPENDIXES

8.1 Appendix 1

CD ROM with DST and databases

8.2 Appendix 2

Review Report of the DST and website by EEA, Wouter De Ridder

EEA review of test web site www.cleaner-drive.co.uk and the Decision Support Tool (DST)

Reviewer: Wouter de Ridder
Date of Review: 25 July 2003
Position: Project manager transport and environment, European Environment Agency
Contact details: Wouter.de.Ridder@eea.eu.int (+45 3336 7135)

General Comments:
I think the tool is useful for potential car buyers, especially when the user interface will be developed further and would allow for more interactive choices. The project is interesting for the EEA, because of the role it plays as public/businesses information tool.

Detailed comments

I was requested to comment on a number of specific areas:

1. How well the DST communicates the subject
    a. is it laid out well and easy to understand,
    b. how easy is it to get the information required,
    c. is the information provided helpful and relevant and
    d. is there anything missing?
2. Is it clear what the DST is supposed to do for the user – and does it achieve this?
3. Does the DST appear to operate well or are there difficulties in using it?
4. Are there any gaps / improvements that should perhaps be covered in future work?

Before answering these specific questions with respect to the decision support tool (DST), I would like to analyse first what I think a DST should be: a tool (e.g. web based information system) providing the user of that tool with what he/she needs to make a proper decision. This decision concerns the purchase of (a) new vehicle(s).

People are able to buy cars *without* this tool. Personal preferences and some boundary conditions – like size and model of the car and the financial possibilities of the buyer – are usually the determining factors in the decision making process for both private persons and businesses. Only people with an interest in the environmental effects of driving cars are potential users for the DST. This *decision support tool* should therefore, in my view, aim to

1. add to these boundary conditions the environmental performance: for instance, when car A, B and C are equally preferred and alike in size and

price, then the environmental performance, added by the DST, will contribute to make a 'cleaner' decision; and/or

2. alter the boundary conditions by proposing cars that (in terms of weight, size, price) come close to the initial selection made by the potential buyer, whereby the environmental benefit of such alternative proposal will be presented (and perhaps even the financial benefit when calculating the costs of the car over the user period, taking into account average annual mileage etc.): for instance, when car A, B and C are being compared on environmental performance, car D – same weight/size class but scoring better in environmental performance than A, B or C – is also shown (and perhaps car E, which is more expensive but significantly less fuel consuming, which results in the same costs in the purchase and use period).

There might be more functions that can be fulfilled with the DST, but I just point out these two above as being the two most relevant ones. Thus, I assess the usefulness of the DST against this background.

1. How well the DST communicates the subject

a. Is it laid out well and easy to understand?

No. The entry of the data base is making a selection of fuel type, fuel consumption etc. I would assume users to be more interested in being able to make a selection of 1–5 vehicles and compare the environmental performance. This option cannot be selected from the entry point of the business view or personal view. It only becomes visible when a selection of vehicles has been shown, meaning that a number of 'decisions' have already been made (e.g. which model/make, fuel type/consumption, environmental criteria, technology). This lowers the usefulness of the *decision supporting* tool.

b. How easy is it to get the information required?

Not that easy (see above). The ease to retrieve relevant information would increase when the user interface would allow quick access to the vehicle database. It should be made easier to compare a certain Mercedes, with a certain Ford and Opel. Creating a 'tree' structure could do this: first show brands and only show the brands' models when the users click on that brand.

c. Is the information provided helpful and relevant?

Yes: the information in the database – but also the additional information available on the web – is useful. But, as it stands now it takes significant efforts to retrieve exactly that selection of information that the user is looking for.

d. Is there anything missing?

Yes: the functionality of the DST could be merged with the financial tool available on the web site, as I think that would help the user in making a decision on which car to buy. Users can compare cars within the same category of weight and size, given a certain use period and average annual mileage in this period, for the total cumulative costs over the use period. The DST informs the user about the purchase costs and an approximation of total cumulative fuel costs and road tax, and the environmental 'costs' (total emissions). In addition, the DST could also try to propose e.g. cars that run on alternative fuels or cars that comply with more

stringent emission standards. By doing so, users are informed about the extra costs (or not, when fuel saving are significant) when buying a cleaner car.

2. Is it clear what the DST is supposed to do for the user – and does it achieve this?

Yes. From the introductory text on the web site it becomes clear to me what the DST is supposed to do. However, I doubt that the DST can provide such service in the way it is currently presented on the web site. The actual *decision support* element of the web site should be strengthened, by facilitating the user better in the comparison of various cars (see also my answers to the first question).

3. Does the DST appear to operate well or are there difficulties in using it?

The DST does not operate well in supporting users in making a decision on which car to buy. In my opinion, the main reason for that is the relative complex way of selecting 4–5 cars in which a user is potentially interested, which are most likely several brands and models, of more or less equal weight, size and price. In addition, the missing link between the financial calculator and the environmental rating tools further limits in my opinion the usefulness of the tool in supporting decision-making.

4. Are there any gaps / improvements that should perhaps be covered in future work?

I identified several aspects missing / or subject to improvement:
- A link between the financial calculator and the environmental rating tool;
- Easier access to making a selection of vehicles for which the environmental performance will be shown;
- More ‘intelligence’ from the DST, by proposing to the user other types of cars that come close the user’s selection in terms of weight, size and price category, but with higher environmental performance.
- The database should be extended with trucks and small delivery vans – this would be very useful for the business tool.

Previously made comments (slightly changed to make them clearer):

- The environment-rating tool is rather slow when it retrieves all the information required to show all vehicles that are stored in the database. It might be worthwhile showing a "Please wait" message or something alike, or to allow for making the selection of vehicles in another way, circumventing polling the database for thousands of vehicles.
- Selecting a certain car (e.g. Ford Focus) and checking its environmental performance against some other car (e.g. Ford Mondeo) is not very straightforward because both car types are not easy to find in the large database. Searching for a certain car and type of car should be made easier and quicker. I also think it would be helpful to allow users to select fuel type

after choosing the vehicle type, so that users can compare the environmental performance of different "fuel versions" of a certain car type/model (e.g. diesel/LPG/petrol of the Ford Focus).

- To increase the "fun" of playing with the database it might be interesting to allow users to enter some (more) personal information (e.g. average number of kilometres driven annually and number of years one aims to use the same car) and to use this information to estimate the overall environmental (and fuel) savings per year of one vehicle type compared with another (types to be selected by the users). In that way, one can select a few car models/types and look for the best performing vehicles/fuels within the required class.
- It would be useful to put the description of the used methodology to rate the environmental performance of cars more upfront on the web site. Within this description it should also be made clear what is *not* included in the rating calculation (e.g. the vehicle production emissions). The sources of the data should also be made clear, i.e. tailpipe data is from type approval (mostly supplied by vehicle manufacturers).
- The financial calculator included in the business view should also be included in the personal view.
- It would be useful to include other hints/tips, etc. example check tyres inflated properly (quantify savings), regular maintenance, effect of driving style (link to the eco-driving project, http://www.ecodrive.org/), etc.

8.3 Appendix 3

Log book remarks

Date	By	Stakeholder	Medium	Remark
15/01/03	EST, Bob Saynor	CD partner	Meeting	Skip the first page: people should go immediately to a default language and database
31/01/03	AEAT, Nikolas Hill	CD partner	mail	UK-tool cost calculation should be linked to the DST
31/01/03	AEAT, Nikolas Hill	CD partner	mail	Market class should be front end selection criterium
31/01/03	AEAT, Nikolas Hill	CD partner	mail	Vehicle sheet: reduce information to make it more clear, clear denomination of selected vehicle necessary
18/03/03	Leen Govaerts	CD partner	Mail	possibility to select on 'technology bifuelled vehicle' (integration T6)
08/04/2003	EST, Bob Saynor	CD partner	Mail	Under 'Environmental Score' we can't choose options under 'local air quality emissions' or under 'greenhouse gas emissions'. Is this deliberate?
22/05/2003	e-mobile, Urs Schwegler	CD partner	Mail	think the tool is not very userfriendly. But this is mainly due to the complexity of the matter. only well educated people will use it, common people will rather use a simple and rough energy label.
22/05/2003	e-mobile, Urs Schwegler	CD partner	Mail	The "well educated people" might appreciate the background of the calculation model. As an alternative you could show the Excel sheet on the website
22/05/2003	e-mobile, Urs Schwegler	CD partner	mail	a environmental decision tool for heavy duty vehicles doesn't make sense, why don't you just remove the heave duty vehicles from the vehicle type list? Regarding the test run of the website by stakeholders I would even suggest to remove all vehicle types for the moment (as long as they are implemented).
13/06/2003	CD consortium		Meeting Stockholm	Maximise pages detailed environmental info
26/06/2003	Vito, Sabine Roels		tel	'how clean is your car, compare environmental rating scores' is a gif that is not translated in all languages, thus this stays in english in the national sites in which the DST is included
26/06/2003	Vito, Leen Govaerts			Selection national database: should be clear for consumers on every page which dbase he's searching.
26/06/2003	Vito, Leen			Completeness of data: calculate CO2 from fuel consumption if available
26/06/2003	Vito, Leen			Different units for expressing fuel consumption causes mistakes (km/l and l/100km)
15/07/03	User (BE)	Fleetowner		Too complex to find most environmental car in certain segment
01/09/2003	Vinnova, Hans	CD		There is an English heading that is independent of language choice. "How clean is your car? Compare..." It is not a big problem in itself to have an English heading but space is a problem. Would it

				be possible to reduce/eliminate the heading in order to save space for more dynamic information?
01/09/2003				2) In general - is it possible to change size of columns in tables and similar in order to save space? As you might know, we have not all data in the Swedish database and consequently some empty columns are displayed.
01/09/2003				3) First page in the DST gives the user possibility to select language and vehicle database. Maybe it would be good to have an information on this page (preferably in all languages) telling something like: "Please select language (upper row) and country of vehicle database(lower row)"
05/09/03	e-mobile, Urs	Other		got some feedbacks, that the window showing the results in the DST (http://www.cleaner-drive.ch/howclean/index.cfm) is too small. Couldn't you change the width so that you can see the whole page (e.g. comparison of 5 vehicles) without scrolling?
05/09/03	Focus group EST	?	Focus group EST	There is a lack of coverage of bigger, commercial vehicles on the site with the majority of emphasis being on smaller vehicles and vans
05/09/03				It would be beneficial to be able to search just by vehicle category e.g. MPV
05/09/03				The DST is confusing - It would be useful to have a novice users guide to the DST
16/10/03		CD partner	Cleaner Drive QM	Cookies hinder people from entering the website (both DST and main site). This is because some Internet options refuse cookies
16/10/03				The time for downloading pages is too long
16/10/03				Database not complete and not up to date
16/10/03				Prototypes should not be included
16/10/03				frame is too small. Removing pictures would provide more space. The restriction on the size of the DST frame relates to constraints set by Reading Room. A possible solution would be to allow the DST to open in a new, full window, especially when in the long term the individual national websites will have a different look and feel.
16/10/03				On the opening vehicle data screen, it would be best to offer less detail, with a second link to a page offering more specific vehicle information
16/10/03				The environmental score link on the opening screen must be made clearer else users may miss it.
16/10/03				There is a need to make the environmental score much clearer on all vehicle detail screens
16/10/03				It would be good to able to cross compare vehicles from a differing market

				class of vehicle. At the moment, you can only easily compare vehicles within the same market class
16/10/03				It needs to be made clear that users must select the relevant language and country database before using the DST
16/10/03				The market class is an important aspect of the DST. It will have to be made more prominent in the second version of the DST
20/11/03	EEA, Wouter De Ridder	expert	Review DST	user interface will be developed further and would allow for more interactive choices
20/11/03				Not laid out well ande easy to understand. The entry of the data base is making a selection of fuel type, fuel consumption etc. I would assume users to be more interested in being able to make a selection of 1–5 vehicles and compare the environmental performance. The ease to retrieve relevant information would increase when the user interface would allow quick access to the vehicle database
20/11/03				the functionality of the DST could be merged with the financial tool available on the web site
20/11/03				More 'intelligence' from the DST, by proposing to the user other types of cars that come close the user's selection in terms of weight, size and price category, but with higher environmental performance
20/11/03				The database should be extended with trucks and small delivery vans – this would be very useful for the business tool.
20/11/03				The environment-rating tool is rather slow when it retrieves all the information required to show all vehicles that are stored in the database. It might be worthwhile showing a "Please wait" message or something alike, or to allow for making the selection of vehicles in another way, circumventing polling the database for thousands of vehicles.
20/11/03				To increase the "fun" of playing with the database it might be interesting to allow users to enter some (more) personal information (e.g. average number of kilometres driven annually and number of years one aims to use the same car) and to use this information to estimate the overall environmental (and fuel) savings per year of one vehicle type compared with another (types to be selected by the users)
12/12/03			Rating workshop	Biofuel: link to biofuel information page on all detail page
07/01/04	Infovel, Nico	partner	mail	Field transmission (A/M) on results page

8.4 Appendix 4

Summary of remarks – functional and technical analysis solutions – changes implemented in version 2 DST

Remark		Solution	Functional analysis	Technical analysis	Action
Complexity of information and user friendliness	1	Open DST in new window full screen	OK. Integration with UK-site unnecessary on long term. Consequences for all websites to be discussed on project meeting.	OK	Implement version 2
	2	Reduce number of search possibilities see Figure 4	Not OK. Essential decision of DST1. Remove criterion 'environmental score' and replace with search market segment	?	Implement version 2 'market segment'
	3	Search results (see Figure 5) , too many fields, remove 'commercial name'	OK.	ok	Communicate to partners on update databases (JV)
	4	'shopping basket' of vehicles	Good idea, to be investigated technically	Two possibilities: search make/model double or real shopping basket	Implement option 2 (double search make/model)
	5	Reduce information on vehicle detail sheet, see Figure 6	Not OK. Leave all info but prioritise.	-	-
	6	More clear color 'detail emissions and fuel consumption' see Figure 6	OK	ok	Implement version 2
	7	Choose database and language not clear	Sentence 'choose…'	Ok. Possibilities are investigated	Implement version 2
	8	Speed: too slow when searching a long list	To check.	Max 15 sec	Communicate to parnters (LG) OK
	9	Compare vehicles & detail vehicle not good for printing	To check.	OK	-
	10	Language mistakes	Ask partners to send them to VITO Italian: see logbook remarks VEL2	ok	JV: update adjustments in language matrix and send around to partners
Interactivity	11	Possiblity to fill in own data – possible filling up of databases	Not feasible in budget of Cleaner Drive	-	-
Information	12	Direct links from DST to information pages	Not possible.	-	-
	13	Link to information	Not necessary	-	-

		on calculation of environmental score ?			
Databases – completeness and correctness	14	Different units lead to mistakes	Standard unit not possible	-	-
	15	Segments	To be filled in by partners.	-	-
	16	Possibility of calculating fields	To be filled in by partners	-	-
	17	Data on costs and subsidies	Out of range of DST	-	-
	18	Purchase price (combined criteria): use correct currency (CH Franc)	To be checked.	All currencies are supported	

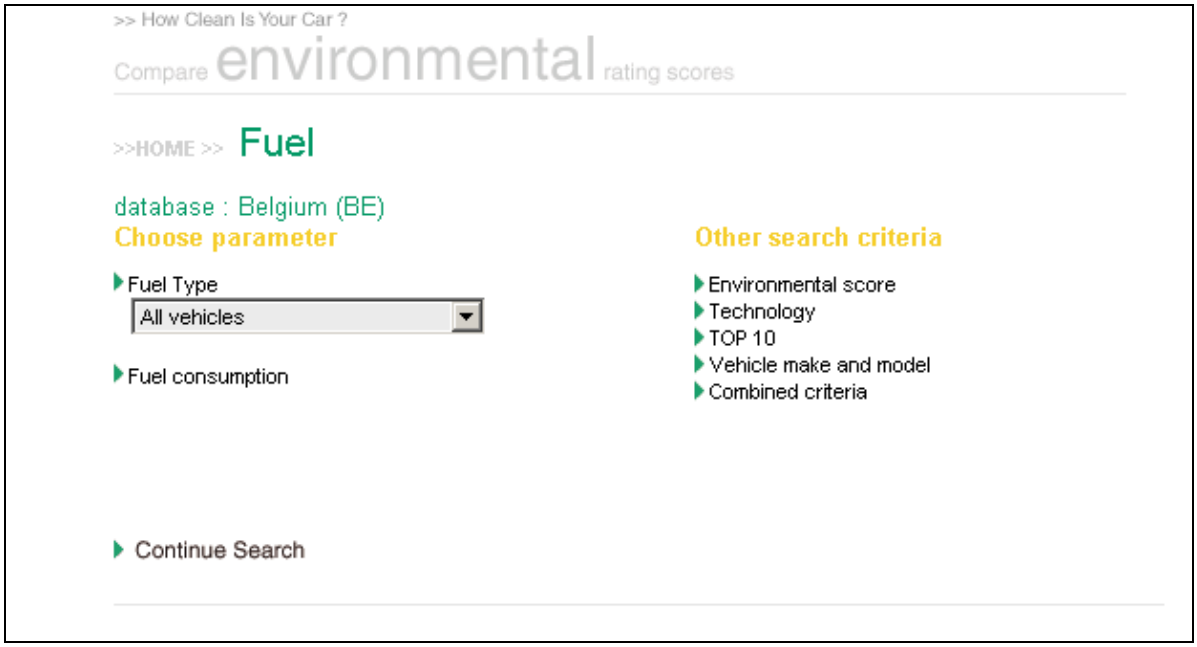


Figure 4 Search Vehicles

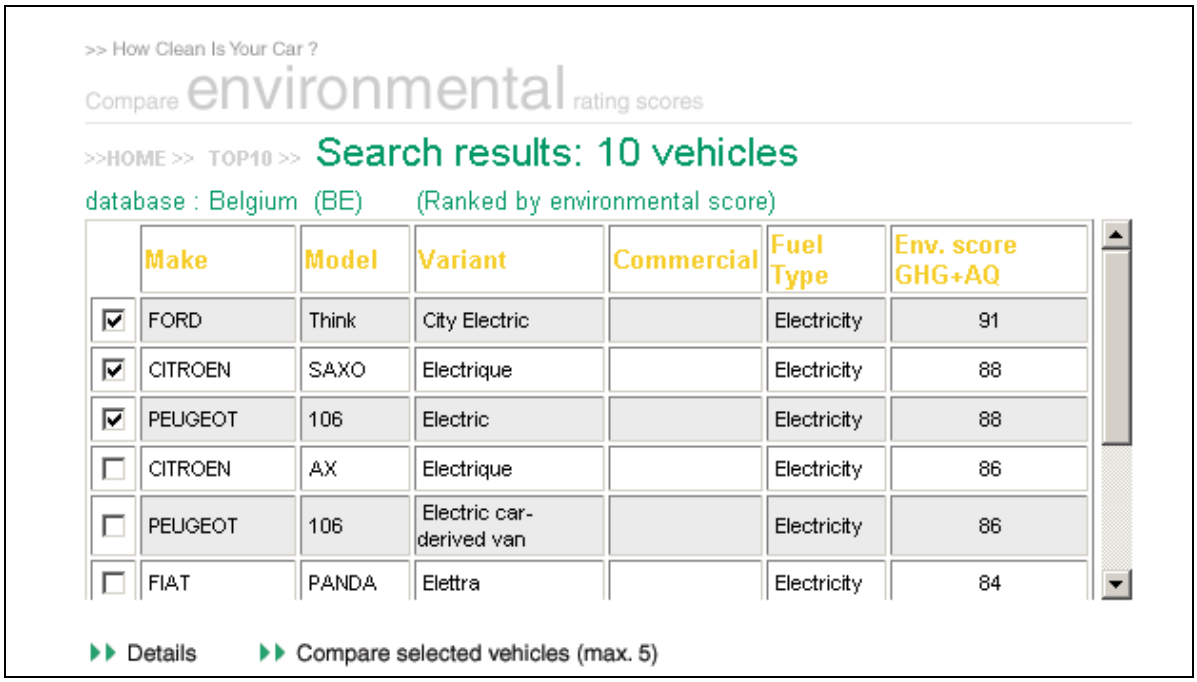


Figure 5 Search results

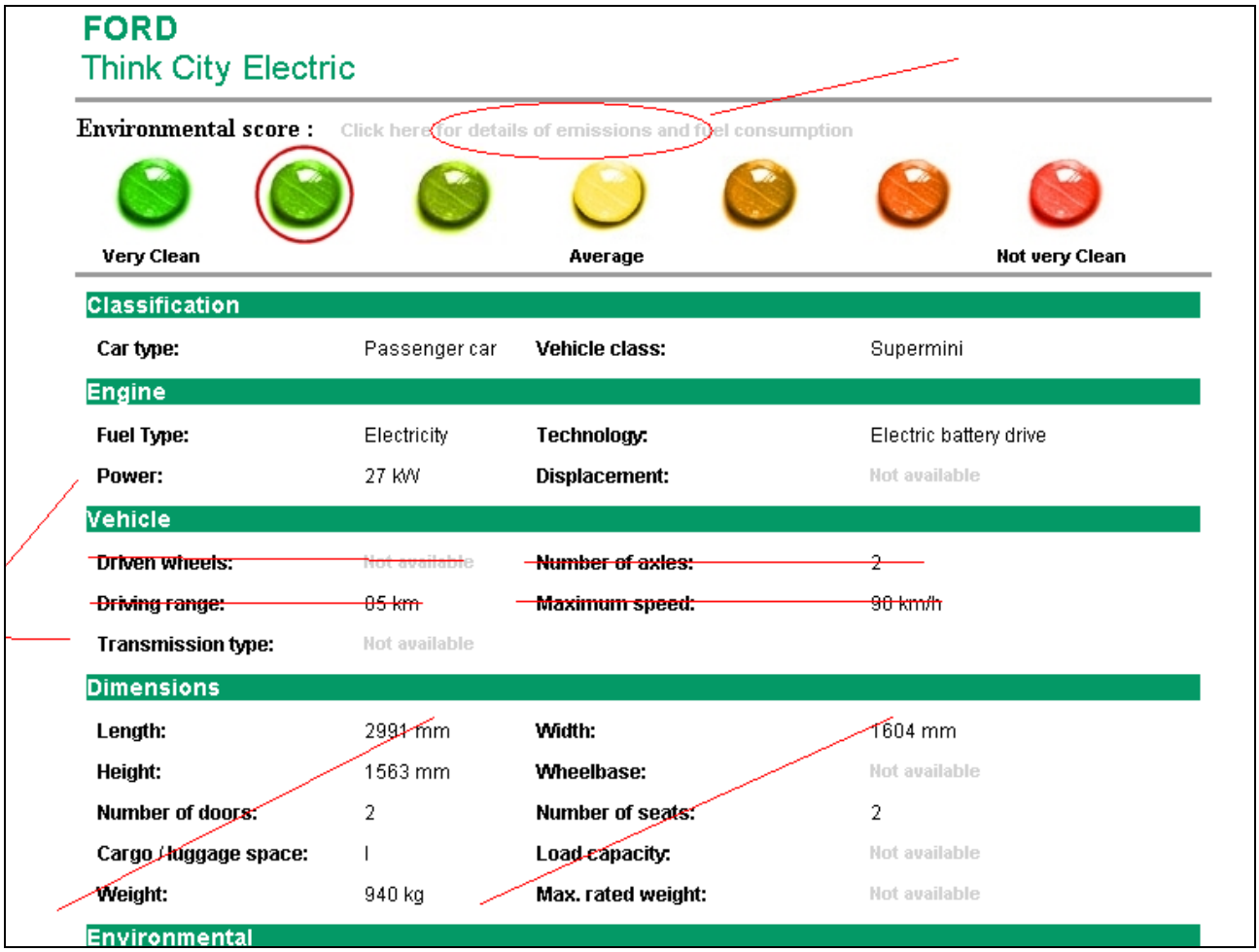


Figure 6 Vehicle detail sheet

8.5 Appendix 5

Vehicle record

Field	*Name*	*Selection*	*Vehicle Parameter*	*unit*	*Min value*	*Max value*	*Format*	*Max. length*	*E.g.*
Denomination									
Den1	CDmake	X	Make				Text	20	BMW
Den2	CDtype	X	Model or type				Text	20	X5
Den3	Cdvariant	X	Variant				Text	15	Station-Wagon
Den4	CDversion	X	Version				Text	15	
Den5	CDengine		Engine				Text	15	4.4i V8
Den6	CDcommercial		Commercial name				Text	20	44kW 5d TDI
Classification									
Cla1	CDkind	X	Car kind				Code		M1
Cla2	CDsegment	X	Segment				Code		S12
Type Approval									
App1	CDtacountry		Country code TA				Text	20	
App2	CDtamake		Make code TA				Text	20	
App3	CDtanumber		Number TA				Text	10	
Engine									
Eng1	CDtechnology	X	Technology				Code		T3
Eng2	CDdispl	X	Displacement	cm^3			Number		4398
Eng3	CDpowermax	X	Max. Power	kW			Number		210
Eng4	CDpowernom		Power at nom. rpm	kW			Text	15	210 at 4500rpm
Eng5	CDinjection		Fuel injection				Text		
Energy									
Ene1	CDfuel	X	Fuel type				Code		F1
Ene2	CDautonomy		Autonomy/Range	Km			Number		-
Vehicle									
Veh1	CDdriven		Driven wheels				Code		D1
Veh2	CDaxles		Number of axles				Number		2
Veh3	CDtranstype		Transmission type				Text	15	Automatic
Veh4	CDmaxspeed		Maximum speed	Km/h			Number		220

Dimensions									
Dim1	CDlength		Length	mm			Number		4159
Dim2	Cdwidth		Width	mm			Number		1714
Dim3	CDheight		Height	mm			Number		1500
Dim4	CDwheelb		Wheelbase	mm			Number		2566
Dim5	CDdoors		Number of doors				Number		5
Dim6	CDseats		Number of seats				Number		5
Dim7	CDcargo		Cargo/luggage space	l			Text	15	750
Dim8	CDweight	X	Weight	Kg			Number		
Dim9	CDmaxweight		Maximum rated weight	Kg			Number		
Dim10	CDloadcap		Load capacity	Kg			Number		
Environmental									
Env1	CDemissionstd	X	Emission standard				Number		3
Env2	*CDenvscav*	*X*	*Environmental score average*				Number		
Env3	*CDenvscairq*	*X*	*Environmental score air quality*				*Number*		
Env4	*CDenvscghg*	*X*	*Environmental score greenhousegas*				*Number*		
Env5	*CDenvscavseg*		*Environmental score average segment*				*Number*		
Env6	*CDenvscairqseg*		*Environmental score air quality segment*				*Number*		
Env7	*CDenvscghgseg*		*Environmental score greenhousegas segment*				*Number*		
Env8	*CDenvscavft*		*Environmental score average fuel type*				*Number*		
Env9	*CDenvscairqft*		*Environmental score air quality fuel type*				*Number*		
Env10	*CDenvscghgft*		*Environmental score greenhousegas fuel type*				*Number*		
Env11	CDco2urb		CO_2-emission	g/km or g/kWh			Number		
Env12	CDco2exurb			g/km			Number		
Env13	CDco2aver			g/km			Number		
Env14	CDhc		HC-emission	g/km	0	0,29	Number		
Env15	CDnox		NO_x-emission	g/km	0	0,78	Number		
Env16	CDhcnox		HC + NO_x-emission	g/km or g/kWh	0	0,86	Number		

Env17	CDco		CO-emission	g/km or g/kWh	0	5,22	Number		
Env18	CDch4		CH_4-emission	g/km or g/kWh			Number		
Env19	CDnmhc		NMHC-emission	g/km or g/kWh			Number		
Env20	CDpm		PM-emission	g/km or g/kWh	0	0,1	Number		
Env21	CDfuelcurb		Fuel consumption (urban cycle)	l/100 km or Nm^3/100km or l/kWh			Number		12
Env22	CDfuelcexurb		Fuel consumption (extra-urban cycle)	l/100 km or Nm^3/100km or l/kWh			Number		10
Env23	CDfuelcaver	X	Fuel consumption Average	l/100 km or Nm^3/100km or l/kWh			Number		11
									17
Env24	*CDfuelcaversegm*		*Fuel consumption segment Average*	*l/100 km or Nm^3/100km or l/kWh*			*Number*		
Env25	*CDfuelcurbsegm*		*Fuel consumption segment urban*	*l/100 km or Nm^3/100km or l/kWh*			*Number*		
Env26	*CDfuelcexurbsegm*		*Fuel consumption segment extra-urban*	*l/100 km or Nm^3/100km or l/kWh*			*Number*		
Env27	*CDfuelcaverft*		*Fuel consumption fuel type Average*	*l/100 km or Nm^3/100km or l/kWh*			*Number*		
Env28	*CDfuelcurbft*		*Fuel consumption fuel type urban*	*l/100 km or Nm^3/100km or l/kWh*			*Number*		
Env29	*CDfuelcexurbft*		*Fuel consumption fuel type extra-urban*	*l/100 km or Nm^3/100km or l/kWh*			*Number*		
Env30	CDelencurb		Energy consumption (urban cycle)	kWh/100 km			Number		

Env31	CDelencexurb		Energy consumption (extra-urban cycle)	kWh/100 km			Number		
Env32	CDelencaver		Energy consumption Average	kWh/100 km			Number		
Env33	CDnoisedb		Noise – drive-by	dBa	50	100	Number		
Env34	CDnoisestat		Noise – stationary	dBa	50	100	Number		
Financial									
Fin1	CDlistprice	X	List price excl. VAT	EUR			Number		
Fin2	CDvat		Purchase tax	EUR			Number		
Fin3	*CDanntax*		*Vehicle tax*	*EUR*			*Number*		
Fin4	CDtaxclass		Tax class	Fiscale PK			Number		
Fin5	CDincent		Incentives	EUR			Number		
Fin6	CDusedprice		Used price 5 year	EUR			Number		
Fin7	Cdmaintc		Maintenance costs	EUR			Number		
Fin8	Cdmainto		Maintenance occurrence	Km			Number		
Fin9	CDinsur		Insurance	EUR/a			Number		
Fin10	CDleas		Leasing	EUR/ month			Number		
Miscellaneous									
Mis1	CDdoi		Date of introduction	Model Year			date		10/05/2000
Mis2	CDcountry	X	Country(nationality database)				Code	2	BE
Mis3	CDpic		Picture				text	20	
Mis4	CDavailability		Availability				Code	15	Purchase, proto
Mis5	CDupdate		Last updated on	Dd/mm/yyyy			Date		18/10/2002
Mis6	CDsource		Data source				Text	30	EMIS-tabellen
Mis7	CDsourceemis		Data source				Text	30	

parameters necassary for selection from vehicle database
the parameters in Italics will be calculated from other parameters

Segmentation

RT-Segment_CrossReference

Cleaner Drive		***EuroNCAP***	***Febiac***	***English***
		http://www.euroncap.com/results.htm		
Kind (*)	Segment			
M1	S11	Supermini		Supermini
			A	Little city car
			B	Little utility car
	S12	Small family car		Small family car
			C	Little family car
			G	Little break
	S13	Large family car		Large family car
			D	Medium family car
			E	Big family car
			H	Medium break
			I	Big break
			O	Medium monovolume
	S14	Mini multi purpose vehicles		Mini multi purpose vehicles
			N	Little monovolume
	S15	Multi purpose vehicles (MPV)		Multi purpose vehicles (MPV)
			P	Big monovolume
	S16	Executive car		Executive car
			F	Big Limousine
			J	Coupé
			K	Cabrio
	S17	Roadster		Roadster
			L	Roadster
			M	Ultra sport
	S18	Off roader		Off roader
			R	Off road car
M2	S21			
M3	S31			City bus
	S32			Touring bus
N1	S41			Van
	S42			Minitruck
N2	S51			
N3	S61			

Calculated values

Calculated Values

	Formula		*Description*
Energy			
CDautonomy	(CDfuelcaver * CDfuelstor) + (CDelencaver * CDelstor) Afhankelijk van land hoe te berekenen!!!!	Integer	The maximal driving range a vehicle can achieve without refuelling.
Environmental			
Emissions			
CDenvscav	See 'environmental rating reference tables_johan.xls'	Integer	
CDenvscairq	See 'environmental rating reference tables_johan.xls'	Integer	
CDenvscghg	See 'environmental rating reference tables_johan.xls'	Integer	
CDenvscavseg	((CDenvscav-(sum CDenvscav of all vehicles within the same CDsegm / number of vehicles within same CDsegm))/(sum CDenvscav of all vehicles within the same CDsegm / number of vehicles within same CDsegm))*100	Integer	The relative difference [%] of Environmental Score with the segment average.
CDenvscairqseg	((CDenvscairq-(sum CDenvscairq of all vehicles within the same CDsegm / number of vehicles within same CDsegm))/(sum CDenvscairq of all vehicles within the same CDsegm / number of vehicles within same CDsegm))*100	Integer	The relative difference [%] of AirQuality Score with the segment average.
CDenvscghgseg	((CDenvscghg-(sum CDenvscghg of all vehicles within the same CDsegm / number of vehicles within same CDsegm))/(sum CDenvscghg of all vehicles within the same CDsegm / number of vehicles within same CDsegm))*100	Integer	The relative difference [%] of GHG Score with the segment average.
CDenvscavft	((CDenvscav-(sum CDenvscav of all vehicles within the same CDfuel / number of vehicles within same CDfuel))/(sum CDenvscav of all vehicles within the same CDfuel / number of vehicles within same CDfuel))*100	Integer	The relative difference [%] of Environmental Score with the fuel type average.
CDenvscairqft	((CDenvscairq-(sum CDenvscairq of all vehicles within the same CDfuel / number of vehicles within same CDfuel))/(sum CDenvscairq of all vehicles within the same CDfuel / number of vehicles within same CDfuel))*100	Integer	The relative difference [%] of AirQuality Score with the fuel type average.
CDenvscghgft	((CDenvscghg-(sum CDenvscghg of all vehicles within the same CDfuel / number of vehicles within same CDfuel))/(sum CDenvscghg of all vehicles within the same CDfuel / number of vehicles within same CDfuel))*100	Integer	The relative difference [%] of GHG Score with the fuel type average.
			het is misschien verstandig hier zes velden aan de vehicle record toe te voegen, met daarin de gemiddelden voor de emissiewaarden per segment en brandstoftype dit maakt de bovenstaande formules iets overzichtelijker ik heb nu met een kleurtje gewerkt in een poging om het duidelijker te maken
Fuel economy			
CDfuelcaversegm	sum CDfuelcaver of all vehicles within the same CDsegm and CDfuel / number of vehicles within same CDsegm and CDfuel	Integer	The average 'average fuel consumption' of all the vehicles driving on the same fuel within the same segment.(multiply with -1 for

			fuel consumption given in mpg and km/l)
CDfuelcurbsegm	sum CDfuelcurb of all vehicles within the same CDsegm and CDfuel / number of vehicles within same CDsegm and CDfuel	Integer	The average 'urban fuel consumption' of all the vehicles driving on the same fuel within the same segment.(multiply with -1 for fuel consumption given in mpg and km/l)
CDfuelcexurbsegm	sum CDfuelcexurb of all vehicles within the same CDsegm and CDfuel / number of vehicles within same CDsegm and CDfuel	Integer	The average 'extra urban fuel consumption' of all the vehicles driving on the same fuel within the same segment.(multiply with -1 for fuel consumption given in mpg and km/l)
CDfuelcaverft	((CDfuelaver-CDfuelcaversegm)/CDfuelcaversegm)*100	Integer	The relative difference [%] of average fuel consumption with the segment average.(multiply with -1 for fuel consumption given in mpg and km/l)
CDfuelcurbft	((CDfuelcurb-CDfuelcurbsegm)/CDfuelcurbsegm)*100	Integer	The relative difference [%] of urban fuel consumption with the segment average.(multiply with -1 for fuel consumption given in mpg and km/l)
CDfuelcexurbft	((CDfuelcexurb-CDfuelcexurbsegm)/CDfuelcexurbsegm)*100	Integer	The relative difference [%] of extra-urban fuel consumption with the segment average.(multiply with -1 for fuel consumption given in mpg and km/l)

8.6 Appendix 6 – Cleaner Drive Partners

The Cleaner Drive project consists of the following partners organisations:

- ADEME, France;
- CETE Lyon, France;
- CETE NP, France;
- DITS, Italy;
- E'mobile, Switzerland;
- European Natural Gas Vehicle Association, Netherlands/Europe-wide;
- Energy Saving Trust, UK;
- Technical University of Vienna, Austria;
- Fondazione VEL (formerly InfoVEL), Switzerland;
- NOVEM, Netherlands;
- OMV AG, Austria;
- TNO, Netherlands;
- VINNOVA, Sweden;
- VITO, Belgium;
- VTT, Finland.

The project is funded be the European Commission DG TREN and national organisations.

8.7 Appendix 7 - External Costs

Greenhouse Gas Emissions
The external cost value for CO_2 has been taken as the upper value from the ExternE study for the European Commission. CO_2 equivalent €/g values may be calculated for methane and nitrous oxide by using their Global Warming Potentials. Since the greenhouse gases are global pollutants, a single external cost value is appropriate, independent of the origin of emission.

Table A2.1: Greenhouse Gas External Costs

	CO2	CH4	N2O
GWP	1	21	310
Cost, €/g	0.000046	0.000966	0.01426

Air Quality Emissions
External cost values for air Quality pollutants are taken from a database produced as an extension to ExternE EC DG Environment (BeTa Benefits Table database: Estimates of the marginal external costs of air pollution in Europe; AEAT 2002).

Table A2.2: Urban Air Quality External Costs

Urban	Cost, €/g				
	SO2	NOx	VOCs	CO	PM10
Austria	0.01500	0.00680	0.00140	3.38E-06	0.12600
Belgium	0.01570	0.00470	0.00300	3.65E-06	0.13320
Denmark	0.01110	0.00330	0.00720	4.35E-06	0.11826
Finland	0.00877	0.00150	0.00049	3.23E-06	0.11466
France	0.01520	0.00820	0.00200	3.48E-06	0.12690
Germany	0.01390	0.00410	0.00280	3.62E-06	0.12780
Greece	0.01190	0.00600	0.00093	3.31E-06	0.12042
Ireland	0.01040	0.00280	0.00130	3.37E-06	0.11709
Italy	0.01280	0.00710	0.00280	3.62E-06	0.12420
Luxembourg*	0.01570	0.00470	0.00300	3.65E-06	0.13320
Netherlands	0.01480	0.00400	0.00240	3.55E-06	0.12960
Portugal	0.01080	0.00410	0.00150	3.4E-06	0.11862
Spain	0.01150	0.00470	0.00088	3.3E-06	0.12051
Sweden	0.00950	0.00260	0.00068	3.26E-06	0.11493
Switzerland**	0.01500	0.00680	0.00140	3.38333E-06	0.12600
UK	0.01230	0.00260	0.00190	3.47E-06	0.12213
EU-15 average	0.013	0.0042	0.0021	3.5E-06	0.126

*assumed to be the same as Belgium in the absence of other data
**assumed to be the same as Austria in the absence of other data

Table A2.2: Extra-Urban Air Quality External Costs

Rural/Extra-urban	Cost, €/g				
	SO2	NOx	VOCs	CO	PM10
Austria	0.00720	0.00680	0.00140	0.00000	0.01260
Belgium	0.00790	0.00470	0.00300	0.00000	0.01980
Denmark	0.00330	0.00330	0.00720	0.00000	0.00486
Finland	0.00097	0.00150	0.00049	0.00000	0.00126
France	0.00740	0.00820	0.00200	0.00000	0.01350
Germany	0.00610	0.00410	0.00280	0.00000	0.01440
Greece	0.00410	0.00600	0.00093	0.00000	0.00702
Ireland	0.00260	0.00280	0.00130	0.00000	0.00369
Italy	0.00500	0.00710	0.00280	0.00000	0.01080
Luxembourg*	0.00790	0.00470	0.00300	0.00000	0.01980
Netherlands	0.00700	0.00400	0.00240	0.00000	0.01620
Portugal	0.00300	0.00410	0.00150	0.00000	0.00522
Spain	0.00370	0.00470	0.00088	0.00000	0.00711
Sweden	0.00170	0.00260	0.00068	0.00000	0.00153
Switzerland**	0.00720	0.00680	0.00140	0.00000	0.01260
UK	0.00450	0.00260	0.00190	0.00000	0.00873
EU-15 average	0.0052	0.0042	0.0021	3.5E-07	0.0126

*assumed to be the same as Belgium in the absence of other data
**assumed to be the same as Austria in the absence of other data

8.8 Appendix 8 - Vehicle Emission and Fuel Quality Standards

CONTENTS

Emission Limits for Passenger Cars (Directive 98/69/EC)
Emission Limits for Light Commercial Vehicles (Classes N1, N2 and N3)
Emissions Limits for Heavy Duty Vehicles
Relevant Fuel Specification Limits:

Emission Limits for Passenger Cars (Directive 98/69/EC)

The following tables give current and future emission limits for passenger cars in grams per km.

Table A3.1: Emission Limits for Cars not exceeding 2.5 tonnes laden [(a)]

Euro Standard	No. Seats	Fuel Type	CO	HC	NO_x	HC + NO_x	PM	As from [(b)]:
EURO III	up to 9	Petrol	2.30	0.20	0.15	N/A	N/A	01/01/00
	up to 9	Diesel	0.64	N/A	0.50	0.56	0.05	01/01/00
	Note (c)	Diesel	0.80	N/A	0.65	0.72	0.07	01/01/01
	Note (d)	Diesel	0.95	N/A	0.78	0.86	0.10	01/01/01
EURO IV	up to 9	Petrol	1.00	0.10	0.08	N/A	N/A	01/01/05
	up to 9	Diesel	0.50	N/A	0.25	0.30	0.025	01/01/05

Notes:

a) "Euro 3 and 4" (Directive 98/69/EC).
b) The above dates refer to new vehicle types; dates for new vehicles are 1 year later.
c) Temporary concession for diesel cars over 2.0 tonnes laden weight which are off road or >6 seats (unladen weight from 1206 to 1660 kg). Concession ceases on 31/12/02.
d) Temporary concession for diesel cars over 2.0 tonnes laden weight which are off road or >6 seats (unladen weight over 1660 kg). Concession ceases on 31/12/02.

Table A3.2: Emission Limits for Heavy Motor Car (more than 2.5 tonnes laden). Unladen weight between 1151 and 1600 kg.[(a)]

Euro Standard	No. Seats	Fuel Type	CO	HC	NO_x	HC + NO_x	PM	As from [(b)]:
EURO III	up to 9	Petrol	4.17	0.25	0.18	N/A	N/A	01/01/01
	up to 9	Diesel	0.8	N/A	0.65	0.72	0.07	01/01/01
EURO IV	up to 9	Petrol	1.81	0.13	0.1	N/A	N/A	01/01/06
	up to 9	Diesel	0.63	N/A	0.33	0.39	0.04	01/01/06

a) "Euro 3 and 4" (Directive 98/69/EC).
b) The above dates refer to new vehicle types; dates for new vehicles are 1 year later.

Table A3.3: Emission Limits for Heavy Motor Car (more than 2.5 tonnes laden). Unladen weight over 1600 kg.[(a)]

Euro Standard	No. Seats	Fuel Type	CO	HC	NO_x	HC + NO_x	PM	As from [(b)]:
EURO III	up to 9	Petrol	5.22	0.29	0.21	N/A	N/A	01/01/01
	up to 9	Diesel	0.95	N/A	0.78	0.86	0.1	01/01/01
EURO IV	up to 9	Petrol	2.27	0.16	0.11	N/A	N/A	01/01/06
	up to 9	Diesel	0.74	N/A	0.39	0.46	0.06	01/01/06

a) "Euro 3 and 4" (Directive 98/69/EC).
b) The above dates refer to new vehicle types; dates for new vehicles are 1 year later.

Emission Limits for Light Commercial Vehicles (Classes N1, N2 and N3)

The following tables give current and future emission limits for light commercial vehicles in grams per kilometre. Light commercial vehicles are divided into three classes N1 (mass below 1350 kg), N2 (between 1305 and 1706 kg), N3 (above 1706 kg). Euro I and II limits are covered under Directive 93/59/EEC. Euro III and IV limits are covered under Directive 98/69/EEC.

Table A3.4: N1 Class (<1350 kg) Emission Limits.

N1 Euro St.	Fuel Type:	CO	HC	NO_x	HC + NO_x	PM	As from:
EURO III	Petrol	2.3	0.2	0.15	N/A	N/A	1/1/2001
	Diesel	0.64	N/A	0.5	0.56	0.05	1/1/2001
EURO IV	Petrol	1	0.1	0.08	N/A	N/A	1/1/2006
	Diesel	0.5	N/A	0.25	0.3	0.025	1/1/2006

Table A3.5: N2 Class (1305-1760 kg) Emission Limits.

N2 Euro St.	Fuel Type:	CO	HC	NO_x	HC + NO_x	PM	As from:
EURO III	Petrol	4.17	0.25	0.18	N/A	N/A	1/1/2002
	Diesel	0.8	N/A	0.65	0.72	0.07	1/1/2002
EURO IV	Petrol	1.81	0.13	0.1	N/A	N/A	1/1/2006
	Diesel	0.63	N/A	0.33	0.39	0.04	1/1/2006

Table A3.6: N3 Class (>1760 kg) Emission Limits.

N3 Euro St.	Fuel Type:	CO	HC	NO_x	HC + NO_x	PM	As from:
EURO III	Petrol	5.22	0.29	0.21	-	-	1/1/2002
	Diesel	0.95	-	0.78	0.86	0.1	1/1/2002
EURO IV	Petrol	2.27	0.16	0.11	-	-	1/1/2006
	Diesel	0.74	-	0.39	0.46	0.06	1/1/2006

Emissions Limits for Heavy Duty Vehicles

The following table gives current and future emission limits for heavy-duty vehicles are in grams per kWh.

Table A3.7: Emission Limits for Heavy Duty Vehicles.

Euro Standard	Test cycle	CO	Total HC	NM-HC	NO_x	PM	As from:
EURO III	ESC [b]	2.1	0.66	-	5	0.10 - 0.13 [a]	1/1/2000
	ETC [c]	5.5	0.78	1.6	5	0.16 - 0.21 [a]	1/1/2000
EURO IV	ESC [b]	1.5	0.46	-	3.5	0.02	1/10/2005
	ETC [c]	4.0	0.55	1.1	3.5	0.03	1/10/2005
EURO V	ESC [b]	1.5	0.46	-	2	0.02	1/10/2008
	ETC [c]	4.0	0.55	1.1	2	0.03	1/10/2008

Notes:
(a) For engines <750 cc per cylinder and with a rated power speed greater than 3000 rpm
(b) Measured on the European Standard Cycle (ESC)
(c) Measured on the European Transient Cycle (ETC)
"Euro III, IV and V": Council position December 1998 and agreed with the European Parliament.

Relevant Fuel Specification Limits:

Table A3.8: Relevant Petrol and Diesel Fuel Specification Limits.

PETROL	2000	2005
RVP summer	60	-
Aromatics, %	42	35
Benzene, %	1	-
Olefins, %	18	-

DIESEL	2000	2005	2009
Cetane # (min)	51	-	-
Density 15°C	845	-	-
Distillation 95°C	360	-	-
Polyaromatics, %	11	-	-

Oxygen, %	2.7	-
Sulphur, ppm	150	50

Sulphur, ppm	350	50	10

'-' = that limits are currently still under discussion

8.9 Appendix 9 - MEET Fuel Cycle & Mileage Distribution Data

CONTENTS

Table A4.1 Background Information and Assumptions
Table A4.2 Mileage Data
Table A4.3 Gasoline Fuel Cycle Data
Table A4.4 Diesel Fuel Cycle Data
Table A4.5 Natural Gas Fuel Cycle Data
Table A4.6 LPG Fuel Cycle Data
Table A4.7 Electricity Fuel Cycle Data

Background Information and Assumptions

The fuel properties data was used in calculating fuel cycle emissions in g[pollutant]/km from the MEET data, as described below:

Gasoline, Diesel & LPG:

1. MEET pollutant emission factors in g[pollutant]/kg fuel are first converted to g[pollutant]/GJ fuel using the relevant fuel Net CV values in Table A4.1;
2. These emissions factors are then converted to values in terms of tailpipe CO_2 emissions for each fuel (g[pollutant]/gCO_2) using the relevant kg CO_2 / GJ values in Table A4.1;
3. Vehicle fuel cycle emissions (in g[pollutant]/km) are then calculated by multiplying their tailpipe CO_2 emissions data (gCO_2/km, from type approval) by the g[pollutant]/gCO_2 data for the relevant fuel.

Table A4.1 Fuel Properties

Fuel Type	Net CV, GJ/tonne	%C	kg C / GJ	kg CO_2 / GJ
Gasoline	44.0	83.1%	18.892	69.270
Diesel	42.8	86.5%	20.205	74.086
LPG	46.1	82.8%	17.961	65.857
CNG	48.0	74.7%	15.561	57.058

Notes:

(a) calculated from kg C/GJ data multiplying by the ratio of relative formula mass (RFM) of CO_2 and that of C, i.e. 44/12.

CNG:

1. MEET pollutant emission factors in g[pollutant]/GJ converted to values in terms of tailpipe CO_2 emissions for each fuel (g[pollutant]/gCO_2) using the relevant kg CO_2 / GJ values in Table A4.1;
2. Vehicle fuel cycle emissions (in g[pollutant]/km) are then calculated by multiplying their tailpipe CO_2 emissions data (gCO_2/km, from type approval) by the g[pollutant]/gCO_2 emission factor.

Electricity:

1. Vehicle fuel cycle emissions (in g[pollutant]/GJ) are calculated by multiplying electric vehicle engine efficiency (in GJ/km) by the MEET g[pollutant]/GJ emission factor.

Mileage Data

Table 7.1 contains data on total passenger car mileage distribution from the EC MEET Project Deliverable 16, 'Road Traffic Composition' (N. A. Kyriakis, Z. C. Samaras & A. E. Andrias; Lab. of Applied Thermodynamics, University of Thessaloniki, 1997).

EU average data is estimated based on the Year 2000 mileage by Member State (Source - EC DG TREN: Transport in Figures).

Table A4.1 Passenger Car Mileage Distribution by Country

		Mileage Distribution % (MEET)			Total Mileage (2000)
	Country	Urban	Rural + Highway		billion pkm
1	Austria	31.0%	69.0%		69.2
2	Belgium	27.1%	72.9%		105.9
3	Denmark	40.0%	60.0%		66.6
4	Finland	30.0%	70.0%		55.7
5	France	40.0%	60.0%		699.6
6	Germany	39.6%	60.4%		723.4
7	Greece	44.0%	56.0%		77.1
8	Ireland	25.0%	75.0%		33.3
9	Italy	40.5%	59.5%		665.2
10	Luxembourg	27.1%	72.9%		5.1
11	Netherlands	32.7%	67.3%		151.5
12	Portugal	24.0%	76.0%		86.5
13	Spain	30.5%	69.5%		331.6
14	Sweden	30.0%	70.0%		92.9
15	Switzerland	39.6%	60.4%		-
16	UK	46.0%	54.0%		625.0
0	EU Average	38.5%	61.5%	EU total	3788.6

Fuel Cycle Data

Tables A4.3-A4.7 contain data on total fuel production pollutant emissions from the EC MEET Project Deliverable 20, 'Fuel and Energy Production Emission Factors' (C.A. Lewis, ETSU, AEA Technology, 1997).

Data for Luxembourg is assumed to be approximately equal to Belgium in the absence of other data. EU average data for gasoline, diesel and LPG (assumed to be similar proportion to gasoline) has been calculated from total sales data by Member State for 2001 (from 'EU Fuel Quality Monitoring Summary 2001', AEA Technology Environment, 2003).

Table A4.3 Total Fuel Production Emissions for Gasoline, by Country

8.9.1.1 Country	CO2	CO	HC	NOx	SO2	CH4	PM
	g/kggasoline	g/kggasoline	g/kggasoline	g/kggasoline	g/kggasoline	g/kggasoline	g/kggasoline
Austria	442.7	0.255	10	2.14	2.94	0.816	0.125
Belgium	433.8	0.237	9.93	1.98	3.08	0.815	0.115
Denmark	421.5	0.238	9.55	2.03	4.38	0.806	0.084
Finland	438.3	0.264	9.8	2.14	3.65	0.811	0.111
France	434.8	0.237	9.97	1.98	2.95	0.814	0.118
Germany	432.3	0.241	9.78	2.03	3.67	0.813	0.103
Greece	443.8	0.272	9.81	2.32	3.73	0.814	0.115
Ireland	419.8	0.235	9.55	2	4.37	0.8	0.084
Italy	437.1	0.255	9.81	2.16	3.66	0.808	0.109
Luxembourg	433.8	0.237	9.93	1.98	3.08	0.815	0.115
Netherlands	433.8	0.238	9.85	1.99	3.39	0.815	0.108
Portugal	437.3	0.251	9.87	2.12	3.39	0.814	0.114
8.9.1.2 Spain	437.6	0.252	9.86	2.12	3.44	0.813	0.113
Sweden	431.8	0.259	9.77	2.1	3.68	0.804	0.107
Switzerland	423.1	0.252	9.55	2.15	4.46	0.794	0.087
UK	435.9	0.238	9.92	1.99	3.14	0.819	0.115
EU Average	**434.7**	**0.244**	**9.85**	**2.05**	**3.44**	**0.813**	**0.110**

Table A4.4 Total Fuel Production Emissions for Diesel, by Country

8.9.1.3 Country	CO2	CO	HC	NOx	SO2	CH4	PM
	g/kgdiesel	g/kgdiesel	g/kgdiesel	g/kgdiesel	g/kgdiesel	g/kgdiesel	g/kgdiesel
Austria	309.2	0.227	4	1.78	2.05	0.714	0.049
Belgium	307.2	0.209	3.98	1.64	2.2	0.714	0.047
Denmark	328.1	0.208	3.92	1.73	3.53	0.708	0.063
Finland	319.1	0.231	3.97	1.79	2.61	0.711	0.058
France	304.1	0.21	3.99	1.63	2.04	0.713	0.045
Germany	314.8	0.21	3.97	1.69	2.63	0.713	0.054
Greece	327.3	0.241	3.96	1.97	2.85	0.714	0.062
Ireland	326.4	0.205	3.92	1.7	3.52	0.702	0.062
Italy	318.8	0.224	3.97	1.81	2.68	0.708	0.057
Luxembourg	307.2	0.209	3.98	1.64	2.2	0.714	0.047
Netherlands	310.3	0.208	3.98	1.65	2.36	0.714	0.05
Portugal	315.8	0.222	3.97	1.78	2.51	0.713	0.054
Spain	314.7	0.222	3.98	1.77	2.48	0.713	0.054

Sweden	319.3	0.228	3.96	1.76	2.81	0.704	0.059
Switzerland	329.4	0.22	3.92	1.84	3.61	0.696	0.066
UK	307.5	0.209	4	1.73	2.16	0.717	0.048
EU Average	**312.5**	**0.215**	**3.98**	**1.72**	**2.43**	**0.713**	**0.052**

Table A4.5 Total Fuel Production Emissions for LPG, by Country

Country	CO2	CO	HC	NOx	SO2	CH4	PM
	g/kgLPG	g/kgLPG	g/kgLPG	g/kgLPG	g/kgLPG	g/kgLPG	g/kgLPG
Austria	296.7	0.21	2.82	1.65	1.49	0.777	0.077
Belgium	295.9	0.203	2.79	1.6	1.57	0.8	0.074
Denmark	306.8	0.208	2.67	1.68	1.96	0.895	0.058
Finland	309	0.235	2.75	1.73	1.71	0.809	0.073
France	285.9	0.201	2.8	1.57	1.49	0.77	0.073
Germany	307.7	0.206	2.74	1.62	1.82	0.833	0.07
Greece	327.8	0.222	2.75	1.76	1.85	0.854	0.077
Ireland	299.3	0.205	2.67	1.64	2.06	0.827	0.059
Italy	305.7	0.214	2.76	1.72	1.83	0.778	0.071
Luxembourg	295.9	0.203	2.79	1.6	1.57	0.8	0.074
Netherlands	307.8	0.206	2.77	1.61	1.63	0.822	0.068
Portugal	307.5	0.212	2.78	1.69	1.78	0.818	0.077
Spain	301.6	0.21	2.77	1.68	1.81	0.81	0.077
Sweden	284.1	0.228	2.74	1.66	1.66	0.763	0.068
Switzerland	270.1	0.208	2.66	1.61	1.86	0.755	0.05
UK	308.4	0.205	2.79	1.66	1.75	0.834	0.08
EU Average	**303.3**	**0.208**	**2.77**	**1.65**	**1.74**	**0.812**	**0.073**

Table A4.6 Emissions for the Production and Distribution of Natural Gas

	CO2, kg/GJ	CO, g/GJ	NMHC, g/GJ	NOx, g/GJ	SO2, g/GJ	CH4, g/GJ	PM, g/GJ
Extraction (1)	1.6	1	11	4.1	2	20	0
Distribution	0	0	16	0	0	198	0
Filling station	2.5	0.4	0.5	6.5	14.9	5.7	0.8
Total	**4.1**	**1.4**	**27.5**	**10.6**	**16.9**	**223.7**	**0.8**

(1) includes natural gas processing

Table A4.7 Total Electricity Production Emissions by Country

Country	CO2	CO	HC	NOx	SO2	CH4	PM
	kg/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ	g/GJ
Austria	62.9	14.5	16	92.7	74.2	80.3	6.9
Belgium	94.3	16.7	12.2	289.4	533.5	240.3	27.2
Denmark	257.3	43	24.7	811.6	912.9	902.7	62.7
Finland	155.1	38.6	15.6	307.3	198	310.9	23.4
France	17.6	3.2	3.2	61	183.9	36.1	7.9
Germany	189.7	27.3	9.4	306.3	931.5	465.1	56.2
Greece	296.4	38.7	38.9	393.6	979.2	604	62.4
Ireland	212.9	33.8	44.6	672	1639.5	466.7	74.3
Italy	162.5	33.4	105.3	551.7	977.2	111.8	41.1
Luxembourg	94.3	16.7	12.2	289.4	533.5	240.3	27.2
Netherlands	175.7	31.6	32	281.8	185.2	392.5	19
Portugal	170.4	34	53.7	507.1	1260.7	359	59.4
Spain	126.8	19.4	16	414.2	1235.8	306.8	57.8
Sweden	20.6	6	6.6	42.2	34.7	22.2	3.1
Switzerland	6.6	2.5	1.4	12.9	21.5	0.7	1.1

UK	167.8	27.4	20.2	631.8	1445.8	458.9	69.9
EU Average	**127.4**	**21.3**	**22.6**	**325.9**	**744.9**	**282.6**	**39.1**

8.10 Appendix 10 - WP4.2 Workshop, SwissCore, 12th December 2003

8.10.1 Attendees

- Joeri Van Mierlo; VUB – University of Brussels.
- Don Ridley; The Environment Agency
- Udo Lambrecht; IFEU - Institut für Energie- und Umweltforschung Heidelberg GmbH
- Gabriel Plassat, ADEME
- Remco Hoogma, NOVEM
- Leen Govaerts, VITO
- Markku Ikonen, VTT
- Richard Smokers, TNO
- Nicola Mona, InfoVEL
- Urs Schwegler,
- Heather Haydock, AEA Technology
- Nikolas Hill, AEA Technology
- Bob Saynor, EST
- Hans Pohl, VINNOVA

8.10.2 Agenda

09:45	**Coffee**
10:15	**Welcome and introduction to the workshop**
10:30	**Remote emissions: What are the correct external costs to use for very remote emissions?**
12:00	**Biofuels – availability of fuel cycle and tailpipe emissions data; options for including in rating methodology**
13:00	**Lunch**
14:30	**Real-world drive cycles and data availability**
15:00	**Future of Cleaner Drive & A.O.B.**
16:00	**End of Workshop**

8.10.3 Minutes of WP4.2 Workshop, 12 December 2003

8.10.3.1 Remote Emissions Weighting

RS: NGVs tailpipe CH_4 emissions generally contribute 1-2% of CO_2 eq.

RS: N_2O emissions occur from all green areas, whether under cultivation or natural. [though N fertiliser application must make big difference?]

RS: gasoline vehicles generally perform well below the limit values. diesel generally perform very close to the limit values due to the Nox/PM trade-off. [This would have had implications for comparison of the different fuels IFF comparisons were made at the limit values]

NH: the suggestion is to reduce the weighting given to v remote emissions by a factor of 2 and not to reduce them to zero, which would be inappropriate because:

- Most shipping routes run close to land – and trans-boundary pollutants carried far enough to affect coastal areas.

NH: setting the remote section to zero doesn't have a huge effect because the fuel cycle emissions with the highest external costs are SO_2 and HCs, for which only a small proportion comes from shipping and distribution.

RS: Evaporative emissions (as well as tailpipe AQ) have also been significantly reduced in last 10 years, and much of the quoted data (MEET and elsewhere) may now be out of date.

DR: Tailpipe gasoline emissions are now so low they're not a major prob. We should acknowledge this and address what is the problem, which is evaporative emissions. When a car's fuel tank is filled the same volume of HC-laden evaporative emissions is displaced to atmosphere

UL: don't need as much energy to refine dsl as petrol.

JvM: thinks the split between remote and other fuelcycle emissions may be in the Appendix of the MEET report (though he doesn't recommend we should attempt to use this).

DR: Questions some of the ExternE costs.

BS: Also lacks confidence in some of ExternE's values, especially as CO should have a minimum value of 44/32 x CO_2's value but in fact has a far lower score.

RS: Diesel cars are more robust – emissions deteriorate more slowly

Remote Emissions Weighting - Conclusions & Actions

1. WP4.2's report [D6] should discuss the possibility of weighting v remote emissions at a lower value, and should present sensitivity analysis of this,

showing that even if zero-weighted the overall effect would be small. However, the numerical analysis /methodology should not be changed, particularly as we only have appropriate disaggregated data for gasoline split and only for one fuel path (Iran or Iraq to Netherlands!)
2. Add some explanation to the websites as to why there is very little difference between similar gasoline values.
3. Broaden the range of scores by changing the model to use the normal pass car limits rather than the heavy car limits, and by reducing the CO2 value that gives zero from 350g/km to 300g/km.

UL: we may end up with a negative score for some vehicles, but maybe we can live with this.

8.10.3.2 Biofuels

UL: The websites could explain that biofuels are a property of the fuels and not of the vehicles. This will help explain why they are not rated separately on the DST.

UL: biodiesel receiving a much higher score could lead to the conclusion that driving a big diesel is ok, however this would be wrong because why should someone use up a large quantity of the fuel.

DR: biodiesel (RME) is a bad thing as it stands at the moment because of its high fuel cycle emissions, (AQ fuel cycle in particular.) Don advises the EA that biodiesel should not be used for general transport but for specific uses where their environmental performance is more important e.g. inland waterways.

MEET does, in fact, have AQ emissions factors for biodiesel, but it uses wheat-based ethanol rather than beet ethanol.

RS: We could state on the websites that CD's methodology could incorporate biofuels once the data becomes available.

Biofuels - Conclusions & Actions

1. CD should not attempt to include biofuels numerically.
2. Udo to send BS AQ fuelcycle data if there is any available.
3. BS to investigate if it is possible and appropriate (legally etc) to compile for the websites a list of OEMs' stated opinions on biofuels. e.g. "Ford warranty their vehicle at X%…

8.10.3.3 Future of CD

RS: The starting point for calculations of costs required to continue CD should be maintaining the national dbs. Other areas such as improving/updating the methodology should be secondary –first task is to maintain these dbs.

BS: Agree that the national dbs are key, but CD partners have agreed that obtaining and supplying these will be national partners' own responsibility.

RS Proposes that after June04 CD should become similar to NCAP in that it would be a joint EC/industry/other stakeholder project.

HH: maintenance should be via a service contract from the EC rather than a Framework 6 contract, but v. difficult to get such contracts.

LG: Intelligent Energy for Europe (IEE) could be a source of funding for info sharing/dissemination, so possibly for website funding.

US: There are national contact bodies for the IEE (above) that he intends to contact in Switzerland and that others could also contact.

RH: A MEET2 project could be funded as a Co-ordinated Action under Sustainable Energy Systems, (EC).

JvM: The proposal did not contain anything about updating fuel cycle emissions. Would like to see an update / follow up to MEET.

Future of Cleaner Drive - Conclusions & Actions

1. Invite and encourage Frank Jost to the Utrecth meeting in February; present him with plans to maintain and continue Cleaner Drive and ask him the best way to seek further EC funding for the work.
2. Urs to contact the Swiss IEE representative; Bob to contact the UK representative.
3. Those partners that are interested should write a joint Expression of Interest in continuing with Cleaner Drive beyond June 04. This to be discussed further in Utrecht in February.