

TOPTEN – Eco rating system for cars

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1 Introduction

For the environmental rating of passenger cars Topten uses a system which has been developed by the institute for research in energy and environment in Heidelberg (Institut für Energie- und Umweltforschung, IFEU). It was requested in 1997 by the traffic associations (Verkehrsclubs) of Germany, Austria and Switzerland (VCD, VCÖ and VCS) and by the ministry of environment (Umweltbundesamt) of Berlin. It was developed based on recent scientific findings and has been updated several times.

In 2002, a highly regarded study was published by Mark Z. Jacobson, Professor of Stanford University, in which he showed that promoting diesel cars in favour of gasoline cars probably encourages global warming instead of slowing it down. Although diesel cars obtain 25 to 35 percent better mileage and emit less carbon dioxide than similar gasoline cars, they can emit 25 to 400 times more mass of particulate black carbon and associated organic matter ('soot') per kilometer [mile]. According to Mark Z. Jacobson, the warming due to soot may more than offset the cooling due to reduced carbon dioxide emissions over several decades (Jacobson, 2002).

In coordination with the Laboratory of Atmospheric Chemistry of the Paul Scherrer Institute (PSI), factors for the conversion of black-carbon-aerosols emissions into CO₂-equivalents were dedicated, which allow integrating the contribution of the particles to global warming into the rating system. The factor chosen by experts (rather conservative 200) adds the equivalent of 18.35 g CO₂/km to the Eco rating result of Euro-4 models without diesel particulate filter. As a consequence, the Eco rating result of diesel cars without particulate filter is too low to meet Topten's environmental requirements, and no such models make it into the Topten lists.

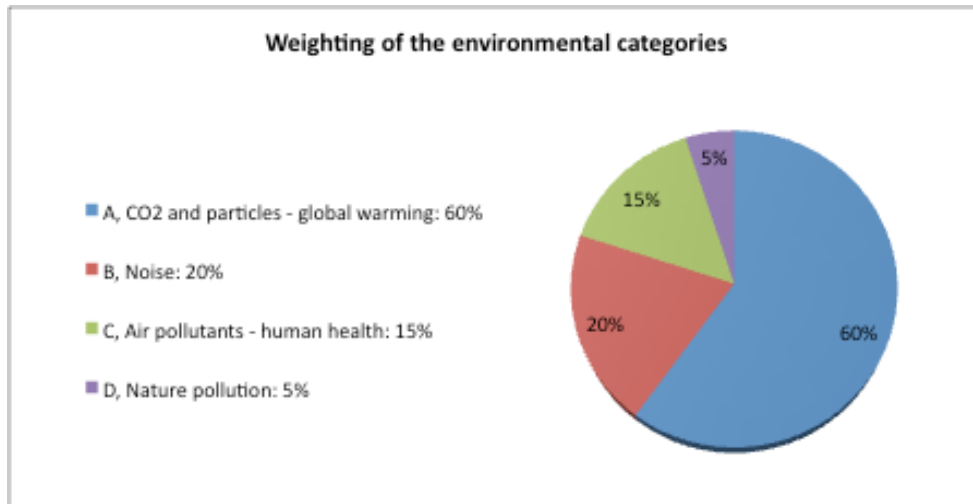
Since the last adaption of the rating system 2010 the carcinogenic effects of Diesel sooty particles and benzol do no longer have to be regarded. These particles remain a problem in few new car models without closed filter system only – and such cars do not make it onto a topten list.

Chapter 2 shows the Eco rating calculations as well as their derivation.

Detail explanations of calculations and weightings of the version by IFEU from 1997 can be found in Chapter 3 in the German version on www.topten.ch, as well as an overview on the adjustments taken since 1997 (Chapter 4 German version).

2. Topten's Eco rating system

Topten's Eco rating system allows to rate polluting effects of new cars comprehensively. The rating is based on comparable data on carbon dioxide, air pollutant and noise emissions, which is available for all cars. Pollutants are allocated to categories of similar effects on environment and human health. In order to obtain the total result, Topten assesses and weights the four environmental categories A to D (see graph).



2.1 The four categories of environmental effects

Category A: CO₂ und black carbon particles – global warming

The pre-industrial proportion of carbon dioxide CO₂ in the air has been increased by roughly 20% due to human emissions, and is still increasing. The result is the global climate warming, with unpredictable, immense consequences. The transport sector is the most important CO₂ emittant: in Switzerland it is responsible for about one third of the total CO₂ emissions, and emissions are still on the rise. CO₂ emissions of cars depend on their fuel consumption. Cars with diesel motors commonly emit less CO₂ than petrol driven cars. In the case of diesel models without particulate filter however, this advantage is offset by the climate harming effect of the soot particle emissions.

Category B: noise emissions

Two thirds of Europe's population feel discommoded by noise immissions, mostly traffic noise. Road traffic is responsible for three quarters of all traffic noise. A considerable part of the population is burdened by noise levels higher than the statutory limits. Chronic exposure to noise provokes stress reactions and can affect health.

Category C: air pollutants (NO_x, HC und particles)

Today new cars emit less air pollutants such as nitrogen oxides (NO_x) and hydrocarbons (HC) than some years ago. In cars with ottomotors only when starting up critical emission levels are measured. Diesel cars however are still emitting high levels of nitrogen oxides. These pollutants influence human health in several ways, such as promoting respiratory diseases and allergies. Apart from their health impact these substances have an important role in the formation of ozone ('summer smog'). Since as a part of particulate matter they also impair lung function, particles are listed again in this category. They can cause respiratory problems and infectious diseases such as acute bronchitis or chronic cough.

Category D: Nature pollution

The main substances responsible for nature pollution are nitrogen oxides (NO_x). Nitrogen oxides as well as sulfur dioxides cause overfertilization of soils and aquatic systems.

2.2 Calculation of the Eco Rating

The emissions in the four categories of environmental effects are measured in different units (g/km, dB(A)), but have to be normalised in order to be comparable. This is done by a score system which rewards a better car with a higher score.

At first, cars are rated for every single of the four categories of environmental effects, on a scale of 0 to 10 (with 10 being the best value). The rating is based on current environmental objectives.

Category A: CO₂ und black carbon particles – global warming

A car's CO₂-emissions are rated here with a linear function. For CO₂-emissions of 60 grams per kilometer (corresponding to a consumption 2.6 liters of gasoline or 2.3 liters of diesel per 100 km) 10 points are granted, while 180 grams of CO₂ per kilometer score 0 points. Vans emitting more than 180 grams get negative points in this category. The precise formula is:
Eco Rating points = (180 – x)*0.0833 , x = CO₂-emissions in g/km

Category B: noise emissions

The rating is based on a model's indications of the type test. The scale runs linearly between 10 points for 65 dB(A) and 0 points for 75 dB(A) and more.

Categories C and D

These categories are both rated according to the same scheme. A car's score in these categories is defined by its emission class (Euro 4, Euro 5 or Euro 6). All diesel cars on Topten have a particle filter. Gasoline cars with direct fuel injection emit more nanoparticles and therefore get less points.

Emission class	Points	
	C: air pollutants	D: nature pollution
Euro 4 gasoline	9.13	6.8
Euro 4 diesel	5.0	0.0
Euro 5 gasoline	9.35	7.6
Euro 5 gasoline, with direct fuel injection	8.1	7.6
Euro 5 diesel	6.4	2.8
Euro 6 diesel	8.4	6.8

Eco points

For a car's total score (Eco points) the scores of the single environmental effect categories are weighted and added up:

$$\text{Eco points} = \text{score}(\text{cat.A}) * 0.6 + \text{score}(\text{cat.B}) * 0.2 + \text{score}(\text{cat.C}) * 0.15 + \text{score}(\text{cat.D}) * 0.05$$

The minimum score necessary for Topten can be found in Topten's Selection criteria (www.topten.eu > Cars > Selection criteria).

Eco stars

To increase the result's readability, it is multiplied by the factor 10, and displayed graphically with Eco stars. The resulting total score has to be interpreted the following way: the higher a car's score, the smaller its environmental impact.