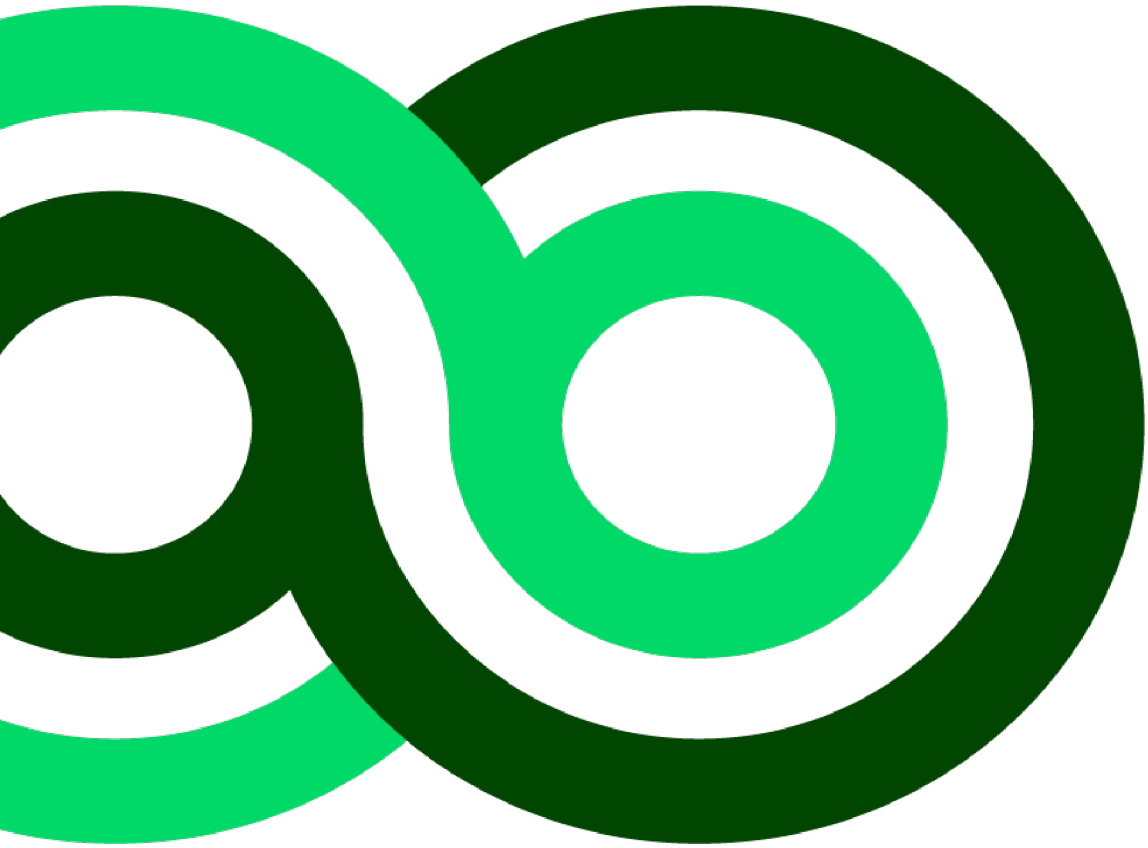
Rating Procedure 2022

Version 3.0.0 June 2022



Version 3.0.0 June 2022

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1 INTRODUCTION

Green NCAP is an initiative established in 2018 to provide consumers with comprehensive, holistic and independent information regarding the environmental impact of new cars. Legislation in this area has become very much more rigorous, partly in response to revelations of some manufacturers 'cheating' emissions tests by utilising different software (so-called 'engine maps') when the tests are conducted under controlled certification conditions in comparison to those used in real world driving. However, even without resorting to such measures, vehicle manufacturers are able, perfectly legally, to utilise those areas of the engine map which are not explored in the homologation tests to enhance real-world power, efficiency or durability performance to the detriment of emissions abatement. Green NCAP conducts a wide variety of tests, based on those used in legislation but with 'extended boundaries', to explore more completely the engine speed/load range. In so doing, it aims to promote clean, efficient functioning of the engine and exhaust after-treatment at all times.

Protection of the environment is a broad topic and is divided into three areas in Green NCAP's assessments. The immediate environment, such as those in cities where people work and live, is perhaps most immediately affected by pollutant emissions: those by-products of the combustion process which are harmful to health. This is addressed by the Clean Air Index. The global environment is affected by the emission of gases which prevent heat from escaping from the planet, and which are responsible for the relentless rise in average temperatures which has been taking place for decades. This is addressed by the Greenhouse Gas Index. And, on top of this, the natural resources which need to be put into a vehicle to make it move – directly, in the form of petrol or diesel, or indirectly in the case of electricity – are finite and costly and should be used as sparingly as possible, for the benefit of the planet and for the consumer who pays for them. This area is addressed by the Energy Efficiency Index.

This document details the way in which the results of Green NCAP's tests are scored and how those scores are used to calculate the star rating. The program was revised in 2022. It now has a two stage test approach and the greenhouse gas index is now based on well-to-wheel+[1] calculations in the use phase.

2 STANDARD TESTS AND ADDITIONAL ROBUSTNESS TESTS

As of 2022, all vehicles will be subjected to a series of standard tests. Only cars doing well and meeting certain minimal requirements are eligible for tests in an additional second stage to demonstrate robustness. The underlying philosophy is that the outcome of the standard tests indicates pretty well what the added value of performing additional robustness tests is. Vehicles that demonstrate mediocre (or poorer) control of emissions and / or energy use in the standard tests are unlikely to perform well in the more demanding robustness tests. This approach allows for efficient use of resources. Table 1 lists what tests are included in the two stages.

To qualify for the additional robustness test stage, test scores (out of a maximum of ten) in the standard tests in each pillar must equal or exceed 3.5 and the average value of the three pillar scores must equal or exceed 5.

[1] In contrast to the standard well-to-wheel approach, which considers only the energy flows to produce and supply an unit of energy carrier making use of already existing facilities, the "+" in Green NCAP's well-to-wheel+ signalises that the energy and greenhouse gas emissions of the construction and operation of those facilities (e.g. refineries, agriculture for biofuels, photovoltaics, charging/filling stations, etc.) are taken into account.

Table 1: Standard Tests and Additional Robustness Tests

Standard Tests (Stage 1)	Additional Robustness Tests (Stage 2)
Cold test (WLTC+Ccold, at 23°C)	Cold Ambient Temperature test (WLTC+ CAT at -7°C)
Warm test (WLTC+ Warm, at 23°C)	On-Road Heavy Load (PEMS+ Heavy)
Highway (BAB130, at 23°C)	On-Road Light Load (PEMS+ Eco)
On-Road Drive (PEMS+ Cold)	Congestion
On-Road Short Trip (1st 8km of PEMS+ Cold)	

3 THE STAR RATING

The star rating is derived from the three indexes: Clean Air, Energy Efficiency and Greenhouse Gas. The methods used to calculate those indexes will be described in the sections to follow. For now, it is sufficient to know that index is a score, out of a maximum of ten, for the performance of the vehicle in each of those three areas of assessment. Ten points represents the maximum points that are available in each of the pillars.

3.1 Weighted Average

The three indexes, each to one decimal place, are used to calculate a weighted average, known as the 'overall index'. Currently the weighting is as follows, Table 2:

Table 2: Index Weighting

Index	Clean Air	Energy Efficiency	Greenhouse Gas
Weight	1/3	1/3	1/3

In other words, all three indexes are given equal importance and the overall index is, for now, a simple average of the three. The weighted average is rounded down to the nearest one decimal place e.g. indexes for Clean Air, Energy Efficiency and Greenhouse Gases of 4.9, 5.1 and 4.9 respectively yields a weighted average of 4.967. This is rounded to 4.9, not to 5.0, as the threshold of 4.9 has been met and exceeded, while the threshold of 5.0 has not.
The overall index is then compared to a table of thresholds, at which the car is deemed to have met the requirements of certain star, or half-star, ratings (Table 3) .

Table 3: Star Rating Thresholds

Stars	Threshold
★★★★★	9.0
★★★★½	8.0
★★★★☆	7.0
★★★½☆	6.0
★★★☆☆	5.0
★★½☆☆	4.0
★★☆☆☆	3.0
★½☆☆☆	2.0
★☆☆☆☆	1.0
☆☆☆☆☆	0.0

So, a car with an overall index of 5.2 is rated as a three-star vehicle; another with an overall index of 2.8 is considered a one-and-a-half-star vehicle.

The final result of a first stage vehicles is a score on a one-to-ten scale, based on points scored in relation to the total number of points available in the standard test stage. For vehicles that are subject to additional robustness tests, the score is based on the number of points scored in relation to the total amount of points available in the standard and additional robustness tests. Because of these pre-requisites, vehicles which do not qualify for the additional robustness tests will not reach the highest scores. Vehicles that do qualify and undergo the additional robustness tests, but cannot prove robustness of their performance in the additional test stage, mathematically may fall below the stars value they have reached in the standard test phase. The rating system deliberately prohibits this possibility by granting vehicles, which qualified for the additional robustness tests, a minimum of 3 stars – "safety net". This corresponds to a weighted overall index of 5.
In case the "safety net" is applied, the vehicle will receive 3 stars and its index results will be displayed based on the sub-index results of the standard test stage (i.e. points scored in the 1st stage in relation to the maximum available points in the 1st stage).

3.2 Applicability of the Rating System

Ratings are independent from vehicle class. The system is prepared to deal with a variety of propulsion technologies: vehicles with an internal combustion engine (petrol, diesel, CNG), battery electric (BEV), hybrid and hydrogen vehicles, as well as combined systems: plug-in hybrid vehicles (PHEVs) and Bi-fuel vehicles. Further details on how Bi-fuel vehicles and PHEVs are tested and rated are described in chapters 6 and 7 respectively.

4 THE INDEXES

4.1 The Clean Air Index

4.1.1 The Pollutants

The pollutants considered in the calculation of the Clean Air Index are as follows:

Table 4: Pollutant Emissions

Pollutant	Abbreviation
Non-methane hydrocarbons	NMHC
Nitrogen oxides	NO_x
Ammonia	NH_3
Carbon Monoxide	CO
Particulate Number (23 nm)	PN23

4.1.2 The Tests

The tests employed are as follows:

Table 5: Green NCAP Tests

	Test	StagT
Laboratory Tests	Cold test (WLTC+ Cold, at 23°C)	Standard
	Warm test (WLTC+ Warm, at 23°C)	Standard
	Highway (BAB130, at 23°C)	Standard
	Cold Ambient Temperature test (WLTC+ CAT at -7°C)	Add. Robustness
On-Road Tests	On-Road Drive (PEMS+ Cold)	Standard
	On-Road Short Trip (1st 8km of PEMS+ Cold)	Standard
	On-Road Light Load (PEMS+ Eco)	Add. Robustness
	On-Road Heavy Load (PEMS+ Heavy)	Add. Robustness
	Congestion	Add. Robustness

WLTC: World-harmonised Light-duty Test Cycle
PEMS: Portable Emissions Measuring System

The procedures used for each of the tests are described in detail in the procedure documents available on https://www.greenncap.com/test-procedures/

4.1.3 Threshold Values

For each test, the scoring of each relevant pollutant emission is based on the final measured quantity of that pollutant. For each, there is a lower emissions (i.e. high-performance) threshold, below which maximum points are scored, and an upper emissions (i.e. low-performance) threshold above which no, or negative, points are scored. There is also a 'gross exceedance' threshold for each pollutant (1.5 times upper threshold, except PN: one order of magnitude). Different threshold values apply to different tests, a conformity factor of 1.32 is applied for PEMS compared to laboratory tests. For the PEMS congestion test, only NO_x is measured (in mg/s).

Table 6: Clean Air threshold values (1). Applies to: WLTC+ Cold, WLTC+ Warm, BAB130

Pollutant	Lower Threshold	Upper Threshold	Gross Exceedance
NMHC (mg/km)	0.5	58	87
NO_x (mg/km)	0.5	60	90
NH_3 (mg/km)	0.1	10	15
CO (mg/km)	5	500	750
PN23 (#/km)	1.0E+08	6.0E+11	6.0E+12

Table 7: Clean Air threshold values (2). Applies to: WLTC+ CAT (-7 °C), PEMS+ Cold, 1st 8km of PEMS+ Cold, PEMS+ Eco, PEMS+ Heavy

Pollutant	Lower Threshold	Upper Threshold	Gross Exceedance
NMHC (mg/km) [1)]	0.5	76.6	114.8
NO_x (mg/km)	0.5	79.2	118.8
NH_3 (mg/km) [1)]	0.1	13.2	19.8
CO (mg/km)	5	660	990
PN23 (#/km)	1.0E+08	7.92E+11	1.19E+12

[1] Not relevant to PEMS tests

Table 8: Clean Air threshold values (3). Applies to: Congestion

Pollutant	Average	Maximum
NO_x (mg/s)	0.5	1.0

4.1.4 The Scoring Principle

Within each test, each pollutant can score a maximum number of points for values of emissions which are at or below the lower threshold, down to zero at the upper threshold, and can be negative for values beyond the upper threshold. Particulate number is calculated on a logarithmic scale while all other pollutants are scored linearly.

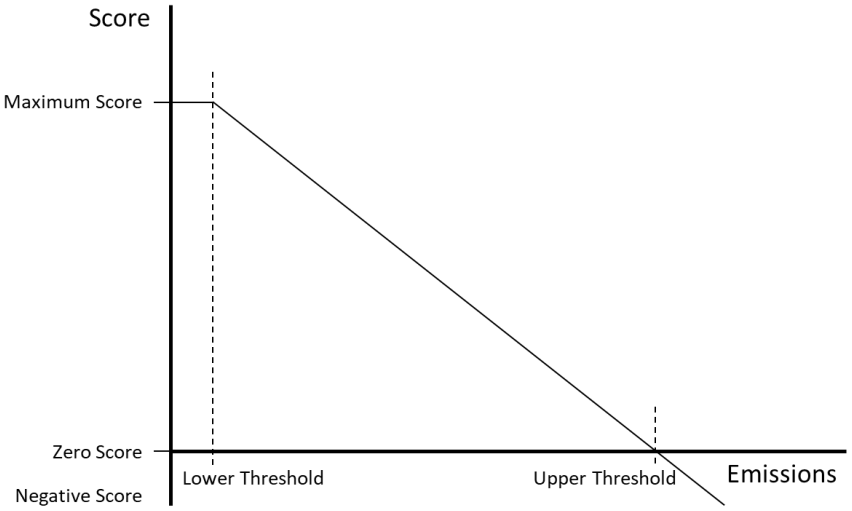

Figure 1: Linear Scoring Method

For particulate number, a logarithmic scale is used:

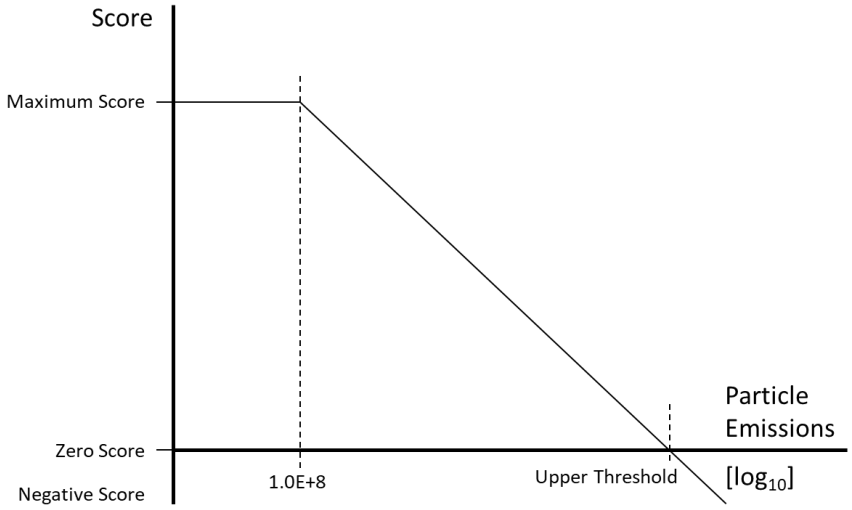

Figure 2: Logarithmic Scoring Method for Particulate Number

The maximum score per pollutant varies by test, see Table 9.

Table 9: Maximum Scores per Test (Clean Air)

Pollutant	all WLTC+ and BAB130	PEMS+ Cold	PEMS+ Eco	PEMS+ Heavy	1st 8km of PEMS+ Cold	Congestion
NMHC (mg/km)	2	-	-	-	-	-
NO_x (mg/km[1)])	3	4	2.25	3.6	2.25	2[2)]
NH_3 (mg/km)	1	-	-	-	-	-
CO (mg/km)	1	2	0.5	0.8	0.5	-
PN23	3	4	2.25	3.6	2.25	-
Maximum Points	**10**	**10**	**5**	**8**	**2.5**	**2**

[1)] mg/s for the Congestion test,

[2)] one point for compliance with average emissions threshold and 1 point for compliance with maximum emissions threshold

The total score per test is the sum of the scores for the individual pollutants, with the following notes:

- **Capping**. If any pollutant, with the exception of NH_3, exceeds its gross exceedance value, the score for that test is set to zero, regardless of the performance of the other pollutants. Tests are not capped in this way for NH_3, which is unregulated by EU legislation.
- If the sum of the scores of individual pollutants is less than zero, the score for the test is set to zero i.e. the **minimum score** for tests in the Clean Air Index is zero.
- In the **Congestion** test, a score of 1 point is awarded if the average NO_x emission rate is less than the prescribed maximum, and an additional 1 point is awarded if the maximum NO_x emission rate is lower than its prescribed maximum.
- Scoring for **PEMS+ Eco**: if the emissions value of NO_x or CO is less than the corresponding value in the PEMS+ Cold test, the maximum score is awarded for that pollutant. If the value of the pollutant is above the upper threshold, no points are scored. For pollutant values between that in the PEMS+ Cold test and the upper threshold, half of the maximum score is rewarded.
  Particle number score for PEMS+ Eco is calculated in the same way as in the other tests.
- Scoring for **On-Road Short Trip** (1st 8km of PEMS+ Cold): if the score for CO or NO_x was zero in the PEMS+ cold test, then no points can be scored for that pollutant in the On-Road Short Trip. If the value of the pollutant emissions exceeds the (extended) gross exceedance threshold, then the score for that pollutant is zero. Otherwise, the score is calculated on a sliding scale between (maximum points) at zero emissions, to zero points at the gross exceedance threshold.
  Particle number score for the On-Road Short Trip is calculated in the same way as in the other tests.

4.1.5 Total Score and Calculation of the Index

The points from each of the tests are summed and the result is divided by the maximum points (standard tests, stage 1) that can be achieved in the Clean Air assessment (see Table 10). The result is rounded down to one decimal place and multiplied by ten. This score is – together with sub-scores in the other pillars – part of the calculation to check eligibility for additional robustness tests, stage 2. If the eligibility for second stage testing is given, after the tests are performed, the total number of scored points (stage 1 and stage 2) is divided through the maximum points available for both standard and additional robustness tests.

Table 10: Maximum Points in the Clean Air Index

Clean Air Index	Standard Tests	Standard + Additional Robustness Tests
Maximum Points	45	70

4.2 The Greenhouse Gas Index

4.2.1 The Greenhouse Gases

The gases considered in the calculation of the Greenhouse Gas Index are as follows:

Table 11: Assessed Greenhouse Gases

Greenhouse Gas	Abbreviation
Carbon dioxide	CO_2
Nitrous oxide	N_2O
Methane	CH_4

The effect of these gases on the climate is considered by their global warming potential (GWP):

Table 12: Global Warming Potential of the Assessed Greenhouse Gases

Greenhouse Gas	GWP
Carbon dioxide	1
Nitrous oxide	298
Methane	25

4.2.2 CO_2-equivalent upstream factor

In Green NCAP's 2022 rating system, the calculation of the Greenhouse Gas Index covers a "Well-to-Wheel+" assessment. This means that the greenhouse gas emissions related to the extraction, production and distribution of energy from the source ("well") are added to the measured tailpipe emissions ("wheel"). The "+" signifies that the construction of powerplants and refineries is also considered, but not yet the vehicle and battery production itself. These upstream numbers are based on European average values from statistical data (for more info refer to *https://www.greenncap.com/wp-content/uploads/Green-NCAP-Life-Cycle-Assessment-Methodology-and-Data.pdf*). For each kilowatt hour of a given energy carrier used to propel the vehicle ('use-phase') the factors in Table 13 are used to calculate the CO_2 equivalent upstream emissions. These are added to the measured tailpipe emissions and basis for the rating.

Table 13: CO_2-equivalent upstream factors

kWh/100km → gCO_2-eq./km	
Petrol E10	0.856
Diesel B7	0.668
Electricity EU27+UK	2.820
CNG	0.423
Hydrogen (nat. gas)	3.635

Part of the fuel used as an energy carrier for petrol and diesel vehicles is from biological origin. Petrol E10 consists of 90 vol% fossil petrol and 10 vol% bio-ethanol. Diesel B7 consists of 93 vol% fossil diesel and 7 vol% bio-diesel. The biogenic fuel share burns CO_2-neutral because the CO_2 which the plants absorbed during their growth is released back into the atmosphere. Hence, the bio-share of the CO_2 emissions measured at the tailpipe of the vehicle shall be subtracted from the calculation of the final CO_2 emissions. It is chosen to subtract this amount at the upstream side of the total Well-to-Wheel+ CO_2 emissions. By doing so, the CO_2 emissions measured at the tailpipe are not changed and the overview over the local CO_2 output of a vehicle remains consistent with the usual indication of vehicle CO_2 emissions (which is the CO_2 measured at the tailpipe regardless of the origin of the fuel used).

The factors used to reduce the CO_2 emissions by the neutrally burning bio-fuel share are displayed in **Table *14***. These factors give the share of fossil CO_2 in the total combustion CO_2 product. The rest to 100% is the biological CO_2 combustion product (i.e. *neutral CO_2 = (1 – factor) x total tailpipe CO_2*)

Table 14: Factors used to calculate the fossil CO_2 share in the total combustion CO_2 tailpipe emissions. The neutral bio-CO_2 can be calculated with the formula "*neutral CO_2 = (1 – factor) x total tailpipe CO_2*". The CO_2 reduction is applied at the upstream side of the total Well-to-Wheel+ CO_2 emissions.

Fossil CO_2 share in the total CO_2 combustion product	
Petrol E10	0.931
Diesel B7	0.935

4.2.3 The Tests

The tests used are the laboratory tests defined previously in Table 5 and used for the Clean Air Index, see Section 4.1.2. Greenhouse gases measured in on-road tests are not currently used for scoring, due to well-known repeatability and comparability issues of real-world consumption tests.

4.2.4 Threshold Values

The following threshold values apply (a conformity factor of 1.6 is applied for N_2O and CH_4 emissions in the WLTC+ CAT test):

Table 15: Greenhouse Gas Threshold Values (1): Applies to: WLTC+ Cold, WLTC+ Warm, BAB130

Constituant	Lower Threshold	Upper Threshold
CO_2 (g/km)	50	225
N_2O (mg/km)	0	10
CH_4 (mg/km)	0	32

Table 16: Greenhouse Gas Threshold Values (2): Applies to: WLTC+ CAT (-7 °C)

Constituant	Lower Threshold	Upper Threshold
CO_2 eq (g/km)	50	225
N_2O (mg/km)	0	16
CH_4 (mg/km)	0	51.2

4.2.5 The Scoring Principle

Points are scored in the same way as for pollutants in the Clean Air Index. A linear scale is used to calculate the CO_2 score. Amounts of emitted N_2O and CH_4 are rewarded with 0.5 point per constituent when below the upper threshold, but the overall score per test is limited to 10 points maximum. If N_2O or CH_4 emissions are above the specific threshold, no bonus points are awarded.

Table 17: Greenhouse Gas Maximum Scores per Test

Greenhouse Gas	All WLTC+ tests and BAB130
CO_2-eq.	10
N_2O	0.5
CH_4	0.5
Maximum Points	**10**

4.2.6 Total Score and Calculation of the Index

The points from each of the tests are summed and the result is divided by the maximum points (standard tests, stage 1) that can be achieved in the Clean Air assessment (see Table 18). The result is rounded

down to one decimal place and multiplied by ten. This score is – together with sub-scores in the other pillars – part of the calculation to check eligibility for additional robustness tests, stage 2. If the eligibility for second stage testing is given, after the tests are performed, the total number of scored points (stage 1 and stage 2) is divided through the maximum points available for both standard and additional robustness tests.

Table 18: Maximum points available in the Greenhouse Gas Index

Greenhouse Gas Index	Standard Tests	Standard + Additional Robustness Tests
Maximum Points	30	40

4.3 The Energy Efficiency Index

4.3.1 What is measured?

In simple terms, energy consumption is measured. The precise way in which this is done varies by fuel/energy type and details are contained in the individual test procedures. In summary, units of consumption are as follows:

Table 19: Energy Efficiency Units of Consumption

Energy Carrier	Units of Consumption
Petrol, Diesel	l / 100 km
Battery Electric	kWh / 100 km
CNG, Hydrogen Fuel Cell	kg / 100 km

4.3.2 The Tests

The tests used are the laboratory tests defined previously in Table 5 and used for the Clean Air Index, see Section 4.1.2. Energy Efficiency measured in on-road tests is not currently used for scoring, due to well-known repeatability and comparability issues of real-world consumption tests.

4.3.3 Energy Equivalent

To be able to compare energy efficiency of different powertrains, using different energy carriers, the consumption is converted into equivalent energy. Conversion factors are based on the known calorific content of the fuel types. In the case of battery electric vehicles, no conversion is needed as the units of consumption are already in SI units.

Table 20: Energy Conversion Factors. Multiplication of the liquid fuel (l / 100 km) or gaseous fuel (kg / 100 km) consumption with the specific factor gives the energy consumption in kWh / 100 km.

Energy Source	Conversion Factor l/ 100 km to kWh / 100 km
Petrol E10	8.64
Diesel B7	9.79
CNG (Methane, High)	13.89
Hydrogen	33.61
Electricity	1.00

4.3.4 The Scoring Principle

A linear sliding scale is used for scoring, as described in Section 4.1.4.
The following thresholds and scores are used for all tests and powertrain types:

Table 21: Energy Efficiency Thresholds

Lower Threshold kWh / 100 km	Upper Threshold kWh / 100 km	Maximum Score (≤ Lower Threshold)	Score at Upper Threshold
20	90	10	0

Energy consumption beyond the upper threshold leads to zero points, no negative points are scored in the Energy Efficiency Index.

4.3.5 Calculation of the Energy Efficiency Index

The scores of the lab tests are summed and the result is divided by the maximum points (standard tests, stage 1) that can be achieved in the Clean Air assessment (see Table 22). The result is rounded down to one decimal place and multiplied by ten. This score is – together with sub-scores in the other pillars – part of the calculation to check eligibility for additional robustness tests, stage 2. If the eligibility for second stage testing is given, after the tests are performed, the total number of scored points (stage 1 and stage 2) is divided through the maximum points available for both standard and additional robustness tests.

Table 22: Maximum points available in the Energy Efficiency Index

Energy Efficiency	Standard Tests	Standard + Additional Robustness Tests
Maximum Points	30	40

5 VISUALISATION OF RESULTS

Green NCAP's website presents the results of the tests to consumers in a way that is easy to comprehend. A colour scheme is adopted, representing different levels of performance. The logic for choosing the colour is based on the scored points as a proportion of the maximum points that could have been scored. This applies to the individual pollutants and gases in each test, to the energy efficiency in each test, and also to indicators of overall performance, such as all laboratory tests combined for example. The colouring logic is as follows:

Table 23: Logic for Colouring in Visualisation

Colour	Description	Logic (x = Score / Max Score)
Green	Good	$x \geq 0.90$
Yellow	Adequate	$0.60 \leq x < 0.90$
Orange	Marginal	$0.30 \leq x < 0.60$
Brown	Weak	$0.00 < x < 0.30$
Red	Poor	$x \leq 0.00$

6 Bi-Fuel Vehicles

Bi-fuel vehicles, e.g. CNG / petrol are tested in CNG mode (primary fuel), but undergo in addition a limited amount of additional tests in petrol mode (secondary fuel tests: WLTC+ Cold, PEMS+ Cold and BAB130). When for a specific constituent the ratio between primary and secondary fuel exceeds 1.5, a modifier of 50% is applied, based on the assumption that that the car's engine is also fed for a considerable amount by secondary fuel. For *monovalent* CNG vehicles, where petrol serves only as a fall back mode the modifier is 10%.

7 Plug-in Hybrid Electric Vehicles

A PHEV can be operated the following ways:

- CD (Charge Depleting) mode: with the high voltage (HV) battery charged where the vehicle will prioritise, if the situation allows it, to be run predominantly in electric vehicle (EV) mode only activating the internal combustion engine (ICE) in exceptional cases.
- CS (Charge Sustaining) mode: with the HV battery discharged where the vehicle acts like a NOVC-HEV (not off-vehicle charging (i.e. conventional) hybrid electric vehicle), running predominantly the ICE. The hybrid management system selects the strategy to be followed, i.e. when the power at the wheels is provided by the ICE, by the electric motor or both.

Green NCAP's test matrix aims to provide consumption and emissions values that are more realistic than the figures stated in official documents. This is achieved by testing under more representative conditions and postprocessing the results in a more sensible way by weighing both modes in accordance to the measured useful electric range.

The standard test stage (stage 1) for PHEVs considers the test matrix for ICE vehicles and HEVs when the vehicle is working in CS (Charge Sustaining) mode with the addition of the following tests done in CD (Charge Depleting) mode: WLTC+ CD Sequence (Cold Laboratory Test), PEMS+ Cold (On-Road Drive) and the On-Road Short Trip. The WLTC+ CD Sequence consists of driving the vehicle over the WLTC+ test starting with the HV battery at 100% state of charge (SoC). The requirements of the test are the same as of the WLTC+ Cold test. The vehicle is driven over multiple WLTC+ tests in a row until it reaches the CS condition. This WLTC+ CD Sequence procedure is also used to determine the available battery capacity and the EAER (Equivalent All Electric Range). EAER stands for the total driving range attributable to the use of electricity from the battery over the WLTC+ CD Sequence.

The tests driven in CD mode in the additional robustness test stage (stage 2) are PEMS+ Eco (On-Road Light Load) and PEMS+ Heavy (On-Road Heavy Load). These tests are not conducted in CS mode.

For PHEV, each index scores are calculated in both CD and CS mode and combined. The contribution of results in each mode is determined by the obtained EAER. The higher the EAER, the lower the influence of the results in CS mode and the other way round, see Table 24.

Table 24: CS/CD determining ratings for PHEV

PHEV	CD mode	CS mode
EAER > 100 km	80%	20%
25 km ≤ EAER ≤ 100 km	Sliding Scale	
EAER < 25 km	20%	80%

At a test level, the score of a test which is conducted in both CS and CD mode is the result of a weighting based on the assumed ratio of usage with charged battery and as a conventional hybrid vehicle. For this reason, the PHEV result of the Cold Laboratory Test (which is performed in CS and CD mode) is displayed to be higher than the result of the Warm Laboratory test (which is conducted only in CS mode).

8 APPENDIX

8.1 Rationale behind method and threshold values

Section	Rationale
2	Vehicles which are restricted to standard tests will not reach the highest or even a high score. In practice, the maximum score achievable, based on the standard tests only, will be limited to 3 stars. To avoid that vehicles that are subjected to additional robustness tests might drop below the scores based on standard tests only – which cannot be excluded – the minimal final score for these vehicles is set at 3 stars ("safety net").
3.1	Currently, the average index takes equal weights from Clean Air, Energy Efficiency and Greenhouse Gases. This makes all three equally important in terms of their influence on the star rating, reflecting equal weighting for public health, consumer spending and global warming, respectively.
4.1.1	These are the pollutant emissions which are considered the most important ones which can be measured with standard analysers. Particle number (PN23) is based on measurement with particle counters with a 23 nm particle size cut-off. Research has been done to study the correlation between this value and the number of sub-23 nm (PN10) particles for different vehicles and powertrain types. The measurement method may be refined to PN10 in time.
4.1.2	Details of the test methods are given in the specific procedures, available on https://www.greenncap.com/test-procedures/. Laboratory tests (WLTC+ and BAB130) are based on established test procedures. However, Green NCAP extends the boundary conditions to include different start and ambient temperatures and auxiliaries usage. In the same vein, the on-road tests are performed in a variety of load conditions – "normal" load, light load and heavy load – to better simulate real-world car use.
4.1.3	The same threshold values are used for all fuel and powertrain types to make the assessment and comparison of results technology-neutral. The lower threshold values are set close to zero emissions (in the range of the measurement accuracies of the used analysers). The lower threshold for PN23 emissions is set at a level which is representative for ambient emission levels. In other words, practically, only zero tailpipe pollutant emission powertrains are given the maximum score for the Clean Air Index. The upper thresholds for laboratory tests are based on the lowest value of diesel and petrol Euro 6d limit values. As this is the allowable legal limit, no points are scored for the pollutant at these values or beyond. In the THC threshold, CH_4 was taken out and shifted to 'Greenhouse Gas', resulting in a threshold for NMHC. The gross exceedance threshold represents the point at which the score for the entire test is capped to zero i.e. if any constituent pollutant reaches or exceeds this value, no points are scored in that test. The only exception is ammonia, NH_3, which is not regulated by legislation. For NH_3 the threshold value is derived from the requirements for heavy duty vehicle's (UN-R49) A conformity factor of 1.32 (recommended by JRC) is applied for the upper thresholds of PEMS tests compared to the lab tests as measurement repeatability is less precise.
4.1.4	A linear scale is used for scoring of all pollutants except PN23, between a maximum number of points for result values at or below the lower threshold, to zero points at the upper threshold. Beyond this upper threshold, scoring becomes negative, following the same slope. Thus, a car which performs well for one pollutant will have its score in that test decreased if another pollutant is above the upper threshold. This encourages good performance all-round and discourages optimisation of one at the expense of another pollutant. For PN23, a logarithmic scale is used, decreasing from a maximum at a PN23 measured value of 10^8 (i.e. a $\log_{10}$ value of 10^8 for the scale) to a score of zero at 6 x 10^{11}($\log_{10}$ value of 6 x 10^{11} for the scale) the Euro 6d limit. The upper threshold for on-road tests, WLTC+ CAT (-7 °C) and the respective gross exceedance limits are

	depicted in Table 6 and Table 7. Beyond the upper threshold (6 x 10^{11} for WLTC+ Cold, WLTC+ Warm and BAB130) the score continues to follow the line, becoming negative. The maximum score per pollutant reflects their relative harmful effects, and varies by the importance of the test.
4.2.1	These are the three most significant greenhouse gases emitted by vehicles. CO_2 is emitted in vastly greater quantities than N_2O or CH_4. However, the latter have a higher global warming potential.
4.2.1	CH_4 and N_2O are not regulated in Europe. The upper threshold value for N_2O is set at 10 mg/km based on analysis of already tested vehicles and expected Euro 7 proposal. CH_4 upper threshold corresponds to the result of the subtraction of NMHC (non-methane hydrocarbons) Euro 6d limit from the THC (total hydrocarbons) Euro 6d limit. The CO_2 threshold is derived from the fleet average of cars tested in ADACs Ecotest program, taking into account both tailpipe and upstream emissions for the Well-to-Wheel+ calculation. CH_4 and N_2O are considered with their global warming potential in the calculations of the total CO_2 emissions. The exceedance of the limits set for these gases do not lead to any negative score, but 0.5 bonus points per species and per test are credited to vehicles, which manage to keep the CH_4 and N_2O emissions below the respective thresholds. This measure should motivate manufacturers to keep the emissions low under all driving conditions. N_2O has also an ozone layer damaging properties due to its chemical reactions in the stratosphere, which is a further reason to give bonus points for good control of the emissions of this gas. There are no gross exceedance values for the Greenhouse Gas Index, and no capping of tests. The minimum test score is 0, the maximum is 10 points.
4.2.5	Only a linear scale is used in the Greenhouse Gas Index. Measurements in on-road tests (PEMS+ tests) are not repeatable enough to be used in the calculation of this index, so they do not currently contribute to the score. The test results, however, are used for informational purposes and are analysed to develop of a methodology for rating of the real-world fuel/energy consumption.
4.3.3	Reference test fuels with known properties are used.
4.3.4	A linear scale is used. However, for energy efficiency, the lower threshold (maximum points) is not zero, as all cars need to use *some* energy to move. The lower threshold in this case is 20 kWh/100km; the upper threshold, at which no points are scored, is 90 kWh/100km. These values are chosen to reflect the typical range of energy consumptions seen in modern vehicles and to give sufficient resolution of the results. The minimum score per test is zero (i.e. a test cannot have a negative score).
5	Colours are based on scored points as a proportion of the maximum available points for that constituent in that test. A band of 10 percent below the maximum possible score is allowed to define ‘good’ performance. ‘Poor’ performance is defined as a value of emission at or beyond the prescribed upper threshold. The bands representing other levels of performance are split equally between in the range 0 to 90 percent.