Green NCAP

Addendum – Vehicles 2019

www.greenncap.com

....

Dipl.-Ing. Marcus Szikora

This report consists of 56 pages.

Executive Summary

Green NCAP, founded with its launch on 28th Feb. 2019, is an independent initiative which promotes the development of cars which are clean, energy efficient and not harmful to the environment. It aims to improve the quality of the air that we breathe, to maximise the use of resources used for passenger transportation and to reduce global warming.

Based on the work done in recent years, testing continued in 2019. The Green NCAP program selected mainly Euro6d-temp vehicles representative of high market shares, of representative engine type and latest technologies available in the EU. Except for one vehicle fuelled with CNG, which is a Euro6b vehicle. In 2019, 2 petrol, 3 diesel, 1 pure electric and 2 bi-fuel vehicles (CNG/petrol) were tested.

A summary of Green NCAP star ratings for the 2018 and 2019 batch of vehicles is shown in *Figure 1*. For further information, please see www.greenncap.com.
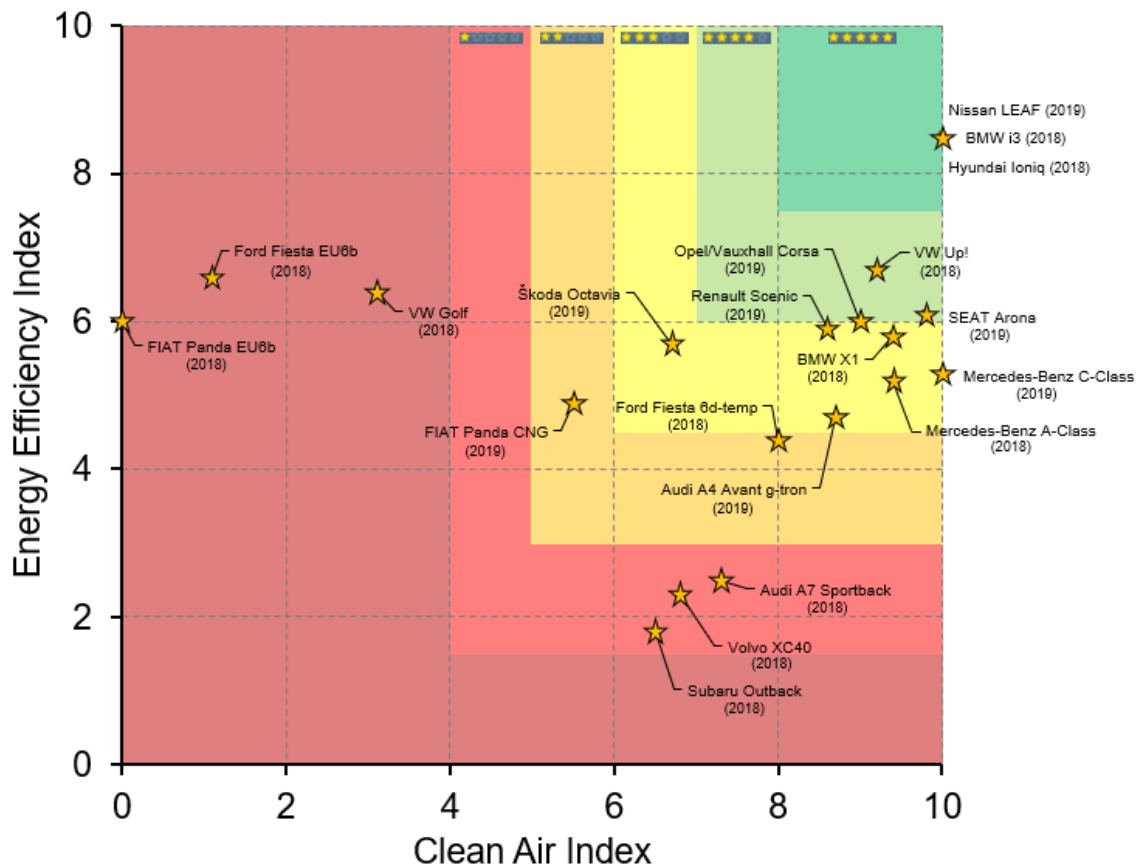

Figure 1: Star Rating of all tested vehicles within the Green-NCAP program
(numbers in brackets indicate Green-NCAP test year)

Table of content

1 Introduction

1.1 Mission & Vision

Green NCAP, founded with its launch on 28th Feb. 2019, is an independent initiative which promotes the development of cars which are clean, energy efficient and not harmful to the environment. It aims to improve the quality of the air that we breathe, to maximise the use of resources used for passenger transportation and to reduce global warming.

The highest standard is attributed to a car that maximises the reduction of its own pollutants and greenhouse gases and, at the same time, operates at minimised fossil fuel consumption and/or maximized energy efficiency under real-world conditions.

Pollutant emissions from transportation are one of the main contributors to poor air quality world-wide, especially in cities. Air quality problems are known to be the root cause of many health problems and even premature death, so the need to reduce the pollutants emitted by road vehicles has never been greater.

Good progress has been achieved over the past decades through a combination of policies and measures, such as technological standards for vehicle emissions and fuel quality, legislation establishing air quality limits, and improved transport planning and public transport incentives. Nevertheless, the overall increases in passenger and freight demand, as well as the under-performance of certain vehicles in real-life driving conditions, as opposed to their performance in a test environment, mean that emission reductions have not always been as large as expected.

Emissions of several pollutant gases are regulated by legislation in the EU. All cars sold in Europe must pass type-approval tests to demonstrate that their emissions of carbon monoxide, oxides of nitrogen, unburnt hydrocarbons and particulate matter do not exceed certain critical values. However, regulation offers no reward to manufacturers who go beyond the minimum standards of approval testing.

Green NCAP uses a broad range of tests to address the flaws in approval tests and, through consumer information, rewards those manufacturers whose vehicles go beyond the

minimum requirements and offer excellent, robust, real-world performance. Regulatory testing is a good starting point. Green NCAP's tests are an addition and complementary to these legislative requirements.

For further information, please see www.greenncap.com.

1.2 Scope

Until recently, the internal combustion engine was the only power unit readily available to car buyers. Petrol and diesel-powered cars have been around for decades and have become increasingly sophisticated, delivering ever-better on-road performance and improved fuel economy. From the 1990s, the diesel engine in particular became increasingly popular, with better fuel economy than petrol and lower carbon dioxide emissions. In recent years, the harmful effects of diesel engines have become apparent; some cities are banning, or proposing to ban, such vehicles from their centres and there has been a sharp drop in sales.

Car manufacturers are looking to electric propulsion to reduce the emissions footprint of the fleet. Hybrid vehicles have been offered for several years and, more recently, fully electric cars have emerged which promise to drastically reduce emissions from transportation.

Today, most new models are offered with a range of power units: petrol, diesel, hybrid and, sometimes, full electric. Petrol and diesel variants may be offered with a choice of power/torque outputs, most often achieved by different mapping. Green NCAP aims to provide information about as many of these variants as possible but it is almost impossible for an independently-funded organisation to test all of them. The most popular vehicle types, across the range of powertrain types will be tested, to try to maximise the information available to consumers. In time, as more cars are added, the database will expand to provide a comprehensive resource to individual car-buyers and to fleet managers. To begin with, Green NCAP will look only at passenger cars. The impact of goods and freight vehicles is recognised but is beyond the scope of the initiative, at least to begin with.

The testing and assessment of hybrid vehicles is very complex. To get representative and comparable figures, the state of charge of the battery must be known and incidences of

battery charging etc recorded. Green NCAP is currently developing these testing protocols and will, in the near future, publish results for hybrid vehicles as well as combustion and electric cars.

Green NCAP's tests currently involve the measurement of gaseous emissions in a range of different test environments, both in the laboratory and on the road. The tests therefore consider only the emissions generated by the vehicle once it is on the road. This is known as 'tank to wheel' assessment. However, on a global scale, other factors are important too. For petrol and diesel engines, the energy expended in extracting the fuel and delivering it to the point of sale is important; for electric vehicles, the energy 'mix' of the electricity used for charging the car is important – good if comes from renewable energy; bad if it comes from fossil fuels like coal. This measure of emissions is known as 'well to wheel'. Ultimately, all of the energy that goes into producing the car in the first place should also be considered – a whole 'life-cycle' assessment. This is Green NCAP's ultimate aim: to be able to inform consumers which vehicles are the least damaging to produce, operate and, at the end of their useful lives, to destruct and recycle. However, at the start, Green NCAP will focus on 'tank to wheel' emissions.

In the future, Green NCAP will also consider environmental factors such as noise – now proven to cause sleep disturbance, cardiovascular disease, elevated hormone levels, psychological problems and even premature death. So, the scope of the program will grow rapidly in the coming years.

2 Legislative vs. Consumer Testing

In Europe the process is known as 'type-approval' and regulates vehicle performance in many areas like noise and emissions, full-scale crash testing but also such things as headlamps, seatbelts etc. In total, there are over 50 areas which have to be covered and each one of these can encompass several tests. Type-approval ensures a minimum standard for all cars – a baseline for all. Tests are conducted by Technical Services – government appointed laboratories – and the results are not made public. Car-buyers know only that, if the car is on sale, it must have met the minimum standards in all areas of type-approval.

Ensuring this baseline standard is, of course, important but type-approval provides no information for consumers to choose one car over another and provides no incentive to manufacturers to improve the performance of their vehicles above the minimum requirements. In some areas, car manufacturers outperform the type-approval requirements. In braking, for example, consumer expectation has far exceeded the regulatory requirements and cars that did no more than the minimum would lose favour in the marketplace.

In some areas, though, consumers have no way of knowing how cars perform: whether they just meet the minimum standards or exceed them. Safety is one such area where, without the information provided by independent bodies like Euro NCAP, consumers would be unable to make a purchasing decision based on measured performance. Likewise, in emissions. Legislation across the world has become tougher and tougher and cars now outperform those of decades ago by several orders of magnitude. But consumers cannot compare the pollutant emissions of one car to those of another so cannot choose a car on this basis, and revelations in recent years have shown how easily manufacturers can exploit loopholes to their advantage.

Consumer testing adds another layer to regulatory requirements, and the two systems complement each other. Consumer tests can be tougher than legislation because there is no pass/fail i.e. cars do not have to be withdrawn from sale if they perform poorly in the tougher tests. Consumer ratings show the relative performance of vehicles, allowing consumers to make a choice. This freedom to choose puts pressure on manufacturers to

perform well; to demonstrate that their vehicles are as good or better than their competitors. Competition in the market-place leads to innovation as manufacturers jostle for position. In the field of emissions, this innovation and competition for excellence will, it is hoped, lead to cars that are cleaner and more efficient, to the benefit of car owners and the environment.

For further information, please see www.greenncap.com.

3 Rating System – Star Rating

This is the highest and simplest level at which cars can be compared. It is a single, overall rating that summarises a vehicle's performance in Clean Air and Energy Efficiency. The higher the star rating, the better the car has performed. Since the star rating indicates the poorer performance in the two areas of assessment, cars with a high star rating have performed well in both; those with a poor rating may have performed well in one but have done badly in another. This prevents that performance in one area is optimised to the detriment of the other.

Green NCAP's test protocols are constantly evolving so a car rated in one year may have been tested and scored differently to one in another year. The baseline tests remain the same but, as new technologies emerge and in order to continue to challenge the car manufacturers, additional tests may be added or the thresholds for star ratings made tougher. For this reason, the ratings are marked with the year they were issued. For the same star rating, the newer it is the better. For example, in the future, a car with a 2022 five-star rating will be better than one with a 2019 five-star rating. Care should be taken to ensure that star ratings can be compared across years.

Small differences in engine tuning can have a significant influence on emissions performance. So, for example, a vehicle may perform very differently in our tests to one with a higher or lower power/torque, even if the main engine block and components are the same. Legislation, which ensures only a minimum level of performance, applies the concept of engine 'families' where the result of the 'worst-case' engine ensures compliance of other, similar engines. However, for consumer information, where specific information is needed, this concept cannot be applied. For this reason, the star rating applies only to the specific vehicle/variant tested.

Interpretation of the star rating given for a specific vehicle:
- **5 stars:** Overall excellent performance, showing very low fuel or energy consumption and at the same time emitting low pollutants and greenhouse gasses. Well-equipped with emission abatement and fuel saving technology.
- **4 stars:** Overall good environmental performance; equipped with good and robust emission abatement and fuel saving technology.

- **3 stars:** Average to good overall performance but equipped with regular emission abatement and fuel saving technology fitted, not outperforming competitors.
- **2 stars:** Nominal overall environmental performance lacking some emission abatement and/or fuel saving technology with room for improvement.
- **1 star:** Marginal environmental performance showing that pollutant control and/or energy efficiency is compromised. The environmental performance design mix constituted by minimising pollutants, greenhouse gasses and fuel & energy consumption leaves considerable room for system design improvements.
- **0 stars:** overall environmental performance just meeting the minimum regulatory standards, possibly outdated emission abatement and fuel saving technology.

For further information, please see www.greenncap.com.

3.1 Indexes

The star rating indicates how well the car has performed overall. If it has a good star rating, it has performed well both for Clean Air and Energy Efficiency; if its rating is poor then it has performed poorly in one or both of these areas of assessment. The two indexes are the second level at which cars can be compared.

The star rating is based on the area of assessment in which the car has performed most poorly. If it has a good star rating, it has performed well both for Clean Air and Energy Efficiency; if its rating is poor then it has performed poorly in one or both of these areas of assessment. The two indexes are the second level at which cars can be compared.

Clean Air Index

This index shows a score out of ten for the performance of a vehicle in mitigating pollutant emissions. These are gases and particulate matter emitted from the tailpipe which are harmful to human health and to the environment.

A high index indicates good performance (i.e. low emissions).

Energy Efficiency Index

This index shows a score out of ten for the efficiency with which energy is converted to propel the vehicle.

A high index shows that little energy is needed per unit distance, indicating an efficient vehicle.

Greenhouse Gases

As well as the Clean Air Index and the Energy Efficiency Index, Green NCAP monitors the emissions of so-called greenhouse gases.

Greenhouse gases absorb reflected solar energy, making the Earth's atmosphere warmer. A lot of the sun's energy reaches the ground directly, and a portion is reflected by the ground back into space. Some gases, when present in the atmosphere, trap that reflected energy and redirect it back to Earth as heat. The gases responsible for this are called greenhouse gases, as they play a similar role to the glass covering a greenhouse.

3.2 Color Code for detailed results

Displaying the results in an easy-to-understand way is important. Therefore, the results of the different tests – laboratory and road – are shown with significant colors. The meaning of those colors regarding the corresponding performance is:

- 🟢 good
- 🟡 adequate
- 🟠 marginal
- 🟤 weak
- 🔴 poor
- ⚪ not available

4 Testmatrix

For the Green NCAP program, tests are performed in the laboratory as well as on road.

Green NCAP performs a wide range of tests on cars in the laboratory. This is the best way of ensuring controlled conditions, to ensure that all cars are tested in the same way so that their results are comparable.

An on-road driving test, using portable emissions measuring equipment, complements Green NCAP's laboratory tests. The test extends the legislative requirements to get an accurate assessment of real-world emissions.

For further information, please see www.greenncap.com.

4.1 Laboratory Tests

In laboratory tests, a car is put on a chassis dynamometer – a 'rolling road' – and is driven through a prescribed test cycle. During the test, exhaust gases are collected. These gases are analysed at the end of the drive-cycle to determine the amount of pollutant emissions, particulate matter and greenhouse gases the car emitted during the cycle.

The dynamometer can be set to simulate the resistance a car would normally experience in real-world driving. These are mainly an inertial resistance (i.e. a heavier car is more difficult to accelerate than a light one) and aerodynamic drag. So, a light, streamlined car is tested on the dynamometer with less resistance than a heavy one with poor aerodynamics.

At the core of Green NCAP's lab tests is the World-harmonised Light-vehicles Test Cycle (WLTC), introduced in 2017 as a global test procedure, developed on the basis of global real-driving data and representative of everyday driving. The WLTC replaced the old NEDC test cycle (New European Driving Cycle) which had been in use for some 40 years previously. The WLTC driving cycle is divided into four parts (low, medium, high, extra high), which address different types of use, with a wide variation of driving behaviour and driving situations. Each part represents different driving phases like city or urban driving with a variation of vehicle speeds and different stop times, accelerations and braking phases.

Green NCAP's laboratory tests are based on the WLTC test procedure but with more realistic boundary conditions. All tests are performed with an ambient temperature of about 14°C which is much closer to the European average than the one used in the legislative test cycle. In addition, the conditioning of the car corresponds more to the real world: the test is driven with a realistic payload and with activation of typical vehicle systems like headlights and air-conditioning.

Green NCAP also evaluates the robustness of the vehicle's exhaust after-treatment system. This 'robustness' checks that the emissions-control systems work effectively over a broad range of conditions and not just in one prescribed test. To evaluate this, the WLTC test is performed several times with different vehicle settings. Different starting conditions like cold start and regular running engine temperature are covered, as well as different driving modes like eco-mode and sport-mode.

To evaluate the robustness of the exhaust after-treatment system at high engine loads, a motorway test-cycle (BAB130) is also performed. This test cycle has a maximum speed of 130 km/h and includes several hard accelerations from 80 km/h to 130 km/h.

In summary five different lab tests are performed:
- WLTC cold
- WLTC warm with standard-mode
- WLTC warm with eco-mode
- WLTC warm with sports-mode
- BAB130 motorway-cycle

During all cycles, the pollutants (HC, CO, NO_x, PN, PM) and CO_2 emissions are measured as well as fuel consumption values.

The main purpose of the lab tests is to have the most realistic and comparable results from different cars and propulsion systems in terms of their emissions and fuel economy/energy efficiency. The test conditions, the vehicle set-up and the execution of the tests are standardised and clearly defined. This is important for a fair and a high-quality assessment and evaluation of cars. Between them, the tests cover such a broad range of engine

performance that there is little opportunity for manufacturers to employ engine management strategies that are not reflective of real-world driving. Only lab tests with a standardised and repeatable methodology allow consumers to compare different car models.

4.2 Road Tests

In addition to the tests carried out in the laboratory, Green NCAP also conducts a real-world driving test, during which tailpipe emissions are collected and sampled. The basis of this test is the Real Driving Emissions (RDE) assessment, introduced into legislation in 2018 to try to control and reduce the gap between emissions values measured in the lab and those emitted in the real world. Green NCAP expands the RDE to make it more challenging and to test under less frequently occurring but realistic traffic situations. Green NCAP's vision is that an engine shall be clean and energy efficient in every operation point under the torque curve. Examples of these enhanced boundary conditions of the PEMS+ test compared to the regulatory RDE test are 0 – 1300 m altitude vs 0 -700m or an ambient temperature between -7 to 35°C instead of 0 to 30 °C.

The drive is split into three parts, representing urban, rural and motorway driving, and exhaust gases are collected from the tailpipe by a Portable Emissions Measurement System (PEMS), attached to the back of the car. The pollutant emissions measured are NO_x, CO and PN. In the future, more robust measurement of hydrocarbons using PEMS will allow the inclusion of this pollutant in the calculation of the Clean Air Index.

In the future, additional PEMS tests will be conducted to further broaden the range of engine load conditions assessed and to explore even further the true effectiveness of a manufacturer's emissions mitigation strategy.

5 2019's tested vehicles and results

The Green NCAP program selected mainly Euro6d-temp vehicles representative of high market shares, of representative engine type and latest technologies available in the EU. Except for one vehicle fuelled with CNG, which is a Euro6b vehicle.

Green NCAP choose not to test hybrid vehicles, because of the complexity of the issue to be developed and the need of longer time than available to develop robust procedures. Nevertheless, as Green NCAP deemed it essential to point out that all engine technologies shall be in the scope of the Green NCAP program, a pure electric vehicle was included in the batch.

In total, eight vehicles were tested in 2019 within the Green NCAP program:

- 2 petrol engine vehicles
    - SEAT Arona (chapter 5.1)
    - Opel/Vauxhall Corsa (chapter 5.2)
- 3 diesel engine vehicles
    - Mercedes-Benz C-Class (chapter 0)
    - Škoda Octavia (chapter 5.4)
    - Renault Scenic (chapter 5.5)
- 1 pure electric vehicle
    - Nissan LEAF (chapter 5.6)
- 2 bi-fuel vehicles (CNG/petrol)
    - Audi A4 Avant g-tron (chapter 5.7)
    - FIAT Panda (chapter 5.8)

5.1 SEAT Arona

The overall rating of the tested SEAT Arona is shown in *Figure 2*.
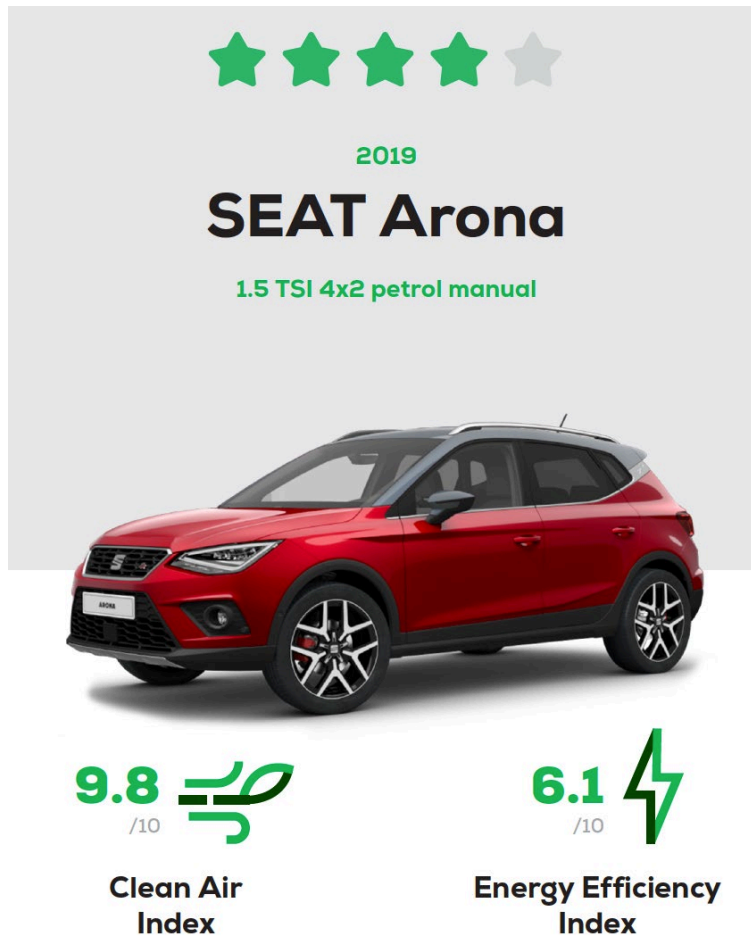
Figure 2: Star Rating for SEAT Arona

The different results, leading to the Clear Air Index and the Energy Efficiency Index respectively, are shown in *Figure 3* and *Figure 4*. Additional information regarding Greenhouse Gases are shown in *Figure 5*. For further explanation on the color code, please refer to chapter 3.2

9.8
/10

Clean Air Tests

	Laboratory test	HC	CO	NO$_x$	PN
9.0/9	Cold Test*	🟢	🟢	🟢	🟢
3.0/3	Warm Test#	🟢	🟢	🟢	🟢
3.0/3	Eco Mode#	🟢	🟢	🟢	🟢
3.0/3	Sport Mode#	🟢	🟢	🟢	🟢
8.6/9	Highway#	🟢	🟠	🟢	🟡
	Road test				
7.0/7	On-Road Drive*	⚪	🟢	🟢	🟢
	Robustness				

Figure 3: Overview – test results for Clean Air Index; SEAT Arona

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)

6.1 /10 ⚡ Energy Efficiency Tests

	Laboratory test	Energy
		🟡
8.0/10	Cold Test*	🟡
2.5/3	Warm Test#	🟡
2.5/3	Eco Mode#	🟡
2.5/3	Sport Mode#	🟡
5.4/10	Highway#	🟠

Consumption	Fuel
Average consumption	5.9 l/100 km
Worst-case consumption	7.3 l/100 km

Figure 4: Overview – test results for Energy Efficiency Index; SEAT Arona

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)*

Additional Information

Greenhouse Gases **	CO_2
Cold Test*	🟡
Warm Test#	🟡
Eco Mode#	🟡
Sport Mode#	🟡
Highway#	🟠

Figure 5: Overview – additional information for Greenhouse Gases; SEAT Arona

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests;*
*** … For indication only. The assessment of greenhouse gases does not currently form part of the rating.)*

Our Verdict:

SEAT's small SUV crossover, the Arona, turns in a strong performance in Green NCAP's tests. With a 1.5 litre GDI engine and comprehensive exhaust after-treatment, including a three-way catalyst and gasoline particulate filter, the Euro 6d-Temp compliant car scores almost full marks for Clean Air, with an index of 9.8 out of 10. Control of all pollutant emissions is good in all tests except the high-load highway test, where particulate emissions are adequate and CO emissions slip to marginal. In general, though, the after-treatment works exceptionally well and the result for Clean Air is an impressive one. For Energy Efficiency, performance is adequate but unexceptional and the car just clears the four-star threshold. Overall, the car's rating is limited by its performance in this part of the assessment.

5.1.1   Test results in detail

The detailed emissions results are listed in *Table 1*, results for fuel and energy consumption in *Table 2*.

Table 1: Results, part 1 – emission components; SEAT Arona

MAIN RESULTS			CO	THC	NO$_x$	PM	PN	CO$_2$
			mg/km	mg/km	mg/km	mg/km	#/km	g/km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	90,0	20,0	23,0	0,000	2,9E+10	133,4
		WLTC+ cold engine 2	92,0	19,0	23,0	0,100	2,6E+10	131,2
		WLTC+ cold engine Average	91,0	19,5	23,0	0,050	2,8E+10	132,3
	Robustness	WLTC+ warm engine	8,0	1,0	20,0	0,000	2,1E+10	130,1
		WLTC+ warm engine Eco mode	12,0	2,0	17,0	0,000	2,3E+10	128,6
		WLTC+ warm engine Sport mode	26,0	1,0	22,0	0,000	2,0E+10	129,5
		BAB130 Motorway	509,0	7,0	3,0	1,100	6,8E+10	168,7
Real-World tests	PEMS+ approval	PEMS+ cold engine	29,7	n.a.	16,5	n.a.	4,6E+09	153,8
	Robustness	PEMS+ warm engine Eco	3,7	n.a.	10,9	n.a.	1,3E+08	132,6
		PEMS+ warm engine Heavy Load	16,7	n.a.	30,6	n.a.	3,8E+09	198,7

Table 2: Results, part 2 – fuel and energy consumption; SEAT Arona

MAIN RESULTS			Fuel Consumption	Energy Consumption
			l/100km	kWh/100km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	5,74	49,8
		WLTC+ cold engine 2	5,65	49,0
		WLTC+ cold engine Average	5,70	49,4
	Robustness	WLTC+ warm engine	5,59	48,5
		WLTC+ warm engine Eco mode	5,53	47,9
		WLTC+ warm engine Sport mode	5,57	48,3
		BAB130 Motorway	7,29	63,2
Real-World tests	PEMS+ approval	PEMS+ cold engine	6,50	56,4
	Robustness	PEMS+ warm engine Eco	5,61	48,6
		PEMS+ warm engine Heavy Load	8,40	72,8

5.1.2 Technical Data

The technical data of the tested SEAT Arona are summarized in *Figure 6*.

Year of Publication	Tested Car	Emissions Class
2019	VSSZZZKJZKR11XXXX	Euro 6d-Temp
Mass	Engine Size	Engine Power/Torque
1,149 kg	1,498 cc	110 kW/250 Nm
Tyres	Published CO$_2$	
215/45 R18	132 g/km	

Figure 6: Technical Data of SEAT Arona

The summarized rating sheet is available on www.greenncap.com.

5.2 Opel/Vauxhall Corsa

The overall rating of the tested Opel/Vauxhall Corsa is shown in *Figure 7*.

Figure 7: Star Rating for Opel/Vauxhall Corsa

The different results, leading to the Clear Air Index and the Energy Efficiency Index respectively, are shown in *Figure 8* and *Figure 9*. Additional information regarding Greenhouse Gases are shown in *Figure 10*. For further explanation on the color code, please refer to chapter 3.2

9.0/10 Clean Air Tests

Laboratory test		HC	CO	NO$_x$	PN
7.0/9	Cold Test*	🟢	🟢	🟢	🟠
3.0/3	Warm Test#	🟢	🟡	🟢	🟢
3.0/3	Eco Mode#	🟢	🟡	🟢	🟢
3.0/3	Sport Mode#	🟢	🟡	🟢	🟢
7.9/9	Highway#	🟢	🟤	🟢	🟡
	Road test				
7.0/7	On-Road Drive*	⚪	🟢	🟢	🟢
	Robustness				

Figure 8: Overview – test results for Clean Air Index; Opel/Vauxhall Corsa

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)

6.0 /10 ⚡ Energy Efficiency Tests

	Laboratory test	**Energy**
8.2/10	Cold Test*	🟡
2.4/3	Warm Test#	🟡
2.4/3	Eco Mode#	🟡
2.4/3	Sport Mode#	🟡
5.1/10	Highway#	🟠

Consumption	**Fuel**
Average consumption	**6.1 l**/100 km
Worst-case consumption	**7.4 l**/100 km

Figure 9: Overview – test results for Energy Efficiency Index; Opel/Vauxhall Corsa

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)*

Additional Information

Greenhouse Gases **	**CO_2**
Cold Test*	🟡
Warm Test#	🟡
Eco Mode#	🟡
Sport Mode#	🟡
Highway#	🟠

Figure 10: Overview – additional information for Greenhouse Gases; Opel/Vauxhall Corsa

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests;*
*** … For indication only. The assessment of greenhouse gases does not currently form part of the rating.)*

Our Verdict:

The iconic Opel/Vauxhall Corsa is due to be replaced later this year with a Peugeot-Citroën derived model. The car tested here is the fifth-generation Corsa E, developed under GM. With a one-litre 66 kW engine, and meeting Euro 6d-temp regulations, the car performed very well for Clean Air, with generally low pollutant emissions. After-treatment includes a three-way catalyst and gasoline particulate filter, which work well to keep emissions well controlled.

Energy efficiency is also generally good, and just above the four-star threshold. In the high-load highway test, efficiency is marginal, and it is here that the maximum fuel consumption of 7.4 l/100 km is recorded.

Four stars is a creditable result for a petrol-engined vehicle, and the Corsa performs especially well in its control of pollutant emissions.

5.2.1   Test results in detail

The detailed emissions results are listed in *Table 3*, results for fuel and energy consumption in *Table 4*.

Table 3: Results, part 1 – emission components; Opel/Vauxhall Corsa

MAIN RESULTS			CO	THC	NO$_x$	PM	PN	CO$_2$
			mg/km	mg/km	mg/km	mg/km	#/km	g/km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	237,8	13,7	9,1	0,404	4,2E+11	128,2
		WLTC+ cold engine 2	319,2	20,7	9,6	0,246	2,2E+11	125,2
		WLTC+ cold engine Average	278,5	17,2	9,4	0,325	3,2E+11	126,7
	Robustness	WLTC+ warm engine	292,5	9,7	7,6	0,000	2,3E+10	130,1
		WLTC+ warm engine Eco mode	no Eco mode available					
		WLTC+ warm engine Sport mode	no Sport mode available					
		BAB130 Motorway	819,7	25,8	1,9	1,134	1,3E+11	167,6
Real-World tests	PEMS+ approval	PEMS+ cold engine	157,4	n.a.	6,2	n.a.	3,7E+10	136,3
	Robustness	PEMS+ warm engine Eco	95,3	n.a.	6,8	n.a.	1,5E+10	117,1
		PEMS+ warm engine Heavy Load	319,3	n.a.	8,4	n.a.	3,0E+10	166,5

Table 4: Results, part 2 – fuel and energy consumption; Opel/Vauxhall Corsa

MAIN RESULTS			Fuel Consumption	Energy Consumption
			l/100km	kWh/100km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	5,65	49,0
		WLTC+ cold engine 2	5,53	47,9
		WLTC+ cold engine Average	5,59	48,5
	Robustness	WLTC+ warm engine	5,74	49,7
		WLTC+ warm engine Eco mode	no Eco mode available	
		WLTC+ warm engine Sport mode	no Sport mode available	
		BAB130 Motorway	7,42	64,3
Real-World tests	PEMS+ approval	PEMS+ cold engine	6,00	52,0
	Robustness	PEMS+ warm engine Eco	5,15	44,6
		PEMS+ warm engine Heavy Load	7,34	63,6

5.2.2 Technical Data

The technical data of the tested Opel/Vauxhall Corsa are summarized in *Figure 11*.

Year of Publication	Tested Car	Emissions Class
2019	W0V0XEP08A602XXXX	Euro 6d-temp
Mass	Engine Size	Engine Power/Torque
1,088 kg	999 cc	66 kW/169 Nm
Tyres	Published CO₂	
195/55R16	138 g/km	

Figure 11: Technical Data of Opel/Vauxhall Corsa

The summarized rating sheet is available on www.greenncap.com.

5.3 Mercedes-Benz C-Class

The overall rating of the tested Mercedes-Benz C-Class is shown in *Figure 12*.
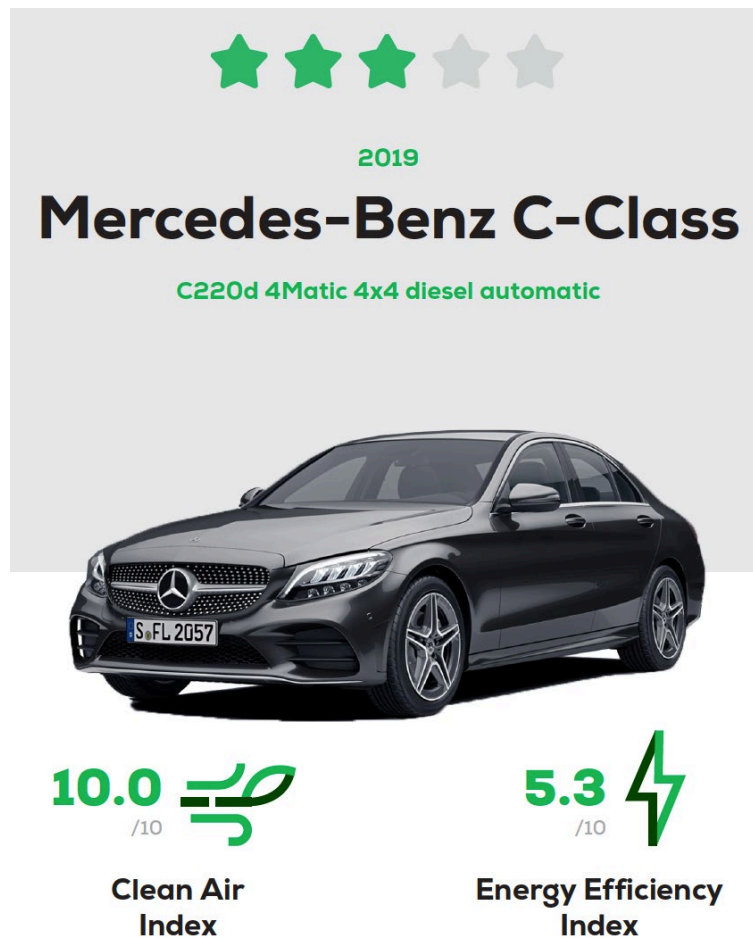

Figure 12: Star Rating for Mercedes-Benz C-Class

The different results, leading to the Clear Air Index and the Energy Efficiency Index respectively, are shown in *Figure 13* and *Figure 14*. Additional information regarding Greenhouse Gases are shown in *Figure 15*. For further explanation on the color code, please refer to chapter 3.2

Clean Air Tests

10.0 /10

	Laboratory test	HC	CO	NO$_x$	PN
9.0/9	Cold Test*	🟢	🟢	🟢	🟢
3.0/3	Warm Test#	🟢	🟢	🟢	🟢
3.0/3	Eco Mode#	🟢	🟢	🟢	🟢
3.0/3	Sport Mode#	🟢	🟢	🟢	🟢
9.0/9	Highway#	🟢	🟢	🟢	🟢
	Road test				
7.0/7	On-Road Drive*	⚪	🟢	🟢	🟢
	Robustness				

Figure 13: Overview – test results for Clean Air Index; Mercedes-Benz C-Class

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)

5.3 ⚡ Energy Efficiency Tests

	Laboratory test	Energy
6.6/10	Cold Test*	🟠
2.3/3	Warm Test#	🟡
2.3/3	Eco Mode#	🟡
2.2/3	Sport Mode#	🟡
4.7/10	Highway#	🟠

Consumption	Fuel
Average consumption	5.7 l/100 km
Worst-case consumption	6.8 l/100 km

Figure 14: Overview – test results for Energy Efficiency Index; Mercedes-Benz C-Class

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)

Additional Information

Greenhouse Gases **	CO_2
Cold Test*	🟠
Warm Test#	🟡
Eco Mode#	🟡
Sport Mode#	🟡
Highway#	🟠

Figure 15: Overview – additional information for Greenhouse Gases; Mercedes-Benz C-Class

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests;
** … For indication only. The assessment of greenhouse gases does not currently form part of the rating.)

Our Verdict:

Mercedes-Benz's fourth generation C-Class, tested here with as the C220d 4Matic, puts paid to the notion that diesel engines are necessarily dirty. With selective catalyst reduction and a diesel particulate filter, the C220d 4Matic delivers exceptionally good results for low pollutant emissions and becomes the first non-electric vehicle tested by Green NCAP to achieve a full score in the Clean Air index. With good performance in all of the lab and on-road tests, the results show that, with careful calibration and effective after-treatment, diesel engine cars can deliver extremely low emissions.

The car's energy efficiency is less exceptional and pulls the overall star rating down to three. Fuel consumption is not much worse in sports mode than it is in normal drive mode, but nor is it noticeably better in eco mode.

Overall, the C220d 4Matic is a strong performer, with excellent results for low pollutant emissions.

5.3.1   Test results in detail

The detailed emissions results are listed in *Table 5*, results for fuel and energy consumption in *Table 6*.

Table 5: Results, part 1 – emission components; Mercedes-Benz C-Class

MAIN RESULTS			CO	THC	NO$_x$	PM	PN	CO$_2$
			mg/km	mg/km	mg/km	mg/km	#/km	g/km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	17,0	4,0	9,0	0,000	2,6E+09	152,6
		WLTC+ cold engine 2	27,0	5,0	9,0	0,100	9,1E+08	151,1
		WLTC+ cold engine Average	22,0	4,5	9,0	0,050	1,7E+09	151,9
	Robustness	WLTC+ warm engine	3,0	1,0	1,0	0,000	1,2E+09	137,2
		WLTC+ warm engine Eco mode	2,0	2,0	1,0	0,000	3,2E+08	138,1
		WLTC+ warm engine Sport mode	2,0	2,0	3,0	0,000	8,2E+08	142,2
		BAB130 Motorway	6,0	0,0	12,0	0,100	6,3E+09	177,8
Real-World tests	PEMS+ approval	PEMS+ cold engine	17,1	n.a.	6,4	n.a.	5,0E+08	152,9
	Robustness	PEMS+ warm engine Eco	13,3	n.a.	3,4	n.a.	6,0E+08	137,0
		PEMS+ warm engine Heavy Load	25,7	n.a.	3,8	n.a.	4,1E+09	168,1

Table 6: Results, part 2 – fuel and energy consumption; Mercedes-Benz C-Class

MAIN RESULTS			Fuel Consumption	Energy Consumption
			l/100km	kWh/100km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	5,80	57,2
		WLTC+ cold engine 2	5,74	56,6
		WLTC+ cold engine Average	5,77	56,9
	Robustness	WLTC+ warm engine	5,21	51,4
		WLTC+ warm engine Eco mode	5,24	51,7
		WLTC+ warm engine Sport mode	5,40	53,2
		BAB130 Motorway	6,75	66,6
Real-World tests	PEMS+ approval	PEMS+ cold engine	5,80	57,2
	Robustness	PEMS+ warm engine Eco	5,20	51,3
		PEMS+ warm engine Heavy Load	6,38	63,0

5.3.2   Technical Data

The technical data of the tested Mercedes-Benz C-Class are summarized in *Figure 16*.

Year of Publication	Tested Car	Emissions Class
2019	WDD2050151F89XXXX	Euro 6d-temp
Mass	Engine Size	Engine Power/Torque
1,590 kg	1,950 cc	143 kW/400 Nm
Tyres	Published CO_2	
225/50 R17	166 g/km	

Figure 16: Technical Data of Mercedes-Benz C-Class

The summarized rating sheet is available on www.greenncap.com.

5.4 Škoda Octavia

The overall rating of the tested Škoda Octavia is shown in *Figure 17*.

Figure 17: Star Rating for Škoda Octavia

The different results, leading to the Clear Air Index and the Energy Efficiency Index respectively, are shown in *Figure 18* and *Figure 19*. Additional information regarding Greenhouse Gases are shown in *Figure 20*. For further explanation on the color code, please refer to chapter 3.2

6.7 /10 **Clean Air Tests**

	Laboratory test	HC	CO	NO$_x$	PN
7.8/9	Cold Test*	🟢	🟢	🟠	🟢
2.7/3	Warm Test#	🟢	🟢	🟡	🟢
2.7/3	Eco Mode#	🟢	🟢	🟡	🟢
2.7/3	Sport Mode#	🟢	🟢	🟡	🟢
0.0/9	Highway#	🟢	🟢	🔴	🟢
	Road test				
7.0/7	On-Road Drive*	⚪	🟢	🟢	🟢
	Robustness				

Figure 18: Overview – test results for Clean Air Index; Škoda Octavia

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)

Energy Efficiency Tests

5.7 /10

	Laboratory test	Energy
7.5/10	Cold Test*	🟡
2.4/3	Warm Test#	🟡
2.4/3	Eco Mode#	🟡
2.4/3	Sport Mode#	🟡
4.9/10	Highway#	🟠

Consumption	Fuel
Average consumption	**5.5 l**/100 km
Worst-case consumption	**6.6 l**/100 km

Figure 19: Overview – test results for Energy Efficiency Index; Škoda Octavia

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)*

Additional Information

Greenhouse Gases **	CO_2
Cold Test*	🟡
Warm Test#	🟡
Eco Mode#	🟡
Sport Mode#	🟡
Highway#	🟠

Figure 20: Overview – additional information for Greenhouse Gases; Škoda Octavia

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests;*
*** … For indication only. The assessment of greenhouse gases does not currently form part of the rating.)*

Our Verdict:

The third-generation Škoda Octavia is tested here with the 110 kW, 2.0 diesel engine. With exhaust gas recirculation, selective catalyst reduction and a diesel particulate filter, control of pollutant emissions, especially hydrocarbons (HC), carbon monoxide (CO) and particulates (PN), is good. For Clean Air, the car is let down only by its emissions of oxides of Nitrogen (NO_x). Adequate in most tests, marginal in the cold-start test, control of NOx is poor in the high-load highway test, with emissions so high that the car fails to score any points in this part of the assessment. This largely contributes to its modest 6.7 for the Clean Air Index. Its Energy Efficiency is also at the three-star level, with adequate performance in most tests and marginal performance in the high-load test. Values of CO_2 very close to its declared value of 139 g/km were recorded in all tests except the high-load assessment. Overall, an average performer, with room for improvement in control of NO_x emissions.

5.4.1 Test results in detail

The detailed emissions results are listed in *Table 7*, results for fuel and energy consumption in *Table 8*.

Table 7: Results, part 1 – emission components; Škoda Octavia

MAIN RESULTS			CO	THC	NO_x	PM	PN	CO_2
			mg/km	mg/km	mg/km	mg/km	#/km	g/km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	24,8	4,6	50,5	0,105	5,7E+08	139,0
		WLTC+ cold engine 2	35,2	3,8	44,1	0,000	3,4E+08	138,2
		WLTC+ cold engine Average	30,0	4,2	47,3	0,053	4,6E+08	138,6
	Robustness	WLTC+ warm engine	7,9	0,7	45,5	0,146	2,4E+08	134,8
		WLTC+ warm engine Eco mode	no Eco mode available					
		WLTC+ warm engine Sport mode	no Sport mode available					
		BAB130 Motorway	1,8	0,0	199,4	0,073	5,2E+09	173,8
Real-World tests	PEMS+ approval	PEMS+ cold engine	28,1	n.a.	29,5	n.a.	5,2E+09	132,3
	Robustness	PEMS+ warm engine Eco	13,1	n.a.	15,7	n.a.	1,9E+09	112,6
		PEMS+ warm engine Heavy Load	47,7	n.a.	52,1	n.a.	8,2E+08	178,5

Table 8: Results, part 2 – fuel and energy consumption; Škoda Octavia

MAIN RESULTS			Fuel Consumption	Energy Consumption
			l/100km	kWh/100km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	5,30	52,3
		WLTC+ cold engine 2	5,28	52,1
		WLTC+ cold engine Average	5,29	52,2
	Robustness	WLTC+ warm engine	5,15	50,8
		WLTC+ warm engine Eco mode	no Eco mode available	
		WLTC+ warm engine Sport mode	no Sport mode available	
		BAB130 Motorway	6,64	65,5
Real-World tests	PEMS+ approval	PEMS+ cold engine	5,03	49,6
	Robustness	PEMS+ warm engine Eco	4,28	42,2
		PEMS+ warm engine Heavy Load	6,78	66,9

5.4.2 Technical Data

The technical data of the tested Škoda Octavia are summarized in *Figure 21*.

Year of Publication	Tested Car	Emissions Class
2019	TMBJJ7NEXK001XXXX	Euro 6d-Temp
Mass	Engine Size	Engine Power/Torque
1,575 kg	1,968 cc	110 kW/340 Nm
Tyres	Published CO_2	
225/45 R17 91W	139 g/km	

Figure 21: Technical Data of Škoda Octavia

The summarized rating sheet is available on www.greenncap.com.

5.5 Renault Scenic

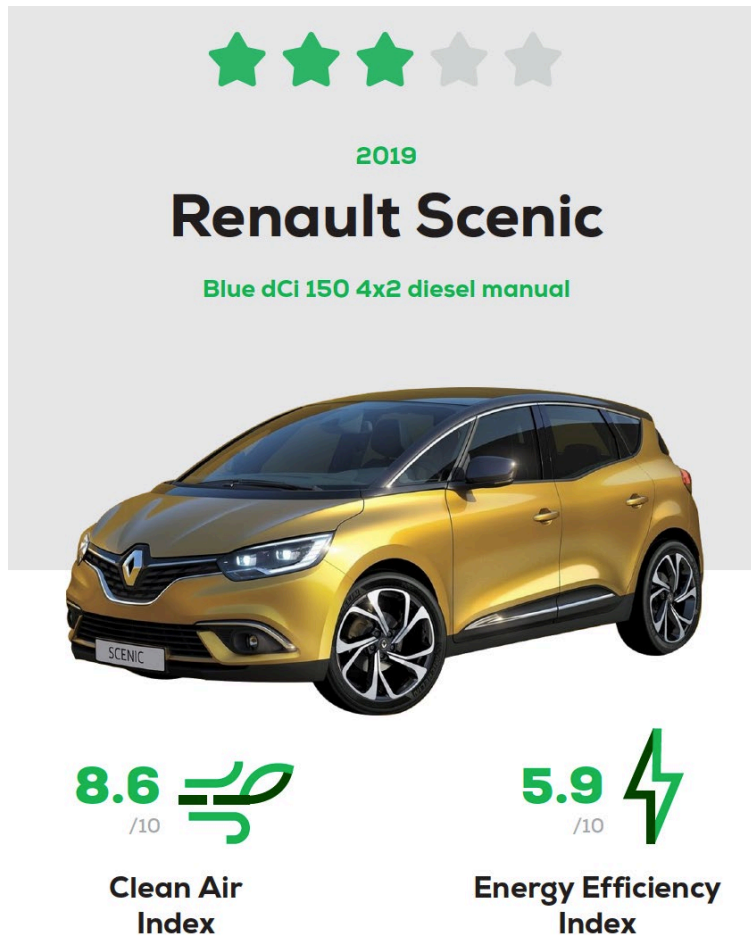The overall rating of the tested Renault Scenic is shown in *Figure 22*.

Figure 22: Star Rating for Renault Scenic

The different results, leading to the Clear Air Index and the Energy Efficiency Index respectively, are shown in *Figure 23* and *Figure 24*. Additional information regarding Greenhouse Gases are shown in *Figure 25*. For further explanation on the color code, please refer to chapter 3.2

Clean Air Tests

8.6 /10

Laboratory test	HC	CO	NOₓ	PN
9.0/9 Cold Test*	🟢	🟢	🟢	🟢
3.0/3 Warm Test#	🟢	🟢	🟢	🟢
3.0/3 Eco Mode#	🟢	🟢	🟢	🟢
3.0/3 Sport Mode#	🟢	🟢	🟢	🟢
4.3/9 Highway#	🟢	🟢	🔴	🟢

Road test

	HC	CO	NOₓ	PN
7.0/7 On-Road Drive*	⚪	🟢	🟢	🟢

Robustness

Figure 23: Overview – test results for Clean Air Index; Renault Scenic

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)

Energy Efficiency Tests

5.9 /10

	Laboratory test	Energy
7.8/10	Cold Test*	🟡
2.5/3	Warm Test#	🟡
2.4/3	Eco Mode#	🟡
2.5/3	Sport Mode#	🟡
5.1/10	Highway#	🟠

Consumption	Fuel
Average consumption	5.3 l/100 km
Worst-case consumption	6.6 l/100 km

Figure 24: Overview – test results for Energy Efficiency Index; Renault Scenic

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)*

Additional Information

Greenhouse Gases **	CO_2
Cold Test*	🟡
Warm Test#	🟡
Eco Mode#	🟡
Sport Mode#	🟡
Highway#	🟠

Figure 25: Overview – additional information for Greenhouse Gases; Renault Scenic

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests;*
*** … For indication only. The assessment of greenhouse gases does not currently form part of the rating.)*

Our Verdict:

The Renault Scenic, one of the earliest multi-purpose vehicles, is tested here in its fourth-generation form, with a 110 kW common-rail diesel. Selective catalyst reduction and a diesel particulate filter contribute to very good abatement of pollutant emissions, and good results in almost all tests. Only in the high-load highway test does the car perform poorly, with high emissions of oxides of nitrogen. Nevertheless, an index of 8.6 for Clean Air is a very creditable achievement.

For energy efficiency, the Scenic scores 5.9 out of 10, just below the 6.0 threshold which would have given the car four stars overall. Efficiency is adequate in all tests except the high-load one, where it is marginal.

Overall, the Scenic impresses with its control of pollutant emissions and is unlucky to miss out on a four-star rating by such a small margin.

5.5.1 Test results in detail

The detailed emissions results are listed in *Table 9*, results for fuel and energy consumption in *Table 10*.

Table 9: Results, part 1 – emission components; Renault Scenic

MAIN RESULTS			CO	THC	NOₓ	PM	PN	CO₂
			mg/km	mg/km	mg/km	mg/km	#/km	g/km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	36,5	9,7	24,0	0,086	2,2E+10	137,0
		WLTC+ cold engine 2	47,8	10,6	25,3	0,122	2,3E+09	137,0
		WLTC+ cold engine Average	42,2	10,1	24,6	0,104	1,2E+10	137,0
	Robustness	WLTC+ warm engine	5,4	5,8	20,9	0,097	1,2E+10	127,7
		WLTC+ warm engine Eco mode	4,8	5,4	14,7	0,233	1,5E+09	131,9
		WLTC+ warm engine Sport mode	4,7	5,7	17,2	0,143	1,9E+09	131,4
		BAB130 Motorway	3,7	2,5	108,0	n.a.	5,2E+09	173,0
Real-World tests	PEMS+ approval	PEMS+ cold engine	103,2	n.a.	28,9	n.a.	8,9E+09	140,8
	Robustness	PEMS+ warm engine Eco	43,6	n.a.	18,2	n.a.	2,1E+10	124,3
		PEMS+ warm engine Heavy Load	126,4	n.a.	47,9	n.a.	4,7E+08	159,0

Table 10: Results, part 2 – fuel and energy consumption; Renault Scenic

MAIN RESULTS			Fuel Consumption	Energy Consumption
			l/100km	kWh/100km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	5,19	51,2
		WLTC+ cold engine 2	5,19	51,2
		WLTC+ cold engine Average	5,19	51,2
	Robustness	WLTC+ warm engine	4,84	47,7
		WLTC+ warm engine Eco mode	5,00	49,3
		WLTC+ warm engine Sport mode	4,98	49,1
		BAB130 Motorway	6,56	64,6
Real-World tests	PEMS+ approval	PEMS+ cold engine	5,36	52,9
	Robustness	PEMS+ warm engine Eco	4,73	46,7
		PEMS+ warm engine Heavy Load	6,06	59,7

5.5.2 Technical Data

The technical data of the tested Renault Scenic are summarized in *Figure 26*.

Year of Publication	Tested Car	Emissions Class
2019	VF1RFA0076165XXXX	Euro 6d-temp
Mass	**Engine Size**	**Engine Power/Torque**
1,562 kg	1,750 cc	110 kW/320 Nm
Tyres	**Published CO$_2$**	
195/55 R20	145 g/km	

Figure 26: Technical Data of Renault Scenic

The summarized rating sheet is available on www.greenncap.com.

5.6   Nissan LEAF

The overall rating of the tested Nissan LEAF is shown in *Figure 27*.

Figure 27: Star Rating for Nissan LEAF

The different results, leading to the Clear Air Index and the Energy Efficiency Index respectively, are shown in *Figure 28* and *Figure 29*. Additional information regarding Greenhouse Gases are shown in *Figure 30*. For further explanation on the color code, please refer to chapter 3.2

Clean Air Tests

10.0 /10

Laboratory test		HC	CO	NO$_x$	PN
9.0/9	Cold Test*	🟢	🟢	🟢	🟢
3.0/3	Warm Test#	🟢	🟢	🟢	🟢
3.0/3	Eco Mode#	🟢	🟢	🟢	🟢
3.0/3	Sport Mode#	🟢	🟢	🟢	🟢
9.0/9	Highway#	🟢	🟢	🟢	🟢

Road test

		HC	CO	NO$_x$	PN
7.0/7	On-Road Drive*	⚪	🟢	🟢	🟢

Robustness

Figure 28: Overview – test results for Clean Air Index; Nissan LEAF

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)

8.5 /10 ⚡ **Energy Efficiency Tests**

	Laboratory test	Energy		
10/10	Cold Test*	🟢	→	**17.1 kWh**/100 km
3/3	Warm Test#	🟢	→	**15.4 kWh**/100 km
3/3	Eco Mode#	🟢	→	**15.2 kWh**/100 km
3/3	Sport Mode#	🟢	→	**15.4 kWh**/100 km
10/10	Highway#	🟢	→	**22.9 kWh**/100 km

Consumption	Electrical energy
Average consumption	**17.2 kWh**/100 km
Worst-case consumption	**22.9 kWh**/100 km

Figure 29: Overview – test results for Energy Efficiency Index; Nissan LEAF

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)*

Additional Information

Greenhouse Gases **	CO_2
Cold Test*	🟢
Warm Test#	🟢
Eco Mode#	🟢
Sport Mode#	🟢
Highway#	🟢

Figure 30: Overview – additional information for Greenhouse Gases; Nissan LEAF

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests;*
*** … For indication only. The assessment of greenhouse gases does not currently form part of the rating.)*

Our Verdict:

The second-generation Nissan LEAF, introduced in 2017, is a pure electric vehicle, powered by a 40 kWh battery. As with all electric cars, the Leaf scores maximum points for Clean Air, as it does not burn any fuel and does not produce any gaseous emissions. The car has an eco-mode but, in Green NCAP's tests, this had no noticeable decrease in energy consumption over the standard setting. Energy consumption increased significantly in the high-load highway test but was still well within Green NCAP's lower limits. The LEAF's average and maximum energy consumption both exceed that of the similarly sized Hyundai Ioniq, tested by Green NCAP earlier in 2019. The LEAF is equipped with 'e-pedal'. With a push of a button the driver can activate one-pedal driving that makes use of strong regenerative braking. In this mode the pedal acts as accelerator and brake.

5.6.1 Test results in detail

The detailed results for energy consumption are listed in *Table 11*.

Table 11: Results – energy consumption; Nissan LEAF (explanation: * … WLTC cold tests average – no sport mode)

MAIN RESULTS			Energy Consumption kWh/100km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	17.1
		WLTC+ cold engine 2	16.5
		WLTC+ cold engine Average	16.8
	Robustness	WLTC+ warm engine	15.4
		WLTC+ warm engine Eco mode	15.2
		WLTC+ warm engine Sport mode*	16.8
		BAB130 Motorway	22.9
Real-World tests	PEMS+ approval	PEMS+ cold engine	15.8
	Robustness	PEMS+ warm engine Eco	14.3
		PEMS+ warm engine Heavy Load	16.4

5.6.2 Technical Data

The technical data of the tested Nissan LEAF are summarized in *Figure 31*.

Year of Publication 2019	Tested Car SJNFAAZE1U003XXXX	Emissions Class Euro 6d-temp
Mass 1,505 kg	Engine Size n.a.	Engine Power/Torque 110 kW/340 Nm
Tyres 215/50R17	Published CO_2 0 g/km	

Figure 31: Technical Data of Nissan LEAF

The summarized rating sheet is available on www.greenncap.com.

5.7 Audi A4 Avant g-tron

The overall rating of the tested Audi A4 Avant g-tron is shown in *Figure 32*.
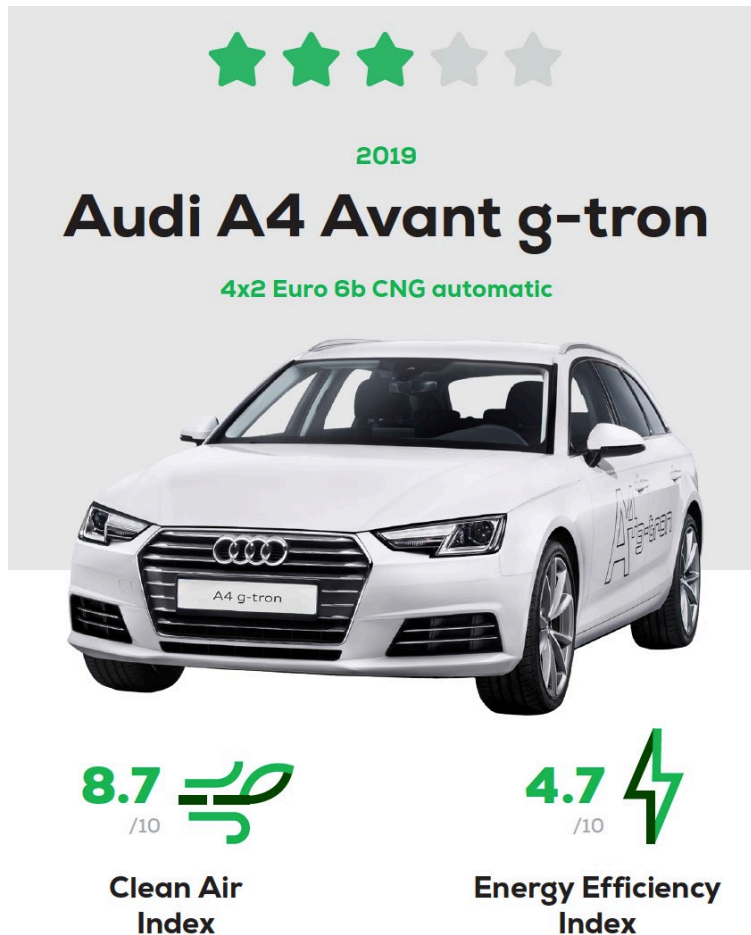
Figure 32: Star Rating for Audi A4 Avant g-tron

The different results, leading to the Clear Air Index and the Energy Efficiency Index respectively, are shown in *Figure 33* and *Figure 34*. Additional information regarding Greenhouse Gases are shown in *Figure 35*. For further explanation on the color code, please refer to chapter 3.2

Clean Air Tests

8.7 /10

Laboratory test	HC	CO	NO$_x$	PN
8.0/9 Cold Test*	🟡	🟠	🟡	🟡
2.9/3 Warm Test#	🟢	🟠	🟢	🟢
2.8/3 Eco Mode#	🟢	🟠	🟢	🟢
2.9/3 Sport Mode#	🟢	🟠	🟢	🟢
6.8/9 Highway#	🟤	🟠	🟢	🟡

Road test

	HC	CO	NO$_x$	PN
6.4/7 On-Road Drive*	⚪	🟡	🟢	🟡

Robustness

Figure 33: Overview – test results for Clean Air Index; Audi A4 Avant g-tron

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)

Energy Efficiency Tests

4.7 /10

	Laboratory test	Energy
5.7/10	Cold Test*	🟠
1.9/3	Warm Test#	🟠
1.9/3	Eco Mode#	🟠
1.7/3	Sport Mode#	🟠
5.0/10	Highway#	🟠

Consumption	Fuel
Average consumption	**4.6 kg**/100 km
Worst-case consumption	**5.0 kg**/100 km

Figure 34: Overview – test results for Energy Efficiency Index; Audi A4 Avant g-tron

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)*

Additional Information

Greenhouse Gases **	CO_2
Cold Test*	🟠
Warm Test#	🟠
Eco Mode#	🟠
Sport Mode#	🟠
Highway#	🟠

Figure 35: Overview – additional information for Greenhouse Gases; Audi A4 Avant g-tron

*(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests;*
*** … For indication only. The assessment of greenhouse gases does not currently form part of the rating.)*

Our Verdict:

The Audi A4 Avant is tested here as the 'g-tron', the CNG (compressed natural gas)-powered variant of the model range. The g-tron's declared CO_2 value of 111 g/km is significantly lower than its purely petrol-engined siblings. The car tested was compliant with Euro 6b emissions legislation. Such cars can still currently be sold in the EU but must soon be upgraded to meet Euro 6d-temp requirements. Green NCAP will test the updated g-tron as soon as possible. While the car operates almost exclusively on CNG, it also has a small 'emergency' petrol reserve, to get it to the nearest gas station. The car was tested in both CNG and petrol modes, the CNG results primarily defining the score and star rating, but with penalties if the performance on petrol was significantly worse. In most of the laboratory tests, control of pollutant emissions was good or adequate, except for carbon monoxide, control of which was marginal. The high-load highway test did not affect the rating of this pollutant, but emissions of unburnt hydrocarbons was noticeably worse than in the other tests, and was rated as weak. In the cold test, particulate emissions were very high when tested on the emergency petrol reserve. Energy efficiency was marginal for all tests, with similar values for the car in standard drive mode and in eco-mode, but noticeably worse in sports mode and in the high load test. All in all, the A4 g-tron performs adequately but should do better when tested in its latest Euro 6d-temp form.

5.7.1   Test results in detail

As the vehicle was tested in both CNG and petrol modes, detailed results for CNG and petrol are summarized in the following tables.

CNG-mode:

The detailed emission results in CNG-mode are summarized in *Table 12*. Results for fuel and energy consumption in *Table 13*.

Table 12: Results in CNG-mode, part 1 – emission components; Audi A4 Avant g-tron

MAIN RESULTS			CO	THC	NOx	PM	PN	CO2
			mg/km	mg/km	mg/km	mg/km	#/km	g/km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	539,7	53,9	30,0	0,300	2,9E+10	126,9
		WLTC+ cold engine 2	571,3	40,4	20,4	0,301	2,5E+10	130,3
		WLTC+ cold engine Average	555,5	47,2	25,2	0,301	2,7E+10	128,6
	Robustness	WLTC+ warm engine	548,5	14,2	12,0	0,333	1,8E+10	119,5
		WLTC+ warm engine Eco mode	705,0	17,1	8,7	0,463	1,7E+10	120,0
		WLTC+ warm engine Sport mode	515,8	9,1	8,1	0,335	2,0E+10	128,7
		BAB130 Motorway	549,4	83,9	6,5	3,218	1,6E+10	134,7
Real-World tests	PEMS+ approval	PEMS+ cold engine	629,8	n.a.	12,4		2,6E+10	110,4
	Robustness	PEMS+ warm engine Eco	603,0	n.a.	13,3		2,9E+10	113,2
		PEMS+ warm engine Heavy Load	1037,5	n.a.	21,1		5,3E+10	171,0

Table 13: Results in CNG-mode, part 2 – fuel and energy consumption; Audi A4 Avant g-tron

MAIN RESULTS			Fuel Consumption	Energy Consumption
			kg/100km	kWh/100km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	4,67	61,4
		WLTC+ cold engine 2	4,79	63,0
		WLTC+ cold engine Average	4,73	62,2
	Robustness	WLTC+ warm engine	4,39	57,8
		WLTC+ warm engine Eco mode	4,42	58,1
		WLTC+ warm engine Sport mode	4,73	62,1
		BAB130 Motorway	4,95	65,1
Real-World tests	PEMS+ approval	PEMS+ cold engine	4,06	53,4
	Robustness	PEMS+ warm engine Eco	4,16	54,7
		PEMS+ warm engine Heavy Load	6,30	82,8

Petrol-mode:

The detailed emission results in petrol-mode are summarized in *Table 14*. Results for fuel and energy consumption in *Table 15*.

Table 14: Results in petrol-mode, part 1 – emission components; Audi A4 Avant g-tron

MAIN RESULTS			CO	THC	NOx	PM	PN	CO2
			mg/km	mg/km	mg/km	mg/km	#/km	g/km
Laboratory	WLTC+ approval	WLTC+ cold engine 1	380,6	29,1	5,0	3,4	3,8E+12	176,1
		BAB130 Motorway	1829,8	22,0	7,7	3,6	5,2E+12	183,5
Real-World	PEMS+ approval	PEMS+ cold engine	266,5	n.a.	6,5	n.a.	7,6E+11	152,3

Table 15. Results in petrol-mode, part 2 – fuel and energy consumption; Audi A4 Avant g-tron

MAIN RESULTS			Fuel Consumption	Energy Consumption
			l/100km	kWh/100km
Laboratory	WLTC+ approval	WLTC+ cold engine 1	7,60	65,9
		BAB130 Motorway	8,03	69,6
Real-World	PEMS+ approval	PEMS+ cold engine	6,57	57,0

5.7.2   Technical Data

The technical data of the tested Audi A4 Avant g-tron are summarized in *Figure 36*.

Year of Publication	Tested Car	Emissions Class
2019	WAUZZZF43JA17XXXX	Euro 6b
Mass	Engine Size	Engine Power/Torque
1,702 kg	1,984 cc	125 kW/270 Nm
Tyres	Published CO_2	
245/35 R19	111 g/km	

Figure 36: Technical Data of Audi A4 Avant g-tron

The summarized rating sheet is available on www.greenncap.com.

5.8 FIAT Panda

The overall rating of the tested FIAT Panda is shown in *Figure 37*.

Figure 37: Star Rating for FIAT Panda

The different results, leading to the Clear Air Index and the Energy Efficiency Index respectively, are shown in *Figure 38* and *Figure 39*. Additional information regarding Greenhouse Gases are shown in *Figure 40*. For further explanation on the color code, please refer to chapter 3.2

Clean Air Tests

5.5/10

Laboratory test		HC	CO	NO$_x$	PN
0.0/9	Cold Test*	🟤	🟡	🟢	🟤
3.0/3	Warm Test#	🟢	🟢	🟢	🟡
3.0/3	Eco Mode#	🟢	🟢	🟢	🟡
3.0/3	Sport Mode#	🟢	🟢	🟢	🟡
4.4/9	Highway#	🔴	🟠	🟢	🟠
	Road test				
5.5/7	On-Road Drive*	⚪	🟢	🟢	🟠
	Robustness				

Figure 38: Overview – test results for Clean Air Index; FIAT Panda

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)

Green NCAP determines particulate number using industry-standard measuring equipment, which can detect particles larger than 23 nm. There is some evidence that cars which perform well when measured in this way may in fact be emitting large numbers of much smaller (sub 10 nm), and very harmful particulates.

Energy Efficiency Tests

4.9 /10

	Laboratory test	Energy
6.7/10	Cold Test*	🟡
2.1/3	Warm Test#	🟡
2.1/3	Eco Mode#	🟡
2.1/3	Sport Mode#	🟡
3.8/10	Highway#	🟠

Consumption	Fuel
Average consumption	**4.2 kg**/100 km
Worst-case consumption	**5.1 kg**/100 km

Figure 39: Overview – test results for Energy Efficiency Index; FIAT Panda

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests)

Additional Information

Greenhouse Gases **	CO_2
Cold Test*	🟡
Warm Test#	🟡
Eco Mode#	🟡
Sport Mode#	🟡
Highway#	🟠

Figure 40: Overview – additional information for Greenhouse Gases; FIAT Panda

(explanation: * … Adapted regulatory test; # … Additional Green NCAP tests;
** … For indication only. The assessment of greenhouse gases does not currently form part of the rating.)

Our Verdict:

The Panda, tested previously by Green NCAP in its Euro 6b petrol form, is assessed here as the Euro 6d-temp CNG/petrol bi-fuel variant. The car has a 12 kg CNG tank and a 35 litre fuel tank, meaning that it will spend much of its time being driven on petrol, in addition to its compressed natural gas (CNG) 'primary' fuel. When running on gas, pollutant emissions are generally well controlled. However, when the vehicle is run on petrol, and with no gas particulate filter, emissions of particulates are extremely high, over twenty times higher than CNG mode in the case of the cold test. Even in CNG mode, hydrocarbon emissions are above Green NCAP's poor-performance limit in the high-load test. As a consequence, the Clean Air Index is a modest 5.5, limiting the overall rating to two stars. Energy efficiency is marginal, especially in the high load test, and the average fuel consumption in gas mode is 4.2 kg/100 km. FIAT expect the car to be used predominantly in gas-mode. However, the relative sizes of the CNG and petrol tank invites drivers to use both fuel modes, while FIAT has optimised the car only for one.

5.8.1 Test results in detail

As the vehicle was tested in both CNG and petrol modes, detailed results for CNG and petrol are summarized in the following tables.

CNG-mode:

The detailed emission results in CNG-mode are summarized in *Table 16*. Results for fuel and energy consumption in *Table 17*.

Table 16: Results in CNG-mode, part 1 – emission components; FIAT Panda

MAIN RESULTS			CO	THC	NO$_x$	PM	PN	CO$_2$
			mg/km	mg/km	mg/km	mg/km	#/km	g/km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	347,1	89,9	22,0	0,863	4,9E+11	110,7
		WLTC+ cold engine 2	293,2	66,1	19,8	0,446	4,3E+11	108,4
		WLTC+ cold engine Average	320,2	78,0	20,9	0,655	4,6E+11	109,5
	Robustness	WLTC+ warm engine	153,1	35,3	9,7	0,285	8,4E+10	107,2
		WLTC+ warm engine Eco mode	no Eco mode available					
		WLTC+ warm engine Sport mode	no Sport mode available					
		BAB130 Motorway	457,6	104,6	6,9	0,710	1,6E+11	138,7
Real-World tests	PEMS+ approval	PEMS+ cold engine	188,0	n.a.	17,7	n.a.	5,3E+10	123,9
	Robustness	PEMS+ warm engine Eco	132,0	n.a.	11,9	n.a.	3,3E+10	108,0
		PEMS+ warm engine Heavy Load	312,0	n.a.	21,3	n.a.	8,0E+10	162,0

Table 17: Results in CNG-mode, part 2 – fuel and energy consumption; FIAT Panda

MAIN RESULTS			Fuel Consumption kg/100km	Energy Consumption kWh/100km
Laboratory Tests	WLTC+ approval	WLTC+ cold engine 1	4,07	56,5
		WLTC+ cold engine 2	3,98	55,3
		WLTC+ cold engine Average	4,03	55,9
	Robustness	WLTC+ warm engine	3,92	54,4
		WLTC+ warm engine Eco mode	no Eco mode available	
		WLTC+ warm engine Sport mode	no Sport mode available	
		BAB130 Motorway	5,10	70,8
Real-World tests	PEMS+ approval	PEMS+ cold engine	4,53	62,9
	Robustness	PEMS+ warm engine Eco	3,95	54,8
		PEMS+ warm engine Heavy Load	5,93	82,3

Petrol-mode:

The detailed emission results in petrol-mode are summarized in *Table 18*. Results for fuel and energy consumption in *Table 19*.

Table 18: Results in petrol-mode, part 1 – emission components; FIAT Panda

MAIN RESULTS			CO mg/km	THC mg/km	NOx mg/km	PM mg/km	PN #/km	CO$_2$ g/km
Laboratory	WLTC+ approval	WLTC+ cold engine 1	399,4	70,0	22,6	5,5	1,1E+13	145,1
		BAB130 Motorway	1078,5	57,7	15,2	5,0	1,8E+13	179,2
Real-World	PEMS+ approval	PEMS+ cold engine	226,1	n.a.	22,3	n.a.	7,1E+12	169,8

Table 19. Results in petrol-mode, part 2 – fuel and energy consumption; FIAT Panda

MAIN RESULTS			Fuel Consumption l/100km	Energy Consumption kWh/100km
Laboratory	WLTC+ approval	WLTC+ cold engine 1	6,40	55,5
		BAB130 Motorway	7,90	68,5
Real-World	PEMS+ approval	PEMS+ cold engine	7,47	64,7

5.8.2 Technical Data

The technical data of the tested FIAT Panda are summarized in *Figure 41*

Figure 41: Technical Data of FIAT Panda

The summarized rating sheet is available on www.greenncap.com.

6 Summary

Green NCAP is an independent initiative which promotes the development of cars which are clean, energy efficient and not harmful to the environment. It aims to improve the quality of the air that we breathe, to maximise the use of resources used for passenger transportation and to reduce global warming.

Green NCAP uses a broad range of tests to address the flaws in approval tests and, through consumer information, rewards those manufacturers whose vehicles go beyond the minimum requirements and offer excellent, robust, real-world performance. Regulatory testing is a good starting point. Green NCAP's tests are an addition and complementary to these legislative requirements.

Based on the work done in recent years, testing continued in 2019. The Green NCAP program selected mainly Euro6d-temp vehicles representative of high market shares, of representative engine type and latest technologies available in the EU. Except for one vehicle fuelled with CNG, which is a Euro6b vehicle. Overall

- 2 petrol,
- 3 diesel,
- 1 pure electric and
- 2 bi-fuel vehicles (CNG/petrol)

were tested in 2019.

The following results were achieved with the 2019 vehicles:

- 1 vehicle with a 2-star rating
- 4 vehicles with a 3-star rating
- 2 vehicles with a 4-star rating
- 1 vehicle with a 5-star rating

A summary of Green NCAP star ratings for the 2019 batch of vehicles is shown in *Figure 42*. For comparison, the results for the 2018 batch of vehicles are included in the figure as well. For further information, please see www.greenncap.com.
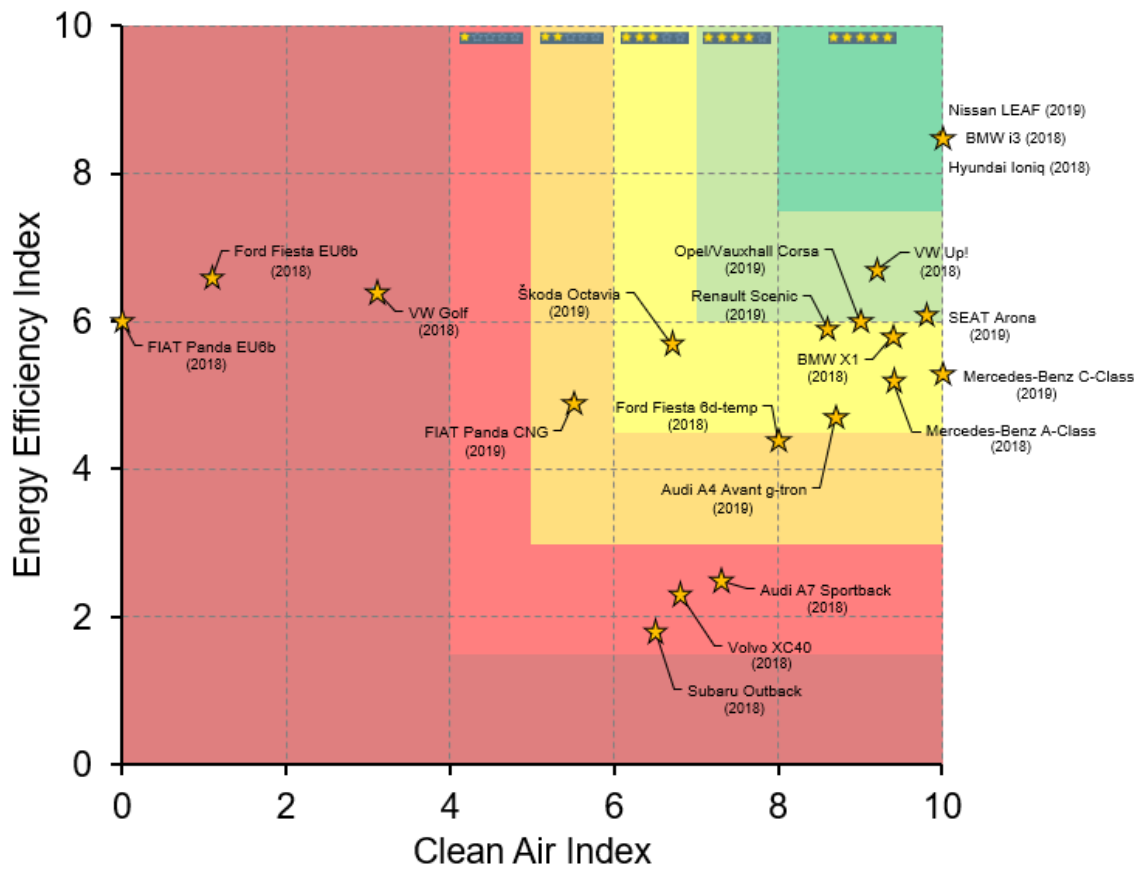
Figure 42: Star Rating of all tested vehicles within the Green-NCAP program (numbers in brackets indicate Green-NCAP test year)