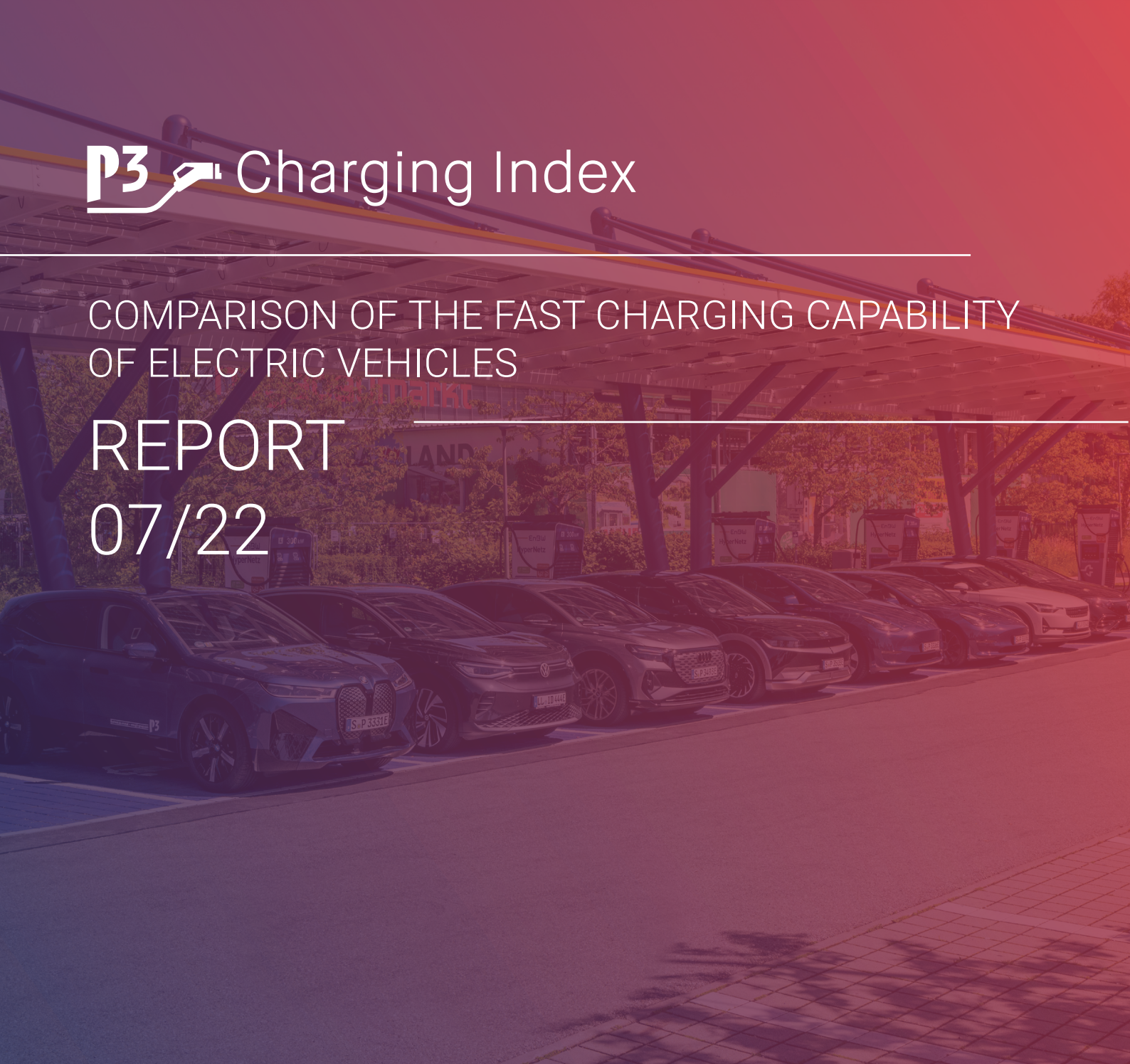




P3 Charging Index

COMPARISON OF THE FAST CHARGING CAPABILITY
OF ELECTRIC VEHICLES

REPORT
07/22



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FOR THE FIRST TIME, AN ELECTRIC VEHICLE EXCEEDS THE IDEAL VALUE OF 1.0: KIA EV6 RECHARGES OVER 300 KM RANGE IN 20 MINUTES AND WINS THE THIRD EDITION OF THE P3 CHARGING INDEX ACROSS ALL SEGMENTS

Currently, almost all of the long-distance electric vehicles (EVs) which are coming to market can be charged with a charging power of more than 100 kW. Some EVs even offer a maximum charging power of more than 150 kW, or up to 270 kW. In a competitive comparison, electric vehicles are often compared in a simplified manner, using the maximum charging power in kilowatts [kW], even though this parameter itself is not reliable and representative of the realistic charging performance of electric vehicles.

THE P3 CHARGING INDEX WAS DEVELOPED TO COMPARE THE REAL CHARGING SPEED BETWEEN VARIOUS ELECTRIC VEHICLES.

The decisive parameter for the user in this context is the time required to recharge the vehicle's range (in km) - this results in the P3 Charging Index, comparing the suitability for long-distances and the daily usage of different electric vehicles. With the combination of the consumption and the charging curves of the vehicles, the recharged kilometers can be mapped over the required charging time. This enables a more accurate assessment of the fast-charging behavior of the vehicles.

At the end of 2019, P3, in cooperation with the industry service electrive.com, established an independent standardization by creating the P3 Charging Index (P3CI), that enables a user-related and realistic comparison of the fast-charging performance of electric vehicles and is now publishing the third edition of the P3 Charging Index in July 2022.

The ideal value of the P3 Charging Index of 1.0 corresponds to the ability of electric vehicles to recharge 300 km of range within 20 minutes, enabling a practical long-distance mobility from the customer's perspective.

$$\text{P3 Charging Index} = \frac{\text{Real recharged range within 20 minutes}}{300 \text{ km}}$$

Since the first edition in 2019, the P3 Charging Index has been continuously developed along with the ever changing EV market. Therefore, for the first time, the P3 Charging Index no longer compares vehicles from all segments, but instead divides them into three categories based on the BAFA net list price¹ of the models under consideration:

- + **Luxury class** (BAFA-Net list price above 65,000 €)
- + **Premium class** (BAFA-Net list price from >35,000 € to 65,000 €)
- + **Compact class** (BAFA-Net list price up to 35,000 €)

In addition to eleven new EVs (including BMW iX xDrive50, KIA EV6 and Peugeot e-208 GT) listed in the P3CI for the first time, there are updates to vehicles from previous releases as well. In comparison to the second edition of the P3CI published in 2021², the Porsche Taycan charging curve has been updated with the new Porsche Taycan GTS, which has been available since spring 2022. In addition, the data of the Mercedes-Benz EQS450+ as well as the charging curves of the Mercedes-Benz EQA250 and the BMW iX3 (2020) have been updated.

DATA COLLECTION FOR THE P3 CHARGING INDEX

For a better comparison of the long-distance suitability of the vehicles, the range derivatives of the vehicles were compared with each other instead of performance. Furthermore, only vehicles equipped with the European charging standard CCS (Combined Charging System - fast charging with Combo 2 plug) were considered. For comparability of the data, all charging curves shown were measured by P3 experts at charging stations of the same manufacturer with a maximum charging power of 350 kW. Only the Tesla Model Y and the Tesla Model 3 were measured at Tesla Supercharger V3. The reason for this is that the maximum charging power of Tesla vehicles is only available at Tesla Superchargers. The vehicles tested were primarily press vehicles from the manufacturers. The selection of vehicles represents a cross-section of the market as large as possible, but not all the vehicles requested were made available to P3 by the manufacturers, which is why some individual electric vehicles might not be included in the P3CI.

The third edition of the P3 Charging Index considers a total of 21 vehicles clustered in the following segments (the battery capacities given are net values in kWh):

¹Cf. BAFA list of eligible electric vehicles (as of 01.07.2022)

²Cf. P3 Charging Index 2021 [Last accessed 21.06.2022]

Luxury class	Premium class	Compact class
+ Audi e-tron GT quattro + Audi e-tron 55 quattro + BMW iX xDrive50 + Mercedes-Benz EQS450+ + Porsche Taycan GTS³	+ BMW i4 eDrive40 + BMW iX3 (2020) + Hyundai IONIQ 5 (72.6 kWh 2WD) + Kia EV6 (77.4 kWh RWD) + Mercedes-Benz EQA250 + Polestar 2 Long Range Single Motor + Renault Mégane E-Tech EV60 + Tesla Model 3 Long Range + Tesla Model Y Long Range + VW ID.4 (77 kWh)	+ Dacia Spring + Fiat 500e + Hyundai Kona (64 kWh) + Mini Cooper SE + Peugeot e-208 GT + VW ID.3 (58 kWh)

CHARGING POWER IS NOT A SUFFICIENT INDICATOR FOR THE CHARGING PERFORMANCE OF ELECTRIC VEHICLES

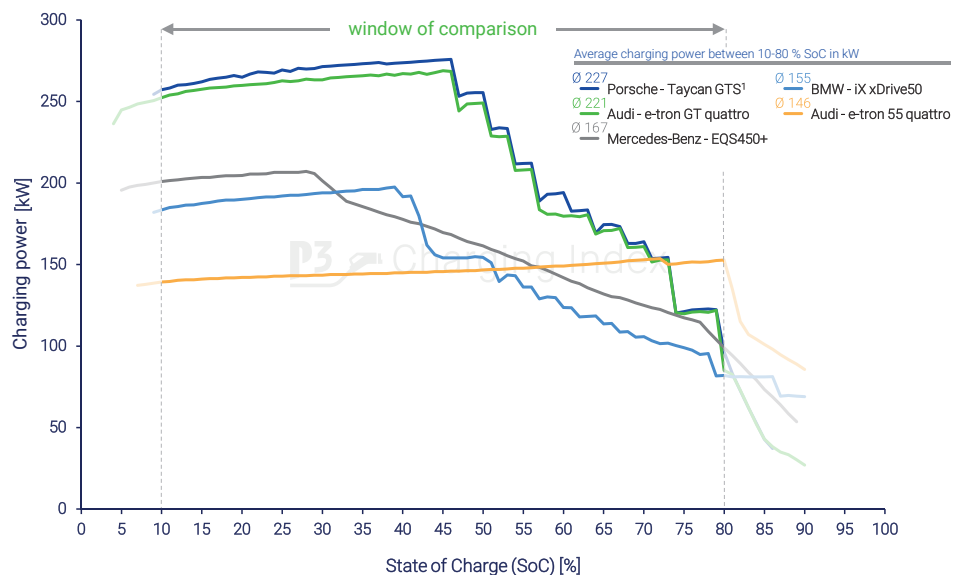
The maximum charging power of electric vehicles is only achieved under ideal conditions and also requires that the battery has a relatively low State of Charge (SoC). It is also necessary that the battery has been preconditioned for fast charging (if the vehicle is equipped accordingly). The P3 Charging Index considers a charging window between 10 and 80 percent SoC, as this represents the best possible charging session based on the experience of P3 experts and users. Manufacturers' charging durations are usually indicated for this range as well.

P3 charging curves for different battery electric vehicle (BEV) models

Luxury class

¹Porsche Taycan GTS Sport Turismo model under review, named in the graphic as Porsche Taycan GTS

Source: P3 Testdrive



³Porsche Taycan GTS Sport Turismo model under consideration, shown in the text as Porsche Taycan GTS

P3 charging curves for different battery electric vehicle (BEV) models

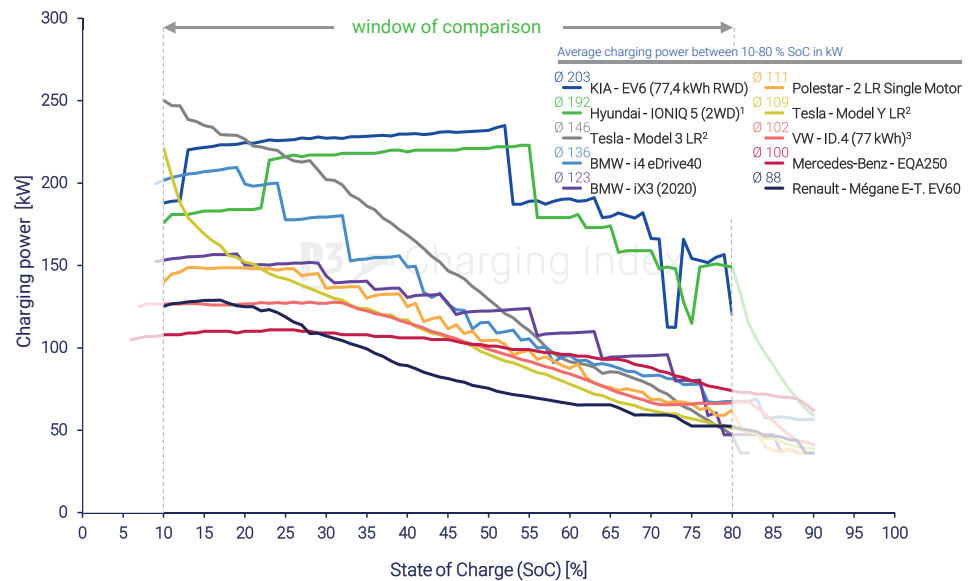
Premium class

¹Hyundai - IONIQ 5 (72.6 kWh 2WD)

²Measured at Tesla Supercharger V3, as maximum charging power is only available there

³measured with ID.Software 2.3

Source: P3 Testdrive

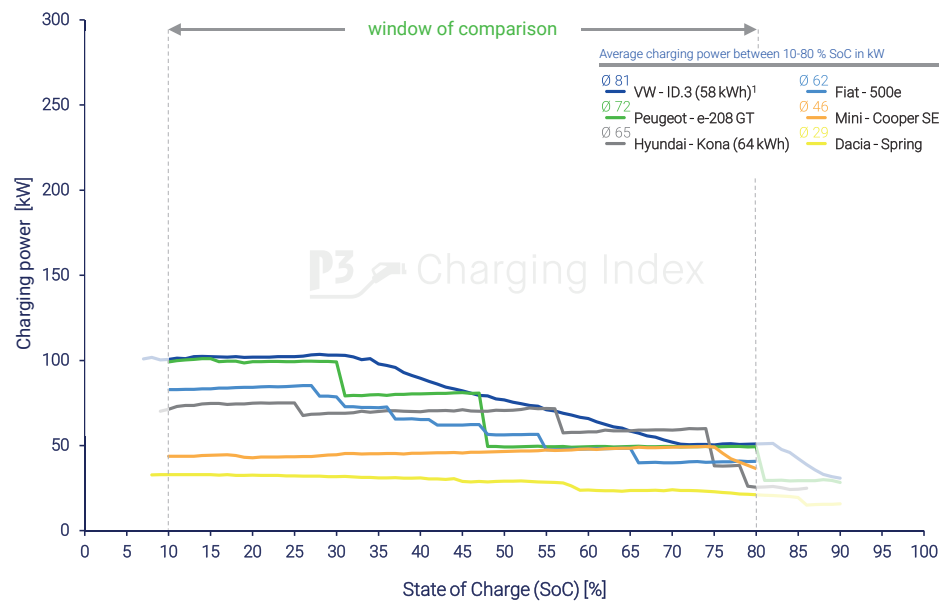


P3 charging curves for different battery electric vehicle (BEV) models

Compact class

¹measured with ID.Software 2.3

Source: P3 Testdrive



A comparison of different electric vehicles shows that the maximum charging power indicated by the manufacturers is only achieved for a few minutes during the charging session - and the vehicle-specific performance varies greatly. Looking at the average charging power in a "charging window" between 10 and 80 % SoC is representative to compare the charging speed of the vehicles with each other, which is also underlined by the comparison of selected vehicles:

LUXURY CLASS



PORSCHE TAYCAN GTS

The **Porsche Taycan GTS** with a maximum charging power of 276 kW which has been measured, achieves an average charging power of 227 kW in the selected charging window. Thus, Porsche has both the highest maximum charging power and the highest average power across all vehicles compared in the P3CI, which is also due to the vehicle's 800 V architecture. This model can be charged to over 55% SoC with more than 200 kW at an appropriate charging infrastructure.



MERCEDES-BENZ EQS

The **Mercedes-Benz EQS450+** is based on a 400 V architecture, however, its high battery capacity of 107.8 kWh enables a peak power output of around 210 kW and an average value of 167 kW in the measured SoC window (10-80%).



BMW iX xDrive50

The **BMW iX xDrive50** has a 105.2 kWh battery and, like the Mercedes, is based on a 400 V architecture. At its peak, the iX reaches a maximum charging power of 197 kW and is charged at an average of 152 kW from 10% to 80% SoC.

PREMIUM CLASS

KIA EV6



The **KIA EV6** takes the lead in the premium class. Like the Hyundai IONIQ 5, the EV6 is based on the Hyundai Group's 800 V E-GMP platform and manages a maximum charging power of around 235 kW at peak. On average, it can be charged with 203 kW up to the 80% SoC target under ideal conditions.

TESLA MODEL 3



The **Tesla Model 3** is stated by the manufacturer to have a maximum charging power of about 250 kW at a Supercharger Version 3, but it only achieves an average charging power of 146 kW within P3CI measurements, since the charging curve within the charging window (10 and 80% SoC) drops more than that of other vehicles. This behavior can also be observed in the Tesla Model Y, which reaches a maximum of 221 kW at a Tesla Supercharger Version 3.

BMW i4



The electric components of the **BMW i4** have been integrated into the chassis of the conventionally powered BMW 4 Series Gran Coupe. Like the BMW iX, the BMW i4 uses BMW Gen5 eDrive technology on a 400 V architecture. At peak, the BMW i4 manages around 210 kW of charging power while the average is 136 kW.

COMPACT CLASS

VW ID.3



The compact segment is led by the **VW ID.3** with the 58 kWh battery: the vehicle was charged with a maximum of 103 kW with the ID.Software 2.3 and achieves an average of 81 kW, which both show the best performances in the compact segment.

CONSUMPTION OF THE VEHICLES ACCORDING TO WLTP AND ADAC ECOTEST [KWH/100KM]

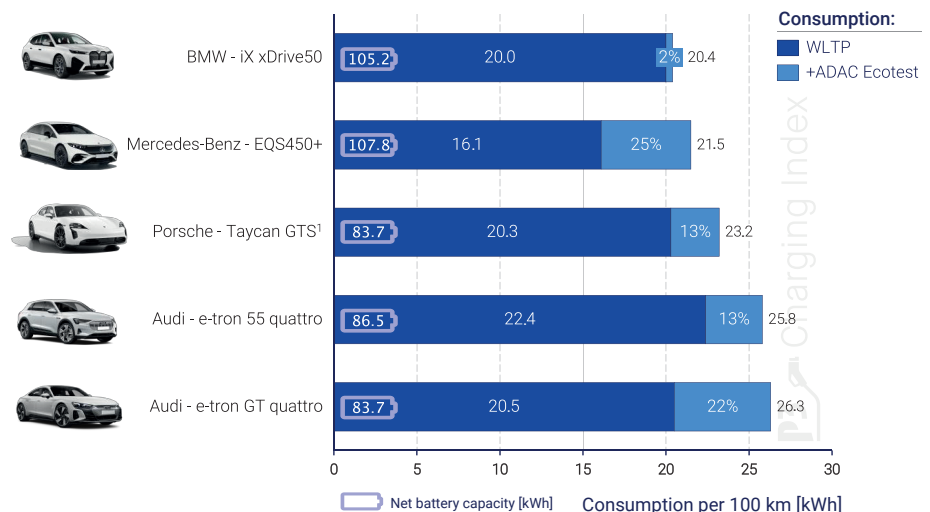
In order to assure realistic consumptions of the individual electric vehicles in the calculation of the P3 Charging Index, the ADAC Ecotest consumptions have been included. These can be seen in the graph in comparison with the WLTP consumption. The electric cycle is run in one piece and repeated until either a SoC <50% is reached or the cycle has been run six times. Finally, the vehicle is fully charged using a Type 2 charging plug (22 kW or maximum possible AC charging power) and the required electrical energy is determined. The energy measurement also considers the charging losses which occur during normal charging (AC charging).⁴

Comparison of the BEV consumption (WLTP absolute and additional percentage ADAC Ecotest)

Luxury class

¹Porsche Taycan GTS Sport Turismo model under review, named in the graphic as Porsche Taycan GTS

Source Vehicle pictures: Manufacturer



⁴Cf. ADAC

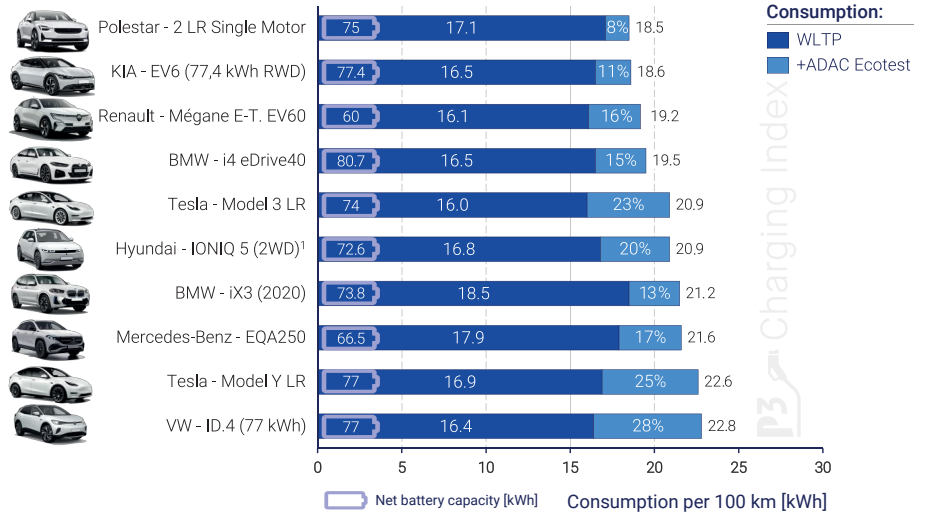
Source Vehicle pictures: Manufacturer

Comparison of the BEV consumption (WLTP absolute and additional percentage ADAC Ecotest)

Premium class

¹Hyundai - IONIQ 5 (72,6 kWh 2WD)

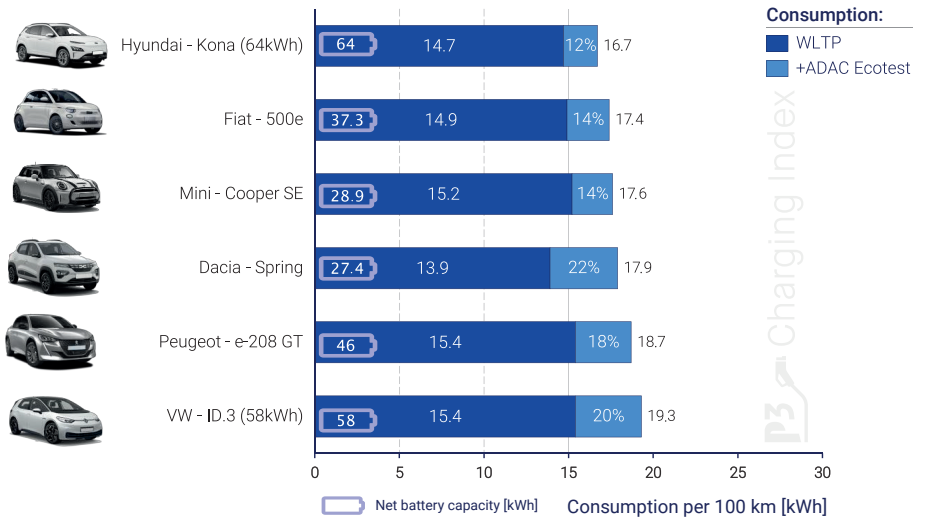
Source Vehicle pictures: Manufacturer



Comparison of the BEV consumption (WLTP absolute and additional percentage ADAC Ecotest)

Compact class

Source Vehicle pictures: Manufacturer



FROM A CUSTOMER'S PERSPECTIVE, CONSUMPTION AND CHARGING DURATION MUST ALSO BE CONSIDERED IN THE EVALUATION

From the customer's perspective, neither the maximum charging power nor the consumption are individually determining the long-distance suitability, because a typical, real charging session needs to answer one important question for the electric vehicle driver:

What range is required to reach the next destination and how long does it take to recharge that range?

CONSIDERATION OF THE RECHARGED DISTANCES (KM) WITHIN THE P3 CHARGING INDEX – LUXURY CLASS

In the luxury class, the three leading models are moving even closer to the ideal value of the P3 Charging Index of 1.0 and lead the field across all segments:

The best value in the luxury class was reached by the **Mercedes EQS450+**, and a value of 0.92 was determined. In just 10 minutes, the EV from Stuttgart had recharged an impressive 154 km. After an additional 10 minutes, the EV had recharged another 121 km. The rate corresponds to a recharged range of 275 km in just 20 minutes.

The **BMW iX xDrive50** (0.91 in the P3 Charging Index) follows close behind, having 273 km recharged after just 20 minutes. The SUV recharges 157 km in the first 10 minutes and 116 km in the next 10 minutes.

Right after the iX comes the **Porsche Taycan GTS** in a close third place with 183 km recharged after 10 minutes, well ahead of the Mercedes and BMW in the first 10 minutes. However, with only 88 km in the second 10 minutes, the Taycan results in a total of 271 km after 20 minutes and a P3 Charging Index of 0.90.

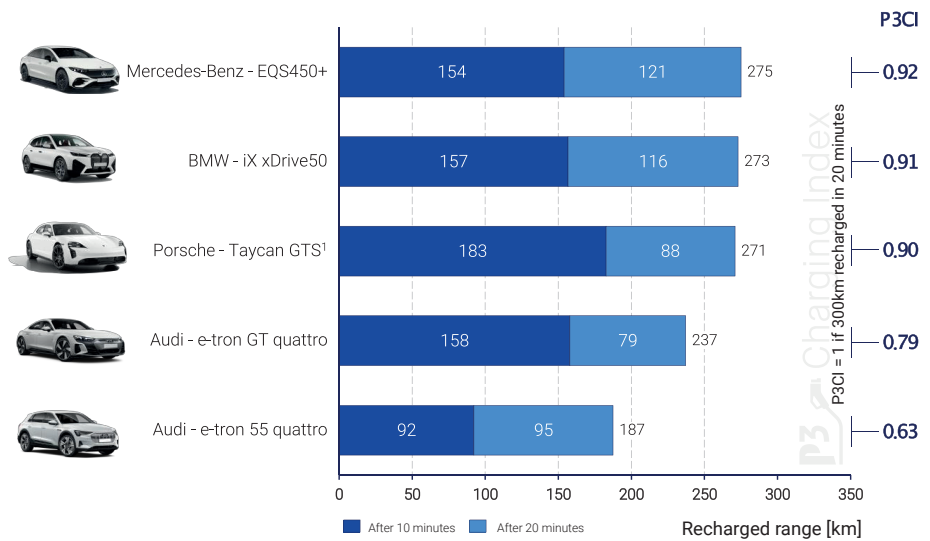
The two Audis fall slightly behind: The **e-tron GT quattro** achieves a P3 Charging Index of 0.79 and can recharge 237 km in 20 minutes. The **Audi e-tron 55 quattro**, which has been available on the market since 2019, achieves a P3 Charging Index of 0.63 with 188 km recharged in 20 minutes, but still offers a relatively constant charging power of almost 150 kW with up to 80% SoC.

Comparison of recharged ranges after 10 and 20 min of charging (start @10% SoC)

Luxury class

¹Porsche Taycan GTS Sport Turismo model under review, named in the graphic as Porsche Taycan GTS

Source Vehicle pictures: Manufacturer



CONSIDERATION OF THE RECHARGED RANGES (KM) WITHIN THE P3 CHARGING INDEX – PREMIUM CLASS

The KIA EV6 with a 77.4 kWh battery and rear-wheel drive is the first electric vehicle ever to reach the ideal value of 1.0 and even slightly exceeds the value with 1.03. Thus, it wins the third edition of the P3 Charging Index across all segments. The electric vehicle from the South Korean manufacturer can recharge 309 km of range in 20 minutes which further emphasizes the vehicle's long-distance capability.

The Hyundai IONIQ5 that is like the Kia based on the E-GMP platform is following close behind with a P3CI of 0.91 at 272 recharged kilometers in 20 minutes.

The third place goes to the BMW i4 eDrive40, achieving a total of 235 recharged kilometers after 20 minutes with a P3 Charging Index of 0.78, although having a 400 V architecture and the resulting lower charging powers.

The Tesla Model 3 Long Range can only secure fourth place with a P3CI of 0.74 at 221 recharged kilometers in 20 minutes despite the highest maximum charging power in the premium class by using the Supercharger V3. However, the Tesla is also the vehicle with the longest market availability in this segment - the Model 3 has been delivered to customers since 2018.

The Polestar 2 Long Range Single Motor which is particularly efficient with a consumption of 18.5 kWh can compensate well for its rather average charging performance of 111 kW in the considered charging window. The mid-size sedan achieves a P3CI of 0.73 and recharged 218 km in 20 minutes.

The VW ID.4 (with ID.Software 2.3) is ranked behind the Tesla Model Y Long Range (0.58) in the P3 Charging Index with a value of 0.57, which means 171 km (ID.4) or 175 km (Model Y) after 20 minutes.

The Mercedes Benz EQA achieves a P3CI of 0.54 and can recharge enough energy for 163 km in 20 minutes.

The field is rounded off by the Renault Mégane E-Tech EV60 which recharges a total of 160 km after 20 minutes.

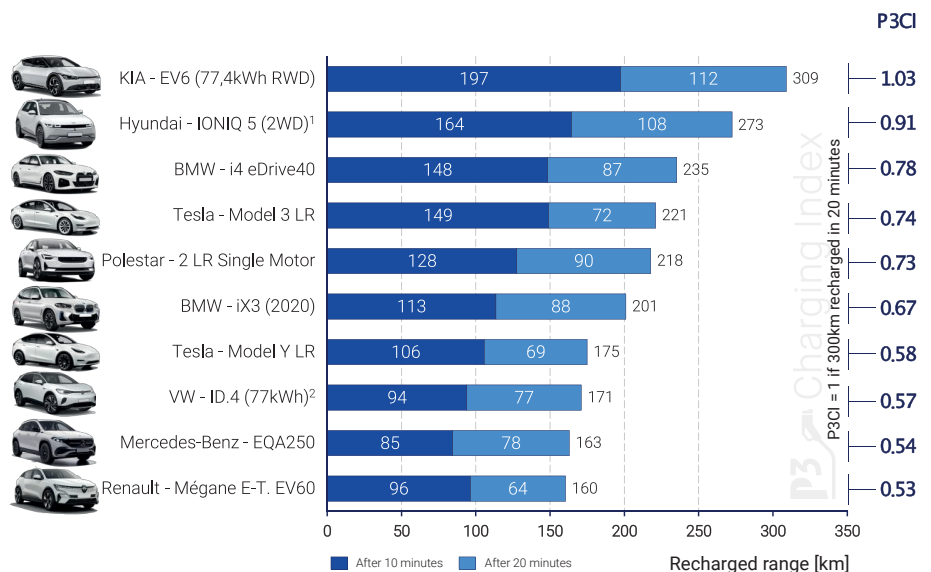
Comparison of recharged ranges after 10 and 20 min of charging (start @10% SoC)

Premium class

¹Hyundai - IONIQ 5 (72.6 kWh 2WD)

²VW ID.4 measured with ID.Software 2.3

Source Vehicle pictures: Manufacturer



CONSIDERATION OF THE RECHARGED RANGES (KM) WITHIN THE P3 CHARGING INDEX – COMPACT CLASS

In the compact class the **ID.3 (58 kWh)** (ID. Software 2.3) leads the field with a P3 Charging Index of 0.51 and can recharge around 154 km of range in 20 minutes.

The **Hyundai Kona** with a 64 kWh battery is close behind with a P3 Charging Index of 0.48 and can recharge around 144 km in 20 minutes.

The **Peugeot e-208 GT** (0.43), identical in construction to the Opel eCorsa, and the Fiat 500e (0.41) follow.

The **MINI Cooper SE** which is in high demand but uses technology from the BMW i3 (on the market since 2013), follows at a considerable distance with a value of 0.29.

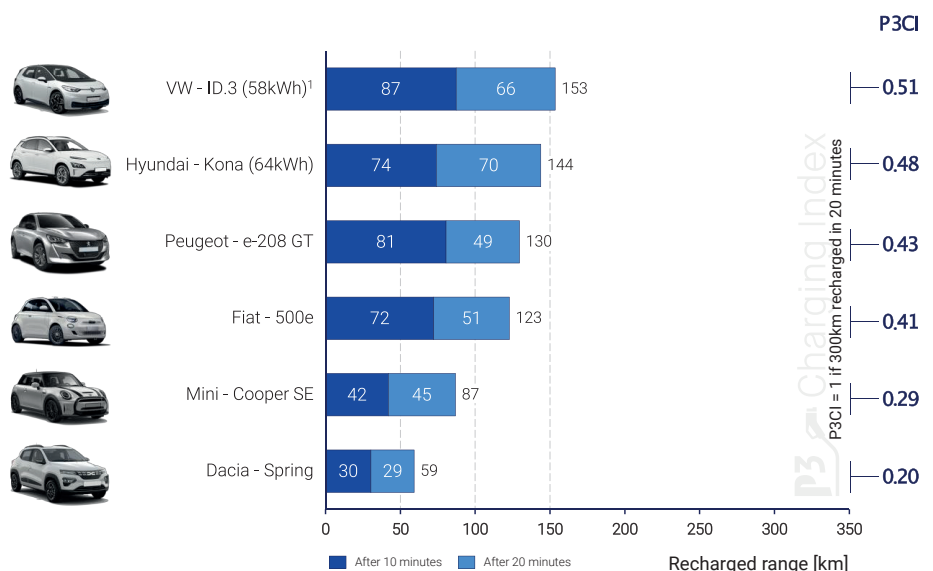
The field is closed by the **Dacia Spring** achieving a P3 Charging Index of 0.20 and corresponds to 59 recharged kilometers in 20 minutes.

Comparison of recharged ranges after 10 and 20 min of charging (start @10% SoC)

Compact class

¹VW ID.3 measured with ID.Software 2.3

Source Vehicle pictures: Manufacturer



CONSIDERATION OF THE RECHARGED RANGES (KM) WITHIN THE P3 CHARGING INDEX – TOP 5

1ST PLACE



The KIA EV6 emerges as the winner across all segments with a score of 1.03 in the third edition of the P3 Charging Index, compensating for a slightly lower charging performance than some luxury class vehicles thanks to its high efficiency. Consequently, the KIA EV6 is the first electric vehicle to exceed the ideal value of 1.0 in the P3 Charging Index.

2ND PLACE



The Mercedes-Benz EQS450+ follows in second place with a P3 Charging Index of 0.92.

3RD/4TH PLACE



BMW iX xDrive50, launched in 2021, and the Hyundai IONIQ 5 share third place with a P3CI of 0.91 each.

5TH PLACE



The fifth place goes to Zuffenhausen sports vehicle Porsche Taycan GTS which, despite the best maximum and average charging performance in the field, ranks just behind the previously mentioned vehicles in the P3 Charging Index with a P3CI of 0.90 due to its higher consumption.

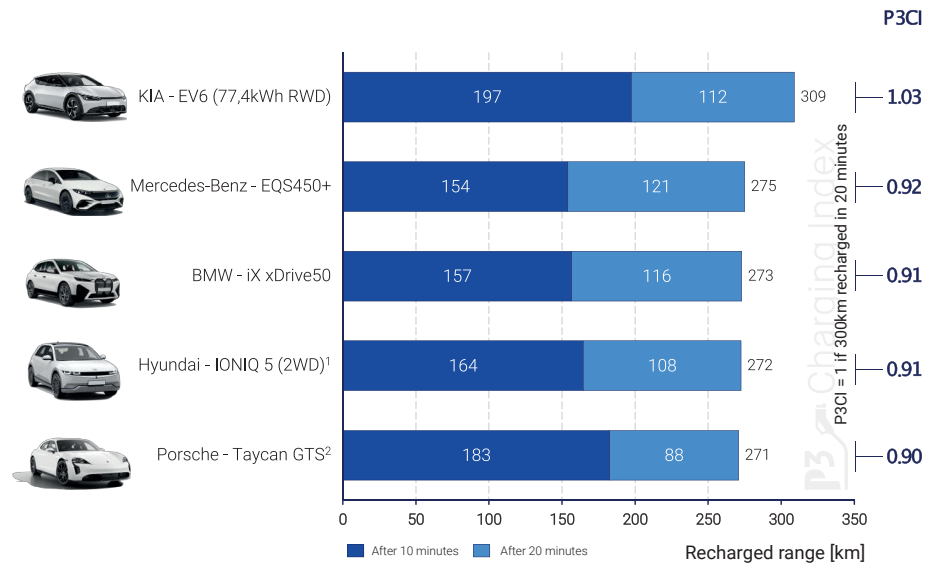
Comparison of recharged ranges after 10 and 20 min of charging (start @10% SoC)

Overall ranking

¹Hyundai – IONIQ 5 (72.6 kWh 2WD)

²Porsche Taycan GTS Sport Turismo model under review, named in the graphic as Porsche Taycan GTS

Source Vehicle pictures: Manufacturer



SUMMARY

In its third edition, the P3 Charging Index once again compares the real and practical charging performance of electric vehicles and – on top of that – divides the ever-growing number of vehicles into three categories for the first time. It considers both, the maximum and average charging performance of vehicles, pairs this with overall efficiency, and normalizes these metrics to a practical and realistic use case. Remarkably, the KIA EV6 wins the P3 Charging Index across all categories with a score >1.0. This clearly indicates that the decisive development towards long-range suitability is not only taking place in the luxury class of electric vehicles but is driven forward in other segments simultaneously.

It is also clear that the long distance suitability of electric vehicles depends on multiple factors. An example of this is the 800 V architecture enabling higher charging power but only having a positive overall impact on long distance suitability in conjunction with low consumption. Although the Mercedes-Benz EQS450+ and the BMW iX xDrive50 can also achieve high charging capacities with their 400 V architecture, they would not be able to achieve the recharged ranges without their low consumption.

The matter of long distance capability is rounded off by the vehicle battery's need for preconditioning, as this has a considerable influence on good charging performance, especially at low temperatures, and thus can significantly affect the recharged range per time. The behavior of some vehicles at low temperatures without preconditioning were most recently observed in the past winter, which is the reason why P3 has dedicated itself to this topic in a further publication in April 2022:

STUDY

Cell behavior at low temperatures and the importance of preconditioning

LINK: <https://www.p3-group.com/en/study-cell-behavior-at-low-temperatures-and-the-importance-of-preconditioning/>

The current leading edge of the P3 Charging Index ranges from a P3CI of 1.03 to 0.90 across five vehicles. The progression of electric vehicle development can be inferred by looking at the P3 Charging Index over time as follows: While the peak values were ~0.7 in the first release in 2019, the ideal value of 1.0 is now exceeded for the first time. The improvement in fast charging capability extends across all segments and even the compact class vehicles with values in the range of 0.51 to 0.43 in the P3 Charging Index are above some premium electric vehicles of previous generations, e.g. the Mercedes-Benz EQC400 with 0.42 or the Jaguar i-Pace with 0.37.

For further vehicle development both the increase in charging power and the optimization of consumption values must be considered. On the one hand, it can already be expected that new electric vehicles achieve charging powers of more than 300 kW in the future (e.g. Rimac Nevera with up to 500 kW⁵ according to the manufacturer's specifications or Lucid Air which was documented to have a maximum charging power of 304 kW⁶ during test drives). On the other hand, the focus is shifting to consumption as the second adjusting screw where further improvements can be expected in the future through additional increases in efficiency. A prime example of this is the Mercedes-Benz VISION EQXX which drove a distance of 1,202 km on one battery charge in real road traffic during a test drive in June 2022 consuming only 8.3 kWh/100km.⁷

Although increasing the battery capacities in the vehicles results in an improvement of the value of the P3 Charging Index, P3 believes it does not make sense technically nor economically, to continue increasing the battery sizes. Rather the focus should be on the optimization of charging power, efficiency, and possibilities of vehicle and battery conditioning. These are the most important factors for optimal performance and user-friendly electric vehicles in the future.

⁵Cf. Rimac-Automobili [Last accessed 21.06.2022]

⁶Cf. Insideevs [Last accessed 21.06.2022]

⁷Cf. Media Mercedes-Benz [Last accessed 07.07.2022]

Current vehicle updates and new versions are included in the P3 Charging Index. However, this is always dependent on vehicle and update availability at the time of testing. For example, new values can be expected for the VW models as the models under ID.Software 3.0 are available with increased charging performance. At the time of publication, ADAC had not yet published consumption data for an ID. Model with ID.Software 3.0. Updates and deviations in future publications will be marked.

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P3 is an independent and international consulting company that offers consulting and engineering services, as well as software development for numerous customers.

Since its founding in 1996 in Aachen, Germany, P3 continues to grow with over 1.350 employees in 26 locations.

P3 has been working intensively on electromobility in all these facets and many more since 2008. This has given us a deep understanding of the technologies, production and players, which we continue to develop on a daily basis. This enables us to provide you with comprehensive strategic advice – and thanks to our proven practical relevance, we can also support you in the implementation.

More than 200 of our consultants, engineers and software specialists are now working on e-mobility. Whether it's about the technical transformation of powertrain systems, battery cells, the charging infrastructure or specific application scenarios, we are there as a leading technology consultant. In addition, we dedicate ourselves to the market, analyse, prepare studies and participate in research projects.

At the same time, P3 has long been active itself: we invest in battery cell manufacturers, develop module and drive strategies, 48V on-board network architectures and numerous software solutions around e-mobility. Our customer network includes not only the major car manufacturers and their OEMs and suppliers, but also energy providers, the public sector and the government. Accordingly, we are strong in benchmarking and in looking at complex challenges from the outside to develop solutions.

EVS CONSIDERED

LUXURY CLASS

Model	BAFA-Net list price	ADAC Eco-Test
Audi e-tron 55 quattro	> 65.000 €	25,8 kWh / 100 km
Audi e-tron GT quattro	> 65.000 €	26,3 kWh / 100 km
BMW iX xDrive50	> 65.000 €	20,4 kWh / 100 km
Mercedes-Benz EQS450+	> 65.000 €	21,5 kWh / 100 km
Porsche Taycan GTS Sport Turismo	> 65.000 €	23,2 kWh / 100 km

PREMIUM CLASS

Model	BAFA-Net list price	ADAC Eco-Test
BMW i4 eDrive40 (Typ: 71AW)	48.991,60 €	19,5 kWh / 100 km
BMW iX3 Impressive (01/21 - 08/21)	58.655,46 €	21,2 kWh / 100 km
Hyundai IONIQ 5 (72,6 kWh) TECHNIQ-Paket 2WD	35.210,08 €	20,9 kWh / 100 km
KIA EV6 RWD (77,4 kWh)	37.806,72 €	18,6 kWh / 100 km
Mercedes-Benz EQA 250	39.950,00 €	21,6 kWh / 100 km
Polestar 2 Long Range Single Motor (78 kWh)	39.071,43 €	18,5 kWh / 100 km
Renault Mégane E-TECH Electric EV60 220hp optimum charge Techno	37.563,03 €	19,2 kWh / 100 km
Tesla Model 3 Long Range AWD	48.555,00 €	20,9 kWh / 100 km
Tesla Model Y Long Range	50.390,76 €	22,6 kWh / 100 km
VW ID.4 Pro Performance (77 kWh) Max	37.352,94 €	22,8 kWh / 100 km

COMPACT CLASS

Model	BAFA-Net list price	ADAC Eco-Test
Dacia Spring Comfort	17.218,49 €	17,9 kWh / 100 km
Fiat 500e Cabrio (42 kWh) Icon	27.361,34 €	17,4 kWh / 100 km
Hyundai Kona Elektro (64 kWh)	29.957,98 €	16,7 kWh / 100 km
MINI Cooper SE	27.310,92 €	17,6 kWh / 100 km
Peugeot e-208 GT	30.756,30 €	18,7 kWh / 100 km
VW ID.3 Pro Performance (58 kWh) 1st Max	30.668,07 €	19,3 kWh / 100 km

BAFA-Net list price as of 01.07.2022

SOURCES

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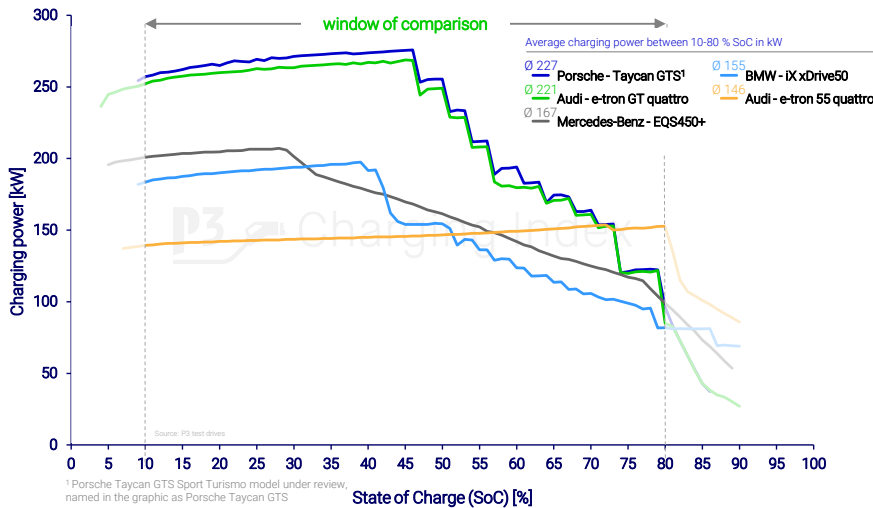
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P3 | Charging curves – Luxury class

IN THE 2022 REPORT OF THE P3 CHARGING INDEX (P3CI), THE LUXURY CLASS INCLUDES THE TOP MODELS WITH NET BAFA LIST PRICES OF ABOVE 65,000€, WHICH INCLUDES ESPECIALLY THE LUXURY MODELS OF THE GERMAN OEMS.

P3 CHARGING CURVES FOR DIFFERENT BATTERY ELECTRIC VEHICLE (BEV) MODELS



KEY FINDINGS

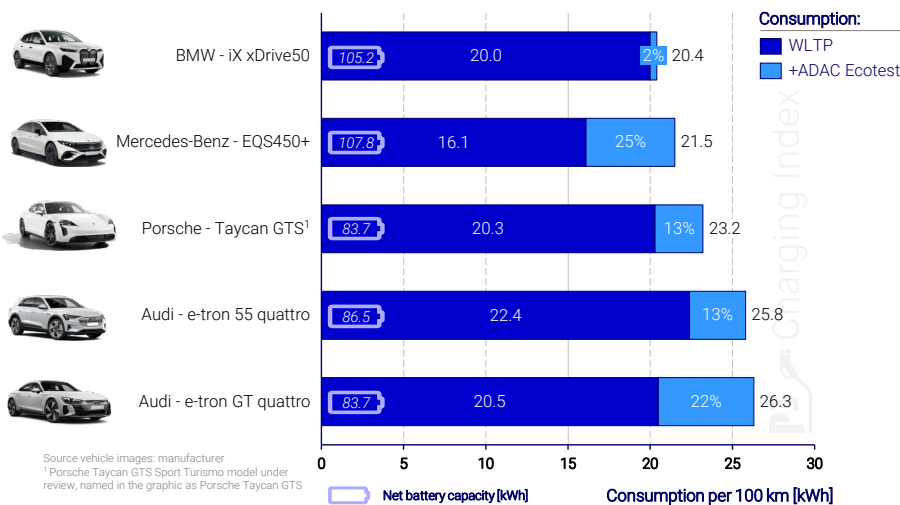
- The **Porsche Taycan GTS¹** is on top with both, peak and average charging power, reaching over 276 kW with its 800 V architecture at peak and 227 kW average over the window 10-80% SoC.
- The **Mercedes-Benz EQS450+** and the **BMW iX xDrive50** both reach a peak power of about 200 kW, which is achieved with a current of 500 A, as both are based on a 400 V architecture.
- The **EQS450+** is starting with a higher charging power at the beginning but also is starting the derating earlier compared to the **BMW iX xDrive50**.
- The charging curve of the **Audi e-tron 55 quattro** is still unique, as it runs constantly up to 150 kW from 10-80% SoC.

1

P3 | Vehicle consumption – Luxury class

INSTEAD OF THE WLTP VALUE, THE ADAC ECOTEST VALUE IS USED FOR CONSUMPTION, WHICH IS MORE REALISTIC THAN THE WLTP VALUE AND TAKES AC CHARGING LOSSES INTO ACCOUNT TO CONSIDER THEM FOR THE OVERALL CONSUMPTION.

COMPARISON OF THE BEV CONSUMPTION (WLTP ABSOLUTE AND ADDITIONAL PERCENTAGE ADAC ECOTEST)



KEY FINDINGS

- In terms of luxury class consumption, the **BMW iX xDrive 50** is particularly impressive, despite its SUV design and the large battery of 105.2 kWh, with an ADAC Ecotest value of 20.4 kWh/100 km.
- The WLTP consumption of the **EQS 450+** is clearly below that of the **BMW iX xDrive 50**, but in comparison of the values for the ADAC Ecotest, the **EQS450+**, including the charging AC losses, ends up just above the **BMW iX**.
- Overall, the vehicles considered in this class have large net battery capacities of at least 83.7 kWh (**Taycan GTS** and **e-tron GT**), but the **BMW iX xDrive 50** and the **Mercedes-Benz EQS450+** standing out clearly with battery capacities of over 100 kWh.

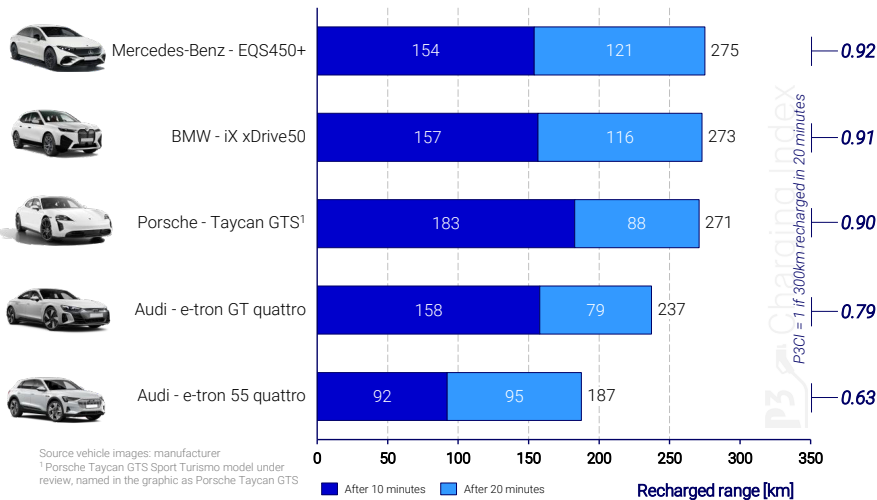
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P3 | Charging Index (P3CI) – Luxury class

WITH THE CONSUMPTION AND CHARGING CURVES OF THE VEHICLES, THE RECHARGED KILOMETERS CAN BE MAPPED OVER THE REQUIRED CHARGING TIME. THIS ENABLES A MORE ACCURATE ASSESSMENT OF THE VEHICLES' FAST-CHARGING BEHAVIOR.

COMPARISON OF RECHARGED RANGES AFTER 10 AND 20 MIN OF CHARGING (START @10% SoC) P3CI

KEY FINDINGS



- The **Mercedes-Benz EQS450+** combines both values best, even though it does not rank first in the luxury class in terms of consumption and average charging power.
- The **EQS450+** is followed by the **BMW iX xDrive50**, which is the more efficient vehicle but has a slightly lower charging performance in a direct comparison.
- The **Taycan GTS** is the front-runner in the comparison of charging power and has the highest range recharged after 10 minutes. The **Audi e-tron GT** is behind the Porsche due to its higher consumption.
- The **Audi e-tron 55 quattro** takes fifth place due to its consumption and comparatively low average charging performance.

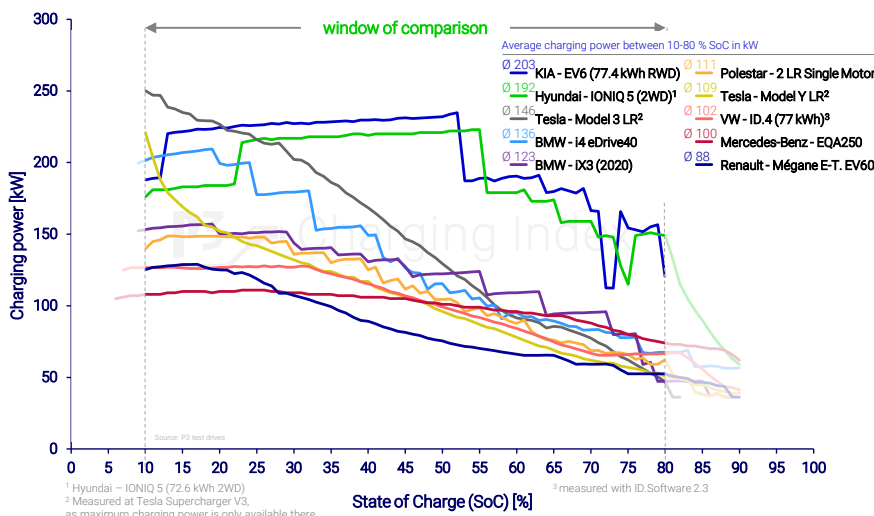
3

P3 | Charging curves – Premium class

THE PREMIUM CLASS INCLUDES ALL EVS IN A RANGE BETWEEN 35,000 € AS LOWER LIMIT AND 65,000 € AS UPPER LIMIT. AS A RESULT OF THIS CLASSIFICATION, THE VARIETY OF VEHICLES IS SIGNIFICANTLY GREATER, WHICH IS REFLECTED IN TEN VEHICLES FROM EIGHTS BRANDS.

P3 CHARGING CURVES FOR DIFFERENT BATTERY ELECTRIC VEHICLE (BEV) MODELS

KEY FINDINGS



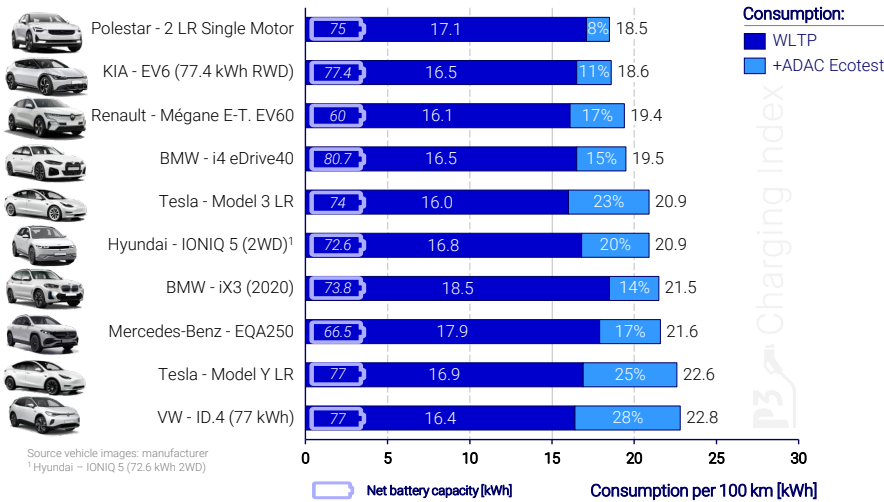
- In terms of average charging power, the E-GMP platform models **KIA EV6** and **Hyundai IONIQ 5** are far ahead with 203 kW and 192 kW based on their 800 V architecture.
- However, the **Tesla Model 3** achieves the highest charging power in the premium class with 250 kW. On average, the Model 3 ranks third with 146 kW, clearly behind the 800 V models, since the peak power is only maintained for a short time and drops off quickly.
- This behavior can also be seen for the charging curve of the **BMW i4 eDrive 40**, where a maximum charging power of over 200 kW is achieved.

4

P3 | Vehicle consumption – Premium class

INSTEAD OF THE WLTP VALUE, THE ADAC ECOTEST VALUE IS USED FOR CONSUMPTION, WHICH IS MORE REALISTIC THAN THE WLTP VALUE AND TAKES AC CHARGING LOSSES INTO ACCOUNT TO CONSIDER THEM FOR THE OVERALL CONSUMPTION.

COMPARISON OF THE BEV CONSUMPTION (WLTP ABSOLUTE AND ADDITIONAL PERCENTAGE ADAC ECOTEST)



KEY FINDINGS

- Compared to the last issue of the P3CI, the **Polestar 2** as LR Single Motor leads the ranking this time, since the version with the single motor achieves a significantly lower consumption.
- The **KIA EV6** can impress with low ADAC Ecotest consumption.
- The **BMW i4 eDrive40** has very low consumption, which can be attributed to the efficient 5th generation eDrive technology that is also used in the **BMW iX xDrive50**.

5

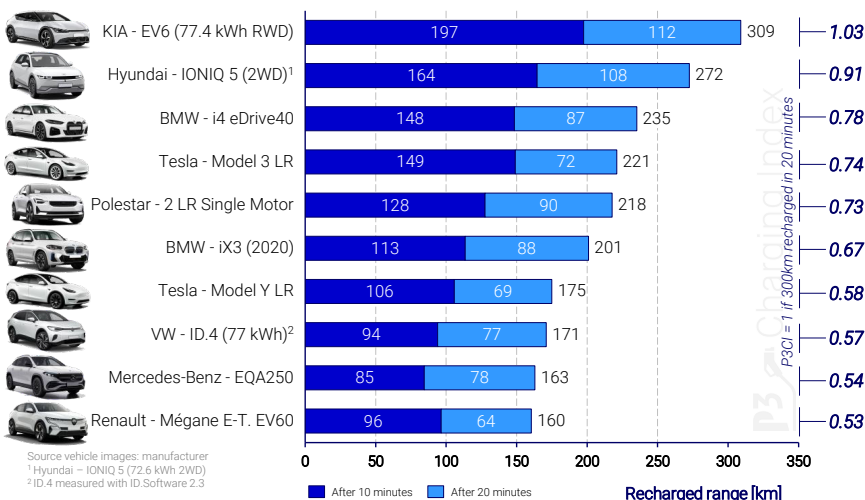
P3 | Charging Index (P3CI) – Premium class

WITH THE CONSUMPTION AND CHARGING CURVES OF THE VEHICLES, THE RECHARGED KILOMETERS CAN BE MAPPED OVER THE REQUIRED CHARGING TIME. THIS ENABLES A MORE ACCURATE ASSESSMENT OF THE VEHICLES' FAST-CHARGING BEHAVIOR.

COMPARISON OF RECHARGED RANGES AFTER 10 AND 20 MIN OF CHARGING (START @10% SoC)

P3CI

KEY FINDINGS



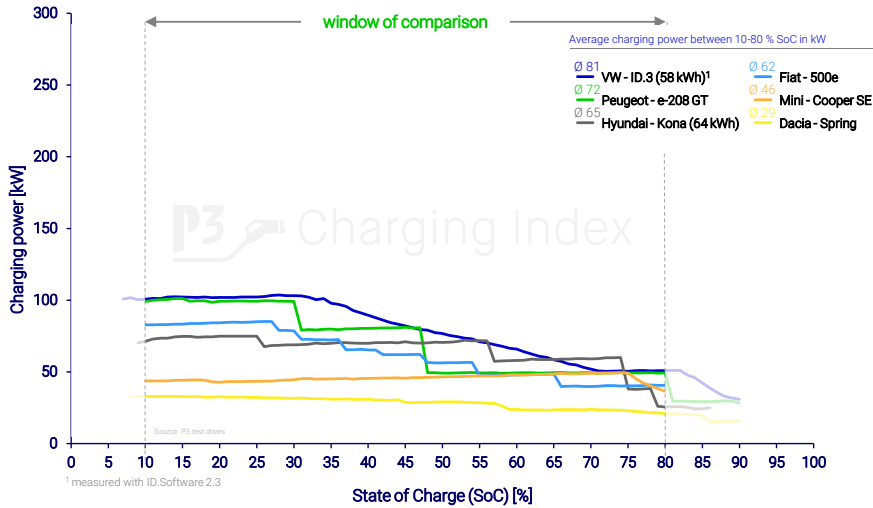
- The two electric vehicles based on the E-GMP platform with an 800 V architecture (**KIA EV6** and **Hyundai IONIQ 5**) take the first two places due to their exceptional charging performance.
- Compared to the **IONIQ 5**, the **EV6** can claim a significantly lower consumption and a slightly better charging performance, which not only gives it first place, but also a P3CI value above 1, which no vehicle has ever achieved before.
- Third place in the premium class is the **BMW i4 eDrive40**, which despite its 400 V architecture achieves a maximum charging power of over 200 kW and combines a good combination of charging power and efficiency with a consumption of 19.5 kWh/100km.

6

P3 | Charging curves – Compact class

THE COMPACT CLASS INCLUDES E-VEHICLES IN A RANGE UP TO 35,000 € BAFA NET LIST PRICE. THIS SEGMENT CURRENTLY INCLUDES VEHICLES WITH LOWER BATTERY CAPACITY AND A MAXIMUM CHARGING POWER OF UP TO 100 KW.

P3 CHARGING CURVES FOR DIFFERENT BATTERY ELECTRIC VEHICLE (BEV) MODELS



KEY FINDINGS

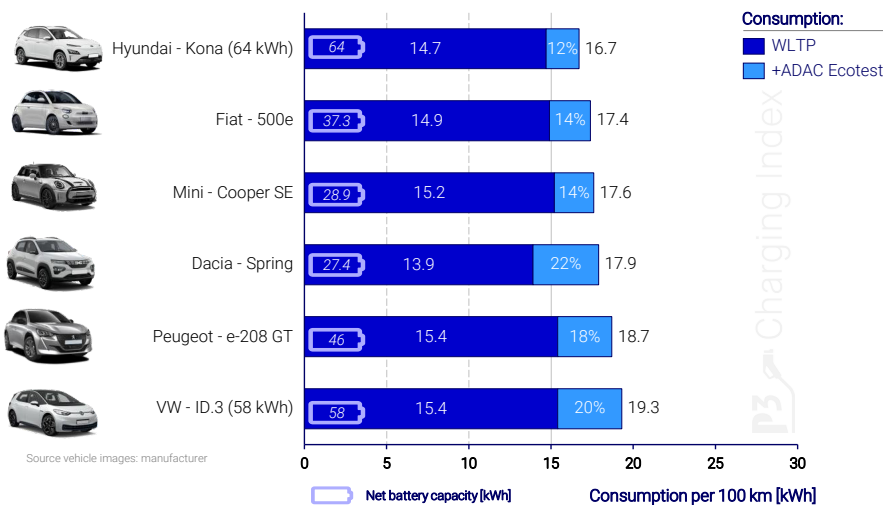
- The **Volkswagen ID.3** with the small 58 kWh battery is the leader among compact class vehicles in terms of maximum and average charging power with about 104 kW as peak and 81 kW as average charging power.
- The **Peugeot e-208 GT** is closest to the ID.3 up to just under 30%, but then gives way significantly in the charging curve and is caught by a consistently good Hyundai Kona 64 kWh.
- The **Fiat 500e** performance is particularly high in the first half of the charging session but decreases continuously and can only maintain its high initial charging power of 85 kW until just above 25% SoC.
- The **MINI Cooper SE** has an almost constant charging curve of around 50 kW in the SoC window under consideration.

7

P3 | Vehicle consumption – Compact class

INSTEAD OF THE WLTP VALUE, THE ADAC ECOTEST VALUE IS USED FOR CONSUMPTION, WHICH IS MORE REALISTIC THAN THE WLTP VALUE AND TAKES AC CHARGING LOSSES INTO ACCOUNT TO CONSIDER THEM FOR THE OVERALL CONSUMPTION.

COMPARISON OF THE BEV CONSUMPTION (WLTP ABSOLUTE AND ADDITIONAL PERCENTAGE ADAC ECOTEST)



KEY FINDINGS

- The **Hyundai Kona 64 kWh** has the lowest consumption in the compact class according to the ADAC Ecotest. In addition, the percentage surcharge between WLTP consumption and the ADAC Ecotest is the lowest at 12% in this class.
- The **Fiat 500e** follows close behind the Hyundai with a consumption value of 17.4 kWh per 100 km according to the ADAC Ecotest.
- Close behind, with consumption of 17.6 kWh per 100 km according to the ADAC Ecotest, is the **MINI Cooper SE**.

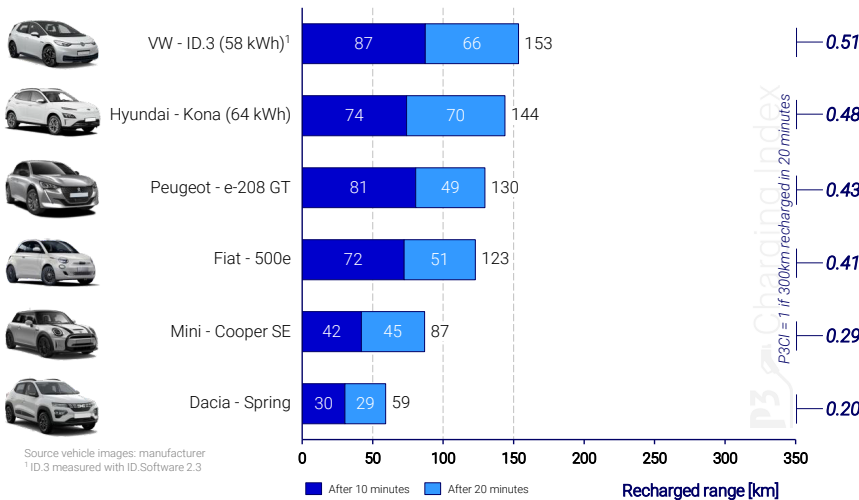
8

P3 | Charging Index (P3CI) – Compact class

P3 Charging Index

WITH THE CONSUMPTION AND CHARGING CURVES OF THE VEHICLES, THE RECHARGED KILOMETERS CAN BE MAPPED OVER THE REQUIRED CHARGING TIME. THIS ENABLES A MORE ACCURATE ASSESSMENT OF THE VEHICLES' FAST-CHARGING BEHAVIOR.

COMPARISON OF RECHARGED RANGES AFTER 10 AND 20 MIN OF CHARGING (START @10% SoC) P3CI



KEY FINDINGS

- The **Volkswagen ID.3** with the 58 kWh battery leads the compact class and can compensate the comparatively high consumption with its good charging performance.
- In second to fourth place are the **Hyundai Kona**, **Peugeot e-208** and **Fiat 500e** with moderate ranges of between 144 km and 123 km in 20 minutes of charging.
- The **Mini Cooper SE** and the **Dacia Spring** each recharge significantly less than 100 km in 20 minutes and close the field.

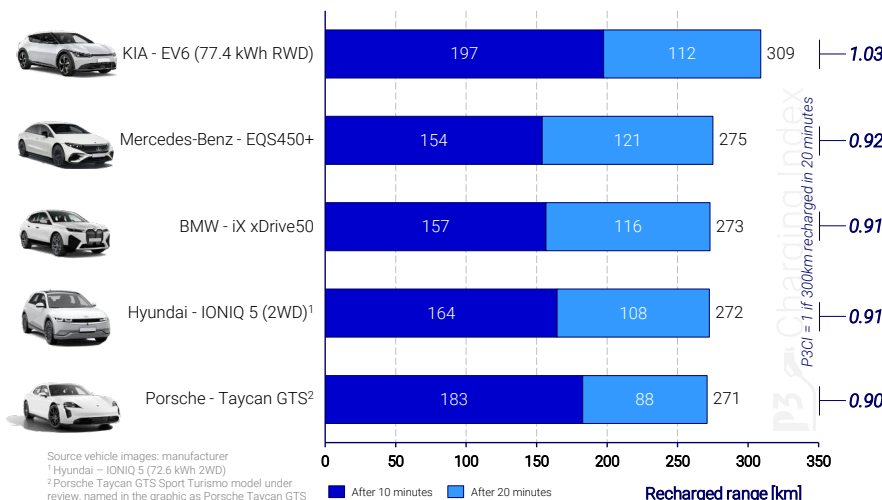
9

P3 | Charging Index (P3CI) – Overall ranking

P3 Charging Index

THE OVERALL RANKING OF THE THIRD P3 CHARGING INDEX ACROSS ALL CLASSES IS WON BY THE KIA EV6 BY A CLEAR MARGIN. IN ADDITION, A P3CI OF MORE THAN 1 IS ACHIEVED FOR THE FIRST TIME.

COMPARISON OF RECHARGED RANGES AFTER 10 AND 20 MIN OF CHARGING (START @10% SoC) P3CI



KEY FINDINGS

- The **KIA EV6** is the winner across all segments with a score of 1.03 in the third edition of the P3 Charging Index. It can compensate for the Porsche's higher charging performance with its low consumption.
- The **Mercedes-Benz EQS450+** follows in second place with a P3 Charging Index of 0.92.
- Third place is shared by the **BMW iX xDrive50** and the **Hyundai IONIQ 5** with a P3CI of 0.91 each.
- The **Porsche Taycan GTS** follows in fifth place, ranking just behind the other vehicles with a P3 Charging Index value of 0.90 due to its higher consumption.

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