AHEAD OF THE TIME.

Volkswagen

HIGHLIGHTS FROM MORE THAN SIX DECADES OF RESEARCH AND DEVELOPMENT AT VOLKSWAGEN.

WE MAKE THE FUTURE REAL – AND HAVE BEEN DOING SO FOR MORE THAN SIX DECADES.

In this booklet, we wish to take you on a journey in time through the history of research and development at Volkswagen.

Even back in 1955, the innovative EA 48 concept vehicle was turning heads with its unitary body, front-wheel drive and independent wheel suspension. From 1965, first crash tests were providing information on vehicle safety. The ESVW I research vehicle from 1972 was a milestone that made a major contribution to improving safety in later production models.

We have been researching into assistance systems since 1978. Our first test vehicle was a 'Bulli' or Microbus for conducting trials of a lane assistance system. And almost 30 years ago, the Futura concept vehicle had technology highlights that are now found in the production models of today.

Did you know that Volkswagen already had Formula E back in the 1980s? Among the features included in this technology were a start/stop system that saved up to two litres of fuel over a distance of 100 kilometres.

And on the subject of fuel: for more than 40 years, we have been conducting research into the use of alternative energy sources. Current production models, such as the fully electric e-Golf[1] or the TGI technology adapted to the use of natural gas testify to the lasting success of this systematic development work.

The next step is implementation of a new generation of emissions-free powered electric vehicles with a range in excess of 600 kilometres: the I.D. Family introduces various body concepts – including the I.D.[2] in the form of a compact saloon, the I.D. BUZZ[2] van, the I.D. CROZZ[2] crossover and the I.D. VIZZION[2] luxury saloon.

[1] e-Golf – power consumption, kWh/100 km: combined 12.7; CO_2 emissions combined, g/km: 0; efficiency class: A+.
[2] I.D., I.D. CROZZ, I.D. BUZZ and I.D. VIZZION – concept vehicles are not offered for sale and therefore Directive 1999/94 EC does not apply.

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RELENTLESSLY DRIVING TOWARDS **THE FUTURE.**

FOR MORE THAN 50 YEARS, SPECIALISTS AT VOLKSWAGEN HAVE BEEN DEVELOPING SOLUTIONS TO MAKE THE VEHICLES OF TODAY AND TOMORROW EVER SAFER. A MAJOR CONTRIBUTION TO THIS HAS COME FROM PROF. DR ULRICH SEIFFERT, FORMERLY HEAD OF RESEARCH AND DEVELOPMENT AT VOLKSWAGEN. HE TREASURES HIS MEMORIES OF THAT TIME.

"We were among the leaders in matters of vehicle safety," says Prof. Dr Ulrich Seiffert, former Member of the Management Board of Volkswagen AG responsible for Research and Development.


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1 Innovation, safety and comfort: self-fastening safety belt with belt lock positioned on the door frame and knee pads instead of a lap belt.

2 A human touch: Ulrich Seiffert and his somewhat static looking 'co-workers': 'Dummies' is the term for these models of driver and occupants used for testing. Their successors are still at work today – Seiffert too.

3 Three – two – one – kerpow! Golf Mk1 piles into Golf Mk1 at 30 km/h. Crash test at Volkswagen, approx. 1974.

When the Golf Mk1 crashes into the barrier at 30 km/h without any braking, it tugs Ulrich Seiffert forwards – into the three-point automatic seat belt of the driver's seat. "You see how I'm a little dazed for a brief moment, then I take active control again," says Seiffert. Peering over the rims of his glasses, he attentively watches the film clip on the monitor – 45 years after the event.

"We were among the leaders in matters of vehicle safety," says Seiffert now, and by 'we' he means Volkswagen – the company for which Prof. Dr Ulrich Seiffert was Head of Research and Development from 1978 to 1987. One of the pioneers in vehicle safety at Volkswagen in 1965 was Dr Friedrich Goes, who conducted the first relevant crash test with a Beetle in that year. This was Goes paying tribute to the increasing importance of the US safety regulations in Wolfsburg.

"All relevant regulations concerning issues of vehicle safety at that time were coming from the USA," confirms Seiffert, who joined Volkswagen in 1966 after studying mechanical engineering in Braunschweig and had already risen to Head of Vehicle Safety Testing by 1969. Seiffert reminisces: "At the peak of discussions on the obligatory wearing of seat belts in the early 1970s, the Federal Justice Minister at that time, Hans-Jochen Vogel, insisted on taking a seat behind the wheel of a crash vehicle himself." The venue for this event was the still almost new test site in Ehra-Lessien near Wolfsburg, which had been opened in 1969.

"We were among the leaders in matters of vehicle safety. All relevant regulations concerning issues of vehicle safety at that time were coming from the USA."

PROF. DR ULRICH SEIFFERT

"Beforehand, Vogel pressed all of his ID papers into my hand and then completed the trial without any mishap." Afterwards, there was an awareness at the highest political level of how valuable this type of belt can be – and, as an exception, a beer for the Minister hailing from Bavaria.

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1 All new: Scirocco Mk1, Passat Estate and Golf Mk1 on the Volkswagen test track in Ehra-Lessien, which was officially opened in 1969.

2 All nostalgic: Beetle and Type 3 underwent the early driving trials on the first section of the test track in Ehra-Lessien, which was completed in 1967.

3 A feast of colours: FS 2 driving simulator in a graphic of its time.

4 Blow twice, please: 50 years ago Volkswagen was already conducting experiments with the airbags that are now taken for granted.

5 Frontal crash with Golf Mk1 and dummy, 1970s. The current crash test facility at Volkswagen 'consumes' far fewer test vehicles thanks to new technology.

6 "It was great that our ideas were implemented": Ulrich Seiffert looks at a picture of himself (r.) with a group of his former colleagues. Standing in the centre: Prof. Ernst Fiala, then Head of Research at Volkswagen.

"The present crash test facility of 2018 was designed specifically for the particular requirements at Volkswagen."

PROF. DR ULRICH SEIFFERT

The seriousness that Volkswagen has always attached to the subject of vehicle safety became apparent from the great variety of research fields, the innovations and their implementation in series production. "Seeing our ideas and results implemented without compromises did of course represent tremendous successes for us," remarks Seiffert, still showing his delight in 2018. Wolfsburg responded promptly to the criticism of the Beetle, and beginning in 1967 it featured safety steering, three-point safety belts from Repa and the detachable interior mirror. Head restraints came as an extra from 1968, and then were standard in Volkswagen vehicles from 1971. Another feature introduced in 1968 was the transmission of crash energy via the longitudinal frame members, as offered by the unitary body of the new Model 411. In 1969, Volkswagen started test trials with the airbag.

Also dating back to the year 1968, is what was the ultra modern crash test sled system of those days; Volkswagen engineers of Technical Development (TE) used it to simulate increasingly more realistic accident scenarios. The design improvements resulting from this had direct benefits for the customer – because innovations were implemented directly in Volkswagen vehicles. In 1988, Research and Development (FE) at that time brought a second system with crash sleds into operation. The safety centre in Wolfsburg was constantly expanding the scope of its functions.

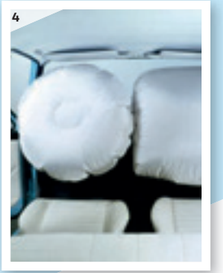
The present crash test facility of 2018 was designed for the special requirements at Volkswagen. Using this system, it is even possible to model rotational movements in the crash and realistically simulate accident scenarios with pre-crash braking. Facilitating innovation is a highly complex and accurately control lable hydraulic system in the sled unit, which simulates a forward pitching motion and a sideward yaw of the vehicle under trial immediately before impact. In addition, the novel pallet-changing system means that the next crash test can be prepared while a test is still in progress.

A great deal of attention was focused on Seiffert's most important 'co-workers' even back in the 1970s: these models of driver and passengers used for test purposes, called dummies, which still have to endure crash test after crash test today. "Their sensors have been undergoing continuous refinement so that our test results have been getting better and more realistic all the time," says Seiffert, still praising his dummies with a metaphorical pat on the back. After all, you can't have a Federal Justice Minister as a test subject every day.

The successes of all this research and development work over the decades and up to the present day are actually clear to see: Volkswagen models from the Polo and the Golf through to the T-Roc and Arteon are currently achieving top ratings in the respective Euro NCAP crash tests.

Even assistance systems, also a major topic in 2018, were undergoing trials at Volkswagen back in 1978. The test vehicle at that time was a Type 2, equipped for vehicle trials of a lane assistance system. "Safety Research at Volkswagen has never needed to be guided back on track like that; it has always stayed true to its successful course," jokes Ulrich Seiffert, who is still actively involved in current events.

Dedicated to safety.



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NEW VOLKSWAGEN SAFETY CENTRE IN WOLFSBURG.

DEVELOPMENT, VEHICLE PREPARATION AND TESTING AT ONE SITE.

The sled system at the new Volkswagen Safety Centre in Wolfsburg permits crash simulations at speeds of up to 100 km/h and vehicle weights of up to three tonnes. The new competence centre for safety covers an area of 8,000 square metres and extends over three storeys. In the simulation of complex accidents, components are tested to the highest standards in the world. For the first time ever, there is a way to simulate lateral and rotational movements of the vehicle body in horizontal and vertical directions, which enables modelling of dynamic rotational movements in a crash as well as realistic simulation of pre-crash braking scenarios.

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REALIST ON WHEELS.

WITH THE EXPERIMENTAL SAFETY VOLKSWAGEN ESVW I IN 1972, VOLKSWAGEN WAS THE FIRST EUROPEAN AUTOMOBILE MANUFACTURER TO PRESENT A RESEARCH VEHICLE THAT NOT ONLY FULFILLED OR EXCEEDED ALL OF THE STRICT US REGULATIONS – BUT AT THE SAME TIME WAS STILL ACTUALLY SUITABLE FOR USE AS A CAR.

Interior safety over an exterior length of 4.73 metres. The ESVW I is a milestone in Volkswagen safety research.

TECHNICAL DATA FOR ESVW I	
ENGINE:	FLAT FOUR-CYLINDER ENGINE; AIR-COOLED, DISPLACEMENT 1,970 CC
MAX. POWER:	73 KW/100 PS
ACCELERATION:	50–110 KM/H IN 15.3 S
TOP SPEED:	150 KM/H
MODEL YEAR:	1971/1972

Ahead of the time. ESVW I.

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"The aim was to demonstrate Volkswagen's expertise in the vehicle safety sector – and to do so under the most extreme conditions conceivable at the time."

EMIL POMMER

When he thinks back to 1970, Emil Pommer can't help smiling. While his hands leaf through the photo album, page by page, his eyes rest on a side view of the first Experimental Safety Volkswagen, ESVW I. "It looked so damned good!"

That's right: what Pommer and 79 other engineering colleagues put onto wheels starting in autumn 1970, under the leadership of Head of Research Dr Ernst Fiala, had character. Namely one of comprehensive safety combined with everyday utility. "The car was a completely new design," says Pommer, whose main assignment was the 'making' of the ESVW front end. "The aim was to demonstrate Volkswagen's expertise in the vehicle safety sector – and to do so under the most extreme conditions conceivable at the time: the US safety regulations."

The explanation for why the USA, in particular, increasingly prioritised safety in cars is explained by the figure of 65,000 traffic fatalities in 1965. Committed US politicians and engineers provoked a real competition amongst national and even international automobile manufacturers, too. By no means were all Experimental Safety Vehicles (ESV) suitable for everyday use; many were 'only' technology platforms. " In our ESVW I, we concentrated on a fully integrated solution from the very start of the project," recounts Emil Pommer. Even though

1 Entrusted with the engineering design of the ESVW I front end from 1970 to 1972 as a young engineer at Volkswagen: Emil Pommer (r.).

2 A cross member between the B-pillars of the ESVW I forms the rear side of the heavily safety-oriented design of the front seats. Solid body sections and 'self-fastening' belts proved their effectiveness in extensive crash tests.

3 Side-by-side levers: while the right-hand side is actually the shift lever for the three-speed automatic gearbox, the lettering for the lever on the left spells out the word BRAKE: in other words, it's the handbrake lever.

4 Fasten your seat belts: the innovative shoulder belts automatically move into the 'belt fastened' position when the ignition is switched on. In the event of a collision, they tighten and provide effective protection in conjunction with the knee belts which fasten in fractions of a second.

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Ahead of the time. ESVW I.

the purpose of ESVW I was primarily to develop systems and components – and above all their integration into future production vehicles.

Unveiled in 1972 at the international safety conference Transpo 72 in Washington, ESVW I was not only the first of its kind from an automobile manufacturer outside of the USA, but also thoroughly functional.

The centrepiece of the 4.73-metre-long car is its solid safety structure in the body: high-strength bumpers at the front, rear and also at the side – with the latter being 'invisibly' integrated into the doors – distribute the forces in a collision to a second zone, designed to be yielding and energy-absorbent. The supporting forces come from the third zone, which comprises a high-strength 'lattice framework' and represents an invulnerable passenger cell. The ergonomically designed seats with cross members between B-pillar and C-pillar are also an integral constituent of the framework and make a significant contribution to stiffness in the event of a side collision. Providing additional protection at the front and rear and mounted behind the solid bumpers are hydraulic absorbers along the axis of the longitudinal frame members. ESVW I thus passed all crash tests to the US standard with flying colours.

Also new were the safety system featuring fully automatic knee and shoulder belts, the adjustable steering and pedals, dual-circuit brake system with ABS, the single wiper arm with maximum wiping field, headlight washer system, four brake lights and brake pressure regulators front and rear. "Our ESVW I also sailed through the brake tests," Emil Pommer recalls, "to both the US and VDA specifications."

At the end, 14 crash test trials with ESVW I passenger cell, countless handling and swerve tests as well as 40 crash tests with production vehicles equipped with ESVW I safety components (incl. Volkswagen K 70 and 411, Audi 100) testified to the innovative power of Volkswagen. The car meets all US standards – or surpasses them significantly. "The Yanks were certainly surprised," says Emil Pommer, who in 2018 is still pleased by this success.

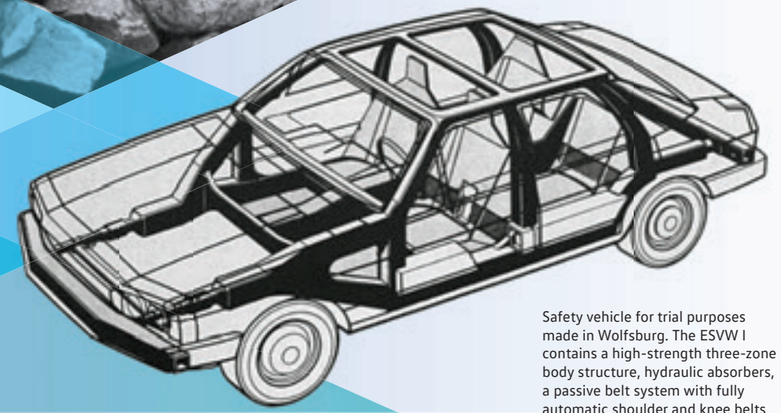
Incidentally, the Volkswagen engineers also carried out a cost-benefit analysis from the outset in order to demonstrate that the ESVW I could have gone into series production even in terms of individual components. "The transfer of research and trials results to production vehicles was always the guiding light for our involvement," says Pommer.

In this respect, nothing has changed at Volkswagen up to the present day.

Fascinating 'formality' – and quiz question: Which car is hiding behind the research vehicle? Answer: Just the ESVW I itself – not a Ro 80, not an Audi 100. However, the design of the Audi 100 C2 (from 1976) was derived directly from the ESVW I.

1 The front luggage compartment lid held open by a gas strut contains a lot: the fuse box, fluid reservoirs and the spare wheel on a specially produce aluminium rim – and according to the concept it would have also contained a water-cooled front engine.

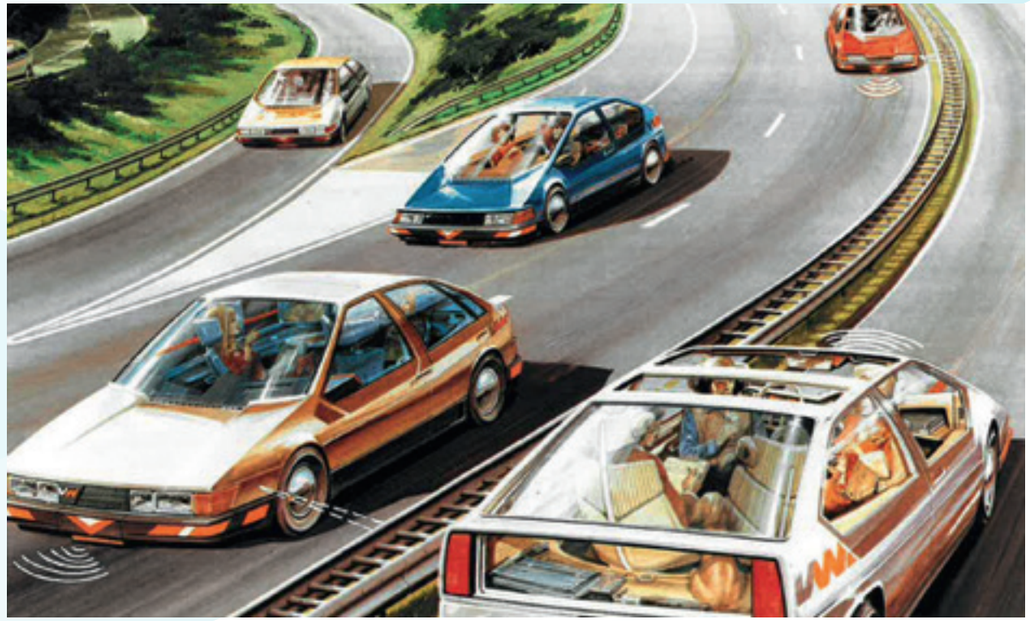
2 In the rear section, which matches the solid design employed throughout the ESVW I, is a pleasantly modified flat engine of the Type 4 411 with two litres of displacement, petrol injection and 73 kW/100 PS.



Safety vehicle for trial purposes made in Wolfsburg. The ESVW I contains a high-strength three-zone body structure, hydraulic absorbers, a passive belt system with fully automatic shoulder and knee belts and much more besides – and all of this in 1972.

AUTOMATICALLY BOUND FOR **THE FUTURE.**

IT IS NEVER INATTENTIVE, TIRED OR DISTRACTED: THE AUTONOMOUSLY DRIVING CAR, AS ALREADY EMBODIED BY THE VOLKSWAGEN CONCEPT VEHICLE SEDRIC, HAS MANY ADVANTAGES. VOLKSWAGEN ALREADY KNEW THIS BACK IN THE EIGHTIES. AND DEVELOPED SOLUTIONS SUCH AS THE OPTOPILOT AT AN EARLY STAGE, WHICH PAVED THE WAY FOR AUTOMATED DRIVING.



Tangible vision: as long ago as the 1970s, staff at Volkswagen were aware of the benefits of autonomous driving. In order to recognise the surroundings, the technology visionaries at that time relied on sensors at the front of the vehicle which are commonplace today.

SEDRIC, the first concept vehicle from the Volkswagen Group that impressively combines fully autonomous driving, electrification and digital connectivity, fascinates people wherever it appears. What only few people know is that the 'SElf-DRIving Car', or SEDRIC for short, had early forerunners.

After all, it was back in the 1970s and 1980s when Volkswagen started to fundamentally rethink mobility – including as part of the European PROMETHEUS research programme, launched in 1986, in which not only automobile producers and suppliers were involved but also research establishments such as the Fraunhofer Institute of Information and Data Processing (IITB) and the University of the German Federal Armed Forces in Munich.

In addition to what still sound like futuristic ideas, such as moving pavements that convey pedestrians from point A to point B, or transport tubes in which people were to be sent on their journey by compressed air, topics included the question of how to lower accident figures and ease the burden for drivers by means of electronics.

Hands off the wheel: Dr Walter Zimdahl tests the automatic steering in a Golf Mk2. The camera takes over the job of the human eye in this process.

Features at Volkswagen that have long been part of standard production, in the form of adaptive cruise control (ACC) or the 'Front Assist' area monitoring system, were then a bold vision – and particularly so in times when computers with the power of today's conventional PCs were still the size of a living room shelving unit.

With his research project 'on automatic steering with computer vision', to give it its official title, Dr Walter Zimdahl and his colleagues from the Department of Future Research, established in 1970, laid the foundation stone for automated driving.

EXCITING IDEA: CAMERA AS AN EYE

The exciting idea for this came from Dr Zimdahl, when in 1982, "more or less by chance", he happens to get hold of a handy TV camera from a Japanese electronics manufacturer. "We take that as a substitute for the human eye and connect it to an electric steering system", was his revolutionary approach. "The image evaluation was in essence relatively simple," recalls the electronics pioneer.

"The idea was to take the camera as a substitute for the human eye and connect it to an electric steering system."

DR WALTER ZIMDAHL

"It was directed towards the contrasts in brightness between the lane markings and the road surface, which were detected by the camera and then converted into control signals for the steering by the processor."

In this way, "microprocessors were used to develop rapid electronics that enable a road vehicle to drive automatically on a carriageway with normal markings," as Dr Zimdahl formulated in a highly regarded lecture on the OPTOPILOT, which he held at a VDI conference entitled 'Electronics in motor vehicles' in 1986.

The underlying idea was "to imitate the main human functions while steering using technical resources". Intended to serve as the 'eye' was the miniature CCD camera attached at the height of the rear-view mirror. "This camera was roughly the size of a spectacle case and, with a wide-angle lens, scanned a zone four to 25 metres in front of the vehicle."

Ahead of the time. Autonomous driving.

HERBIE

Anyone who wants to know how autonomous driving works should have a chat with Herbie. At the time of his movie premiere in 1968, the film-star Beetle's capabilities already included what the developers at Volkswagen are working on today: coping independently in road traffic – and taking over the wheel if necessary.

FORERUNNERS

STANLEY

In 2005, a team from Stanford University lined up at the start of the DARPA Grand Challenge, a 142-mile race for autonomous cars through the Mojave desert with the modified Volkswagen Touareg called 'Stanley'. With a lead of just under seven hours, Stanley was the clear winner.

CAROLINE

With the autonomously driving car 'Caroline' based on a Passat B6, the Technical University of Braunschweig demonstrated what is possible with the aid of radar, lasers and cameras. Its successor 'Leonie' was even able to find its way independently through the urban traffic starting in 2010.

But how do you teach a car to 'think' and steer as well as to see? Electromechanical steering systems would have helped. "Yet none of that was available then," says Dr Zimdahl. "We therefore had an electric motor installed parallel to the steering column and then linked directly to the steering using gear reduction."

It functioned well immediately. "Nevertheless there was of course always someone sitting on the driver's seat with their hands parked on their thighs so as to be able to intervene in an emergency," explains Dr Zimdahl.

NO UNCOMFORTABLE FEELING

That was not necessary – not even with the first driving trials at the company's own test facility, which came about as part of an academic investigation by two students at the Technical University of Braunschweig. "In this way, we then drove with automatic steering at up to 100 km/h". Any uncomfortable feelings during the trial – or at least butterflies in the stomach? "No," says Dr Zimdahl casually with a chuckle, "I really did have absolute confidence in our students – and in our development work." Confidence that was to pay off very soon.

Praise comes from a qualified source. His boss at the time, Dr Adolf Kalberlah, Head of the Future Research Department, still vividly recalls a technology demonstration on the testing site of a Munich competitor also involved in the PROMETHEUS project. "We had two Transporters with us that drove automatically and a third bus carrying all of the development heads and research directors."

"I was there as a project manager in this third bus," he explains. "And was then responsible for setting up a polystyrene wall at a certain spot, in front of which the cars stopped automatically with the aid of radar distance sensors and front camera." And successfully too: "This trial worked so well that we received spontaneous applause from the assembled heads of research."

"This trial worked so well that we received spontaneous applause from the assembled heads of research."

DR ADOLF KALBERLAH

TANGIBLE VISION OF THE FUTURE

Barely had the applause subsided when a relative silence descended upon autonomous driving – at least in the public sphere. Behind the scenes, the research continued. And fortunately, too, because the findings from those times are now providing the foundation for fully autonomous driving at Level 5. The Volkswagen concept vehicles are not presenting science fiction but very tangible visions of the future. Self-driving cars – in future they will be part of everyday life.

Ahead of the time. Autonomous driving.

ENTICING.
The self-driving car – or 'SEDRIC' for short – from the Volkswagen Group was developed for autonomous driving from the every outset. It stands for individual mobility at the touch of a button: simple, convenient, safe and sustainable.

"The car of tomorrow – is today's reality", was the slogan for the IRVW IV Futura in 1989. This idea is worthy of our support in 2018.

Ahead of the time. Volkswagen Futura.

FUTURA MOBILUM EST.

THE RESEARCH UNIVERSE. INFINITE EXPANSES. WE'RE IN THE YEAR 1989. THIS IS THE STORY OF THE SPACESHIP-LIKE VOLKSWAGEN FUTURA. WITH ITS FUTURISTIC TRAITS, IT VENTURED INTO REGIONS OF DEVELOPMENT THAT FEW PEOPLE HAD SEEN BEFORE, AND WHICH WERE NONETHELESS DESTINED TO BECOME STANDARD PRODUCTION FEATURES IN THE NOT TOO DISTANT FUTURE.

An exciting interpretation of a one-box design with lights as a key design feature and seemingly without A-pillar and B-pillar: this is dynamics at work. Identically levelled wheel arches along with the lower broad glass element visually extend the Futura and produce a Cd value of 0.25.

Let's just imagine what it would be like: the wing doors of the space mobile glide open silently. We allow ourselves to sink into the futuristic-looking yet extremely comfortable and very safe seats. A turn of the key starts the economical 1.7-litre direct injection petrol engine with a 'G-Lader' supercharger. Pressing a button releases the electric parking brake, while at the same time the vehicle with four-wheel steering moves out of the parking space autonomously. A computer calculates the most favourable route and displays it in the freely programmable LCD screen, while the generously proportioned surfaces of special heat-reflecting glass give a marvellous sensation of spaciousness. And the best possible all-round view. The rear seats quickly convert into safety child seats when required. Off we go!

TECHNICAL DATA FOR THE FUTURA	
ENGINE:	INLINE FOUR-CYLINDER PETROL ENGINE, DISPLACEMENT OF 1,715 CC, G-LADER
MAX. POWER:	60 KW/82 PS
ACCELERATION:	0–100 KM/H IN 15.0 S
TOP SPEED:	183 KM/H
FUEL CONSUMPTION:	APPROX. 6.0 LITRES/100 KM
MODEL YEAR:	1989

However, that is not all by far: a fully electronic anti-lock system (EBS) that intervenes at the speed of lightning performs faster than all hitherto known systems, while the electromechanical steering permits precise evasive action. Alternatively, we can also activate the front radar to keep the vehicle ahead at a safe distance. One move is all it takes to manage important calls when on the road with the aid of the mobile phone stored in the centre console. And to show off the pioneering one-box design to the extreme, we simply dismantle the wing doors that extend to the roof and the dome on the glazed rear – and voilà, we have the fresh wind of the future stroking our faces.

Recall that this is 1989! Not 2018. "At the time, we wanted to show what in our opinion might play a role in automobile manufacturing during the coming ten to fifteen years," says Prof. Dr Ulrich Seiffert, Head of Research at Volkswagen from 1978 to 1987. Under the slogan "The car of tomorrow – is today's reality", developers and designers at Volkswagen included everything that was technically feasible into a single car – the Futura. By the way, officially it bears the name "IRVW IV Futura" (Integrated Research Volkswagen) – that fits!

If we were to encounter a standard production Futura on the roads today – many of the sights might seem commonplace: one-box design à la Golf, a lot of glass, with black panelled A-pillars and B-pillars behind, headlights with a distinctive design, two-colour paint finishes, cool aluminium wheels, sensors in the front apron. It all seems rather familiar, doesn't it? However, this is by no means a coincidence, but comes from the future research of the past – which still appears to be right up to date. After all, even when viewed from today's standpoint, the Futura – and this is the special feature that distinguishes it from so many other concept vehicles – still appears to provide an accurate view into the all-knowing crystal ball of 1989. Almost everything from the Futura is included as routine in today's automobiles.

Admittedly, the four-wheel steering has not become established – the engineering effort required proved to be simply superfluous: automatic parking also operates with only two steerable wheels. But the rest are certainly there!

Fully glazed roofs have become reality, so have electromechanical steering and parking brake,

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navigation, mobile phones, adaptive cruise control radar, brake assist systems, integrated child seats, seats with pyrotechnic belt tensioners and memory function. The same applies to freely programmable LC displays: "Development and production were estimated to cost a billion German marks at the time, so nobody wanted to touch it. But now that's changed thanks to widespread digitalisation," points out Prof. Seiffert, providing a logical reason as to why this feature from the Futura has only just managed to become established.

So was it all very casual and easy back then, almost 30 years ago? "Ah well," says Seiffert, shaking his hand meaningfully, "we were very jittery, when host Thomas Gottschalk introduced us on his show." Volkswagen had in fact entered the Futura in the popular TV entertainment programme 'Wetten, dass..?', which involved placing bets on daring stunts. "The claim in this case was: Do you want to bet that our car can park automatically? We certainly came out in a sweat – the electronics technology in the ZDF TV studios was properly messing up that of our Futura. However, the whole event succeeded and there were even congratulations – by e-mail from our boss at that time, Dr Carl H. Hahn."

It's somehow comforting that, even in the past, research and development staff would still work up a sweat when their future was on the line.

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1 The Futura cockpit with CD slot gives the impression of coming from a single mould. The confectionery colouring and the creamy designer white are typical products of the late 1980s – the electric parking brake is very much 2018.

2 Open-air pleasure included: the wing doors which extend all the way into the roof can be detached from the vehicle if required.

3 Always a man of the future: Prof. Dr Ulrich Seiffert, former Head of Research and Development at Volkswagen, likes projects such as Futura and Scooter (l.).

How about another glass? Extensive use of special holographic insulating glass in the Futura research vehicle provides excellent transparency and shields against 60 per cent of the incident energy from the sun.

IN 1961

TWO FASTENING POINTS FOR DIAGONAL SEAT BELTS BECOME STANDARD

IN 1973

FRONT SEAT BELTS BECOME STANDARD

THE NEW COMPETENCY CENTRE FOR SAFETY EXTENDS OVER **8,000** SQUARE METRES

SMALL CONCEPT CAR, LOTS OF SPACE: VOLKSWAGEN STUDENT, 1982

3.13 M IN LENGTH

2.31 M² INTERIOR AREA

CD VALUE OF FUTURA (RESEARCH VEHICLE, 1989):

0.25

1979

SAW THE SEDAN 1300 – THE FIRST VOLKSWAGEN TO RUN PURELY ON ETHANOL (BRAZIL)

RANGES:

ELECTRIC GOLF MK1 (PROTOTYPE, 1976):
APPROX. 50 KM

CHICO (CONCEPT CAR, 1991):
400 KM

POLO TGI[1] (2017):
UP TO 1,310 KILOMETRES

I.D. VIZZION[2] (CONCEPT CAR, 2018):
UP TO 665 KM

AT 299,999 KM

PROGRAMMING REASONS MEAN THAT DIGITAL ODOMETER IN THE DIGITAL DRIVER INFORMATION CENTRE (DIGIFIZ, 1986) REACHES ITS LIMIT.

[1] Polo TGI – natural gas fuel consumption (CNG), kg/100 km: urban 4.2 – 4.1 / extra-urban 2.7 – 2.6 / combined 3.2 – 3.1; CO_2 emissions combined (natural gas (CNG)), g/km: 87 – 85; petrol consumption, l/100 km: urban 6.2 / extra-urban 4.1 – 4.0 / combined 4.9 – 4.8; CO_2 emissions combined (petrol), g/km: 112 – 110; efficiency class: A+.
[2] I.D. BUZZ and I.D. VIZZION – concept vehicles are not offered for sale and therefore Directive 1999/94 EC does not apply.

FROM **2025**, THE I.D. FAMILY WILL BE DRIVING FULLY AUTOMATED **('I.D. PILOT')**.

1L (1-LITRE CAR, PROTOTYPE FROM 2002)

0.89

LITRES WAS THE CONSUMPTION OF THE PREDECESSOR OF THE XL1 AT AN AVERAGE SPEED OF 75 KM/H

ALTERNATIVE FUELS

ETHANOL
NATURAL GAS
HYDROGEN
ELECTRICITY
SYNTHESIS GAS

T2 ELECTRIC TRANSPORTER (1972)
MAX. OUTPUT:
32 KW/44 PS
RANGE:
50 TO 80 KM

ELECTRIC CONCEPT VAN I.D. BUZZ[2] (2017)
TOTAL OUTPUT:
275 KW/374 PS
RANGE:
UP TO 600 KM

IN 1969

THE VOLKSWAGEN TEST TRACK IN EHRA-LESSIEN OPENS OFFICIALLY

CLEAR-GLASS HEADLIGHTS (GOLF MK4) IN

1997

WITH PLASTIC FREE-FORM REFLECTOR

WITH ONLY 3.2 KILOGRAMS OF HYDROGEN, THE TIGUAN HYMOTION (TEST VEHICLE, 2008) TRAVELS SOME

230 KILOMETRES

AHEAD OF THEIR TIME.

INNOVATIVE VOLKSWAGEN CONCEPT CARS.

WELL, CAN YOU SEE THEM TOO? THOSE CASTLES IN THE AIR! THEY'VE LONG BEEN A FAVOURITE DESTINATION AT VOLKSWAGEN. HERE YOU CAN VIEW A NUMBER OF MILESTONES IN RESEARCH AND DEVELOPMENT AS WELL AS THEIR SIGNIFICANCE FOR TODAY'S PRODUCTION VEHICLES. JOIN US AS WE FOLLOW IN THE TRACKS OF THE RESEARCHERS AND EXPLORERS!

EA 48 | 1955
In 1955, Volkswagen engineer Gustav Mayer combined independent wheel suspension with MacPherson struts and front-wheel drive for the first time ever in the EA 48 (intended as a model below the Beetle). The four-seater has a unitary body, while beneath the front section that folds up high is a flat two-cylinder engine with a displacement of 600 cc and 13 kW/18 PS. The EA 48 appeared in a future-oriented two-box design with a compact fastback but as yet no boot lid.

The unitary body made its entrance at Volkswagen in 1968 with the Type 4. The first production Volkswagen with front-wheel drive and MacPherson independent wheel suspension was the Passat in 1973 – millions of times over, almost all siblings of this model have been driving with Gustav Mayer's idea, with the Passat and Golf each in their seventh generation. Beneath the Golf as Beetle successor, the Polo made its debut in 1976 – in the two-box design and, of course, with a large boot lid.

STUDENT | 1982
An innovative concept vehicle: only 3.13 m in length, the Student offered an incredible 2.31 m² of interior area thanks to its design that had been thought through down to the finest detail – from the transverse engine to the body, with its reduced number of individual components, and finally the specially shaped seats. Body surfaces designed to sit flush and bonded windows resulted in a Cd value of 0.30. The individually folding rear seats in combination with the high, straight roof resulted in a small estate car.

The key points of extremely compact design, optimum utility value and high performance with low consumption are now called up! at Volkswagen. However, the likeable Lupo (1998–2005) also exhibited direct 'Student DNA' in series production. The front and rear modules in body colour are examples of this as are the individually folding rear seats, the high roof and short overhangs of the body. Just take a closer look at the up! and Lupo!

CHICO | 1991
Environmental pollution, traffic jams, shortage of parking space: with its length of only 3.15 metres, the Chico demonstrates how you can face up to them all in the smallest of spaces with an aerodynamic nose. The true highlight: an in-line two-cylinder petrol engine with 25 kW/34 PS from a displacement of 636 cc powers the Chico – but added to this is a 6 kW electric motor, offering an additional range of 25 kilometres. Thanks to this, the Chico can manage 400 kilometres in one go. That's how hybrid works.

In many details, the Lupo from 1998 is reminiscent of the Chico: C-pillar, rear lights, compactness – they all match. With its sophisticated technology and systematic lightweight construction, the epoch-making Lupo 3L TDI showed that consumption figures of three litres of fuel to cover a distance of 100 kilometres are definitely possible. Since 2013, the smallest Volkswagen vehicle class has been cruising along the roads on electricity in the form of the current e-up![1] – and Volkswagen hybrid models have long been part of series production.

1L | 2002
In 2002, everybody was talking about the 'Cigar'. The two-seater with 6 kW/8 PS was truly a 'new car' – streamlined, efficient, sensational. The 1-litre car offered ESP with integrated ABS, driver air bag, deformation elements in the front section, an 80-litre luggage compartment, stop/start function, a Cd value of 0.159 and top speed of 120 km/h. And all of this with a fuel consumption of only 0.89 litres per 100 km at an average speed of 75 km/h.

In 2009, Volkswagen presented the further development of the 'Cigar' 1L with a hybrid drive: called L1. In 2014, the final version, the XL1, now with two seats next to each other, went into series production as a plug-in hybrid. In 2018, the properties of everyday utility and lightweight construction – while guaranteeing safety and comfort in combination with resource-conserving technology – pervade all Volkswagen model lines.

[1] e-up! – electrical energy fuel consumption in kWh/100 km: 11.7 (combined). CO_2 emissions combined in g/km: 0; efficiency class: A+.

Digital is the key: the electronics pioneers at Volkswagen were quick to realise this – and surprised the automobile world back in 1986 with the 'Digital Driver Information Centre', or 'DigiFiz' for short, which celebrated its premiere in the Golf Mk2.

Ahead of the time. Digital cockpit.

A kind of blue: from the Golf Mk4 onwards, the compact class turned digital. At the base of the analogue round instruments, rectangular digital displays are integrated for the first time to indicate time, distance covered and daily kilometres.

TOTALLY DIGITAL.

TOUCHSCREEN INSTEAD OF SWITCHES, PERSONALISED USER PROFILES AND AMBIENCE IN PLACE OF ONE SIZE FITS ALL. DIGITALISATION AT VOLKSWAGEN IS ADVANCING IN LEAPS AND BOUNDS. WORLDS LIE BETWEEN THE FIRST DIGITAL DRIVER INFORMATION CENTRE FROM 1986 AND THE CURRENT ACTIVE INFO DISPLAY – YET THERE ARE ALSO ASTONISHING PARALLELS.

At the beginning is the timeless recognition that inspiration and change are infinite. "The task we set ourselves then was: 'Why does everything in the car always have to be mechanical? We could in fact also look for electronic solutions!'," says Dr Walter Zimdahl, who was responsible for the field of electronics in the Department of Future Research at the time. One result was the 'DigiFiz' – the short form of the German for 'digital driver information centre'. It was a digital speedometer with a liquid-crystal screen that appeared in the Golf Mk2 and Jetta Mk2 by customer request from 1986.

It offered innovations that literally caught the eye of the beholder, beginning purely externally with what – for the time – were futuristic-looking digital displays and continuing to their precision that is unrivalled to date. These included above all the digital speed and route displays, the fuel gauge measuring to the precise litre, the coolant temperature to the precise degree and the reminder of the next service appointment.

These are stories that Tomasz Bachorski listens to with fascination: "Without these pioneering deeds such as the DigiFiz, we wouldn't have the Active Info Display in production today," says the Head of Interior Design for the Volkswagen Brand, saluting Zimdahl and his colleagues at that time. In 2018, digitalisation has also long since reached Volkswagen Interior Design in all its information functions and comfort zones – which, according to Bachorski, is also what presents the challenge: "Functional, trustworthy technology – in the displays for speed and fuel consumption for example – in harmony with attractive aesthetics and graphic excellence." And, above all, with a healthy portion of options for individualisation.

"Without these pioneering deeds such as the DigiFiz, we wouldn't have the Active Info Display in production today."

TOMASZ BACHORSKI

In concrete terms, this means that the second generation of the Active Info Display operates exclusively digitally – within the framework of the legal provisions that stipulate certain fixed elements such as the indicator lamp for the parking brake – and is, for instance, freely configurable. "From the functional displays to the coordination of instrument lighting and ambient light, everything can be individually selected – if you so wish," explains Bachorski. In the future, the system will additionally 'notice' individual settings of display functions and lighting and will apply them as from the second setting operation. The whole process takes place without obligation: "The driver is asked: 'May your car get to know you, yes or no?'" Bachorski points out.

The completely glass-covered system without analogue buttons allows functions and design to blend with one another. "Digitalisation opens up entirely new stylistic options for us designers, as will ultimately be apparent in the Innovision Cockpit, which we aim to unveil with the new model of the Touareg," continues Bachorski enthusiastically. His team has been involved in the development of new Volkswagen models from the outset, exchanges ideas with ergonomics experts, the developers, consults with sales and pays particular attention to the user experience. In other words, there is direct feedback from users in 'real life'.

That was also available during their days, report the original electronics pioneers with a laugh. The miniscreen called DigiFiz was not in great demand from the customers at that time. Today, it is an extremely sought-after classic item with cult status.

Another milestone on the long road to digitisation of the cockpit, which is also a basic requirement for strategic future issues of today – such as electric mobility or connected driving – was the centrally positioned 'multifunction display' (MFD) that first appeared in Volkswagen production vehicles with the Golf Mk4. In addition to the hitherto unprecedented high resolution of the large screen, it offered coloured navigation maps for the first time. It was a technical masterpiece which the interior developers and designers of today can continue to seamlessly exploit, as Bachorski points out.

Ah yes, the timeless quality mentioned at the beginning. Change and innovation – wasn't there something else as well ...? That's it, the keyword of 'liquid crystal display'. "We found what we were looking for from a producer of digital watches," reports Walter Zimdahl on the pioneering age of DigiFiz. "The only problem was the crystals in the watches could no longer be aligned to an electric field at temperatures above 50 degrees; everything turned grey or black and white, you could no longer make anything out. In the Golf and Jetta, however, the display had to function within a temperature range of minus 40 to +80 degrees!" Instrument manufacturer VDO was consulted – and together we achieved production maturity.

"The Active Info Display is clearly legible in every climatic zone. Night or day, with spectacles or sunglasses."
TOMASZ BACHORSKI

Tomasz Bachorski can only agree: he too knows the crystalline challenges. "Yet ultimately it was not a problem for us – the Active Info Display is clearly legible in every climatic zone. Night or day, with spectacles or sunglasses."

So the outlook is good. For the future as well.

Maximum creative freedom: the Active Info Display in the latest generation leaves the choice up to the driver. Practically all displays can be freely configured, analogue instruments have had their day and are depicted virtually. As is the case here in the T-Roc, the driver can keep track of everything at all times.

THE GOLF RADIOS

1974

RADIO 'BRAUNSCHWEIG'
1ST GENERATION

One rotary knob switches the radio on and adjusts the volume. On the right is another for selecting the station. Three buttons in between: one for AM and two for FM. Nothing else is needed in the Golf Mk1.

1983

RADIO 'GAMMA'
2ND GENERATION

Digital makes its mark in the Golf Mk2 – at least to a small extent. The 'gamma' cassette radio shows the radio frequency in digital form in an LCD display.

1991

RADIO 'ALPHA'
3RD GENERATION

It's still necessary to turn the small knob in the Golf Mk3 to listen to the hits of the 90s live on the car radio. On the other hand, traffic bulletins are now broadcast automatically.

1997

RADIO 'GAMMA'
4TH GENERATION

Paradigm shift: the 'gamma' radio comes for the first time with a CD-changer connection. The large 'multifunction display' (MFD) adds a little colour to the picture.

2003

'RCD 300'
5TH GENERATION

In the Golf Mk5, launched in 2003, the cassette is now old hat and, in exchange, the mobile phone becomes part of the system. As a further option, the MFD2 can be connected up to an MP3 player.

2008

'RNS 510'
6TH GENERATION

The 'RNS 510' introduces multimedia: touchscreen, DVD drive and a 30-GB hard disk celebrate their premiere. Afterwards, the traditional radio is replaced by the **'DISCOVER PRO'** in the current Golf Mk7 starting in 2016. Its functions blend with the optionally available digital instruments to form the 'Active Info Display'.

Attractive prospects: the digital control and display concept in the T-Prime Concept GTE[1] provides a preview of the Innovision Cockpit that is set to launch with the new Touareg. The completely new operating concept merges the Active Info Display and the infotainment system into one. Functions are operated by touchscreen, voice commands or gesture control.

[1] T-Prime Concept GTE – concept vehicle has not yet gone on sale, and therefore Directive 1999/94 EC does not apply.

ECONOMY **FORMULA E.**

START/STOP SYSTEM, AERODYNAMIC OPTIMISATION, INCREASED COMPRESSION, LONGER GEAR RATIOS – THE INGREDIENTS FOR VOLKSWAGEN'S LEGENDARY 'FORMULA E' RECIPE FOR SUCCESS LED TO GENUINE SAVINGS FROM 1980. TODAY THE GOLF 1.5 TSI[1] WITH ITS COASTING FUNCTION PRODUCES A SIMILAR SAVINGS POTENTIALS.

Please follow the arrow. Smart savers were able to shift gear at just the right moment thanks to the illuminated arrow symbols in the instrument clusters of the Formula E models.

My, how the time flies: Back in 1973, Volkswagen fitted a VW 412 with a stop/start system by way of a trial. And some 40 years ago, fuel saving in a form suitable for everyday routine went into series production at Volkswagen. Its name was Formula E. With no sacrifices in comfort and benefits, it was instead a perceptible gain for the environment. Polo, Derby, Golf, Jetta, Passat and Santana were all available with the new technology, which yielded impressive savings potentials from one to as much as just under two litres of fuel per 100 kilometres covered. Incidentally, this was tested and confirmed at the time, by the trade magazine 'auto, motor und sport' (ams). "No one else offers such a complete economy package" was the verdict of ams in March 1981. One thing all the listed models shared was a top gear with an especially long gear ratio, which was indicated by an orange-coloured E on the gear knob. In addition, the developers at Volkswagen had increased the compression ratios of the inline four-cylinder engines.

'E' for 'Economy' – this credo also matched the gear-change indicator on the instrument cluster of the Formula E models, which used an illuminated arrow to indicate the most economical moment to shift up to the next gear. On the outside – depending on the model – the streamlined aerodynamic kits at front and rear together with the discreet 'Formula E' lettering revealed the identity of the smart savers from Wolfsburg. And, exclusively for the Passat and Santana, Volkswagen was offering a stop/start system as a global first in series production – activated simply by a switch on the steering wheel stalk. All of this was because petrol was something that you could save on at the time.

Formula E – a good idea.

[1] Golf 1.5 TSI ACT BlueMotion DSG (96 kW/130 PS) – fuel consumption in l/100 km: urban 6.2 – 6.1 / extra-urban 4.2 – 4.1 / combined 4.9 – 4.8; CO_2 emissions (combined) in g/km: 113 – 110, efficiency class: A.
[2] Golf Estate 1.5 TSI ACT BlueMotion DSG (96 kW/130 PS) – fuel consumption in l/100 km: urban 6.2 – 6.1 / extra-urban 4.2 – 4.1 / combined 4.9 – 4.8; CO_2 emissions (combined) in g/km: 113 – 110, efficiency class: A.

1 One, two, three... E! Boldly positioned on the gear knobs of the Formula E Volkswagen models, the E marked their highest gear. Pictured here: the Polo gear knob.

2 The button for the shortcut command: neatly integrated into the right-hand steering wheel stalk of the Passat and Santana was the switch for the stop/start function. Conveniently and securely within reach – it was easy to get used to.

3 The E emblem: the unmistakable yet unobtrusive lettering indicated the fuel-saving models from Volkswagen – as did the rear spoiler on the Passat shown here.

THE COASTING FUNCTION 2.0

Let it run in coasting mode – in the current Golf 1.5 TSI BlueMotion[1] and Golf Estate 1.5. TSI BlueMotion[2], this is possible at any time. The 'coasting engine off function' in combination with dual clutch gearbox, DSG, makes it possible. This is because if you don't touch the accelerator while the vehicle is free-wheeling, the engine switches off completely up to a maximum of 130 km/h. And the four cylinders treat themselves to a break. As everyone knows, this saves energy, which, in the case of the Golf 1.5 TSI, means a fuel consumption of merely 4.8 litres per 100 kilometres. Meanwhile, a lightweight lithium-ion battery ensures that all electrical functions are maintained while 'coasting'. The smart saver is back.

LIGHT YEARS.

SEPARATING THE BILUX HEADLIGHTS OF THE 6-VOLT BEETLE AND LIGHTING SCENARIOS OF FUTURE MODEL FAMILIES ARE LIGHT YEARS OF DEVELOPMENT. YET IT IS ABOVE ALL NEW MATERIALS AND TECHNOLOGY THAT ARE DEFINING THE FACES OF BRAND AND MODEL. SANDRA STURMAT, URS RAHMEL AND MICHAEL WERNER FROM VOLKSWAGEN DESIGN COMMENT EXCLUSIVELY ON THE WAYPOINTS FROM FUNCTIONAL LIGHTING TO LIGHT DESIGN.

For decades, car headlights were round. Initially, as was the case with coaches, mounted in free-standing form, but next to large radiator grilles. When high-volume production was introduced, cars became more compact and lights were integrated into the body. Shape, size and arrangement of headlights thus started to define the brand look. The round headlights gave the Beetle its typical friendly-looking 'eyes'. The Beetle fronts then changed from the 'recumbent' headlights to the 'upright'. New models with new faces came along too: the 411 with oval main headlights, the K 70 with wideband lights, Passat, Golf... Yet the styling spectrum remained limited until new materials and processing techniques revolutionised lighting design. The clear-glass headlight with plastic free-form reflector that first defined a standard production Volkswagen (Golf Mk4) in 1997 also dates back to the headlamp team newly founded by Volkswagen Design in 1995. Thanks to CAD data, it has since been possible to adopt a fully integrated approach – new terrain for Volkswagen designers. Xenon and LED light up the path to tomorrow's technology and design.

Ahead of the time. Development in lighting.

BEETLE – THE BEGINNINGS

Big, round eyes: the headlights of the early Volkswagen Type 1 have a decisive effect on its appearance. While the headlights in the Prototype V3 (small image) were still mounted externally, in the Beetle they were already integrated into the front of the vehicle.

Due to the 6-volt electrical system, the light output from the Beetle was modest from today's point of view. But it complied with the contemporary standard and achieved the statutory light values. From 1960, the Beetle featured modified headlights for asymmetric dipped beam. Light was functional. Round with a diffusing lens, two-dimensional.

Beetle Prototype V3 (1936), replica

"In the beginning, light was simply just functional."

URS RAHMEL

'Pretzel' Beetle (1951)

BEETLE – 12-VOLT ELECTRICAL SYSTEM (1967)

From 1967 the upgrade of the electrical system to 12 volts proves to be a real bright spot. The position of the headlights on the Beetle changes, too: as from the year in question they have an 'upright' design and produce an altered, modern appearance. In addition, 1969 marks the introduction of the halogen light at Volkswagen, while even more powerful H4 headlights enter the Beetle as from 1971. As a result, the successful model from Volkswagen has the first lamp with halogen lighting for dipped and main beam, which incidentally doubles the range of visibility. The outlook is good!

"Familiar Beetle face, only fresher. Development is always evolution as well."

MICHAEL WERNER

Beetle 1300 (1969)

GOLF MK4 – CLEAR-GLASS HEADLIGHTS (1997)

A quantum leap: from 1997, the Golf Mk4 appeared as an innovation platform. "We are setting new standards with this headlamp – with the styling of the interior! The new technology (plastic free-form reflector) now enabled us to reinterpret and redefine the car's eyes," says Michael Werner, summing up the major technical development.

The diffusing lens had served its time, the free-form reflector significantly increased the usable light intensity. From then on, the new headlights shaped the brand design and gave the vehicle front its own expression, while maintaining the typical Volkswagen design. The combination of xenon light and clear-glass headlights was also available.

"As if the car had opened its eyes."

SANDRA STURMAT

Golf Mk4 (2002)

“LED points to the future.”

URS RAHMEL

Phaeton GP 1 (2007)

PHAETON – FIRST HEADLIGHT WITH LED DAYTIME RUNNING LIGHTS (2007)

LED lamps require only roughly one quarter of the energy of H4 lamps. And in future they are expected to need only half of the energy that xenon bulbs currently consume. Apart from that, they are durable and have a colour temperature close to that of daylight. The first Volkswagen with LED daytime running lights in the headlights and a full-LED 3D rear light was the Phaeton in 2007.

“With LED, technology and design are pointing towards the future,” says Urs Rahmel. So, the Arteon is the first Volkswagen vehicle to offer a dynamic cornering light with new predictive control functionality. The LED dual headlights illuminate the approaching bend up to two seconds before the vehicle even steers into it.

Arteon (2017)

Concept vehicle (2018)

COMPARED WITH H4 HALOGEN LIGHT, XENON AND LED REQUIRE

75 %

LESS ENERGY.

THE LIGHT OF THE FUTURE – A BRIGHT OUTLOOK

It’s not only the exterior design and the type of drive that point to the future. Light is an elemental aspect of the future Volkswagen vehicle family, and the future lies in lighting scenarios. “The Volkswagen show cars are very visionary and offer a glimpse into the future. A lot is still up in the air, but modern lighting technologies offer designers undreamt-of scope for creativity – and it is an incredible amount of fun to express this creatively!” says Urs Rahmel. There used to be the light spot as the basic form – today designers and technicians are capable of creating their very own light signature. This will firstly have a significant recognition value and secondly will be capable of being personalised in the future. The character of the light will change, light will take on completely new assignments. “Light is very dynamic. While design used to deal exclusively in shapes, in future we will be able to include a fourth dimension – time. Time sequences will play a role in creating light scenarios,” explains Sandra Sturmat enthusiastically. Light will serve the purposes of communication and interaction while bringing the car individually to life. The three Wolfsburg designers are certain: light is becoming more and more intelligent.

Urs Rahmel –
Head of Design Exterior Details

“Hardly any element is as emotive as light.”

SANDRA STURMAT

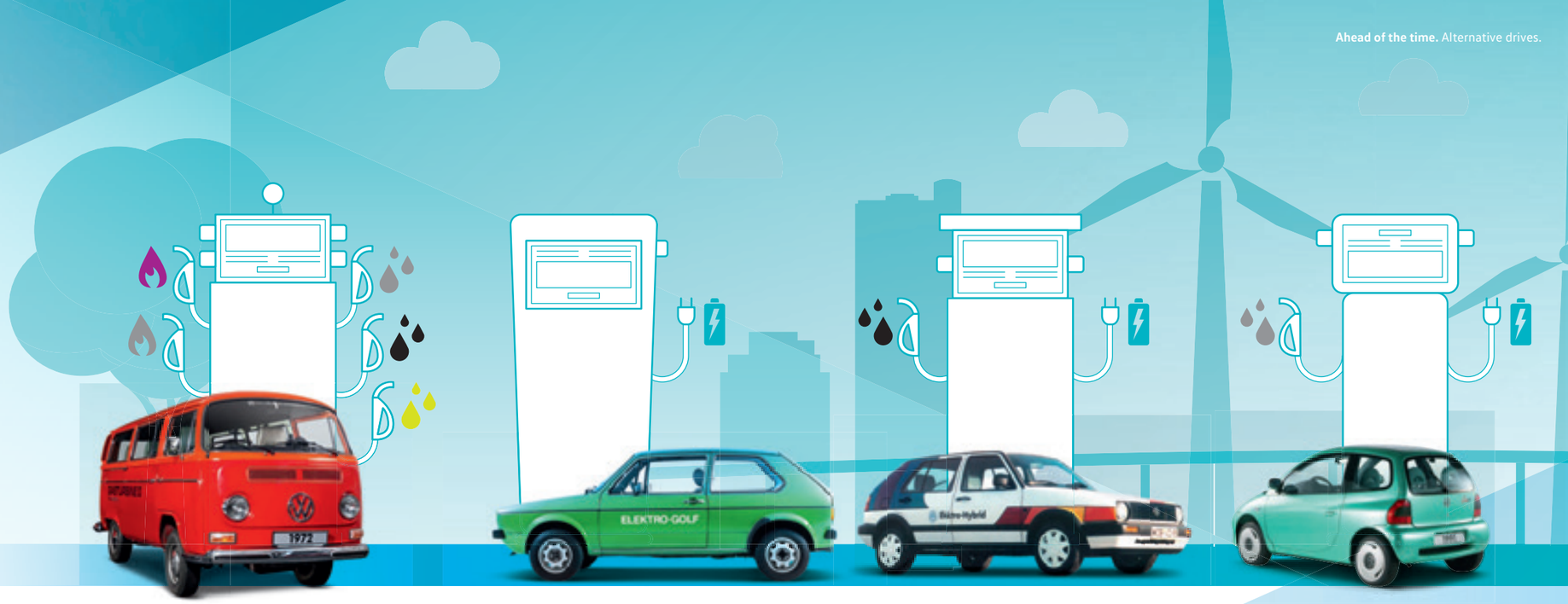
Sandra Sturmat –
Design of Exterior Light Scenarios

Michael Werner –
Design of Exterior Lights Feasibility

Ahead of the time. Alternative drives.

SCHNAPPS IN THE TANK...

... AND MUCH MORE BESIDES: BACK IN THE EARLY SEVENTIES, VOLKSWAGEN BEGAN WORK ON DEVELOPING NEW DRIVE CONCEPTS AND USING ALTERNATIVE FUELS. THE FIRST OIL CRISIS AND THE 'PRICE SHOCK' AT GERMAN FILLING STATIONS PROMOTED THE CONVICTION THAT PETROL AND DIESEL MIGHT NOT BE THE ONLY SOURCES OF ENERGY FOR TOMORROW'S MOBILITY.



Electric alternatives started at an early stage, but natural gas, alcohol, hydrogen and even spirits derived from wood waste also found their way into the fuel tank. The level of creativity was great – as was the number of concepts that arose over more than 40 years of research history.

- Natural gas
- Petrol
- Electricity
- Synthesis gas
- Diesel
- Ethanol
- Hydrogen
- Kerosene
- SunFuel

1972
T2 WITH A GAS TURBINE
The versatile guzzler: petrol, diesel, natural or synthesis gas, kerosene – this T2 consumed (almost) everything. Taking the place of the familiar four-cylinder flat engine was a rear-mounted 170 kg gas turbine with 55 kW/75 PS, created in collaboration with the US company Williams International. The gearbox came from the Volkswagen Type 3 Estate model. After successful experience in aircraft construction and shipbuilding, cars were also being equipped with a turbine drive for test purposes in those times. In addition to multi-fuel capability, advantages of the turbine also included high efficiency and compact design, while disadvantages were its high fuel consumption and the level of noise generated.

1976
ELECTRIC GOLF MK1
The electric Golf: in 1976, just two years after the premiere of the Golf Mk1, this vehicle was already whirring electrically throughout the nation. This prototype, of which only a few models were made, contained a 20 kW/27 PS direct-current electric motor under the bonnet instead of the familiar 55 kW/75 PS petrol engine. It was flange-mounted to the standard four-speed manual gearbox and accelerated the electric pioneer to a speed of 80 kilometres per hour. The range was roughly 50 kilometres, after which the sixteen 6-volt lead batteries had to be connected up to the mains again for about 12 hours. The prototype served as the basis for the later development of the CitySTROMer models of the Golf generations Mk1, Mk2 and Mk3.

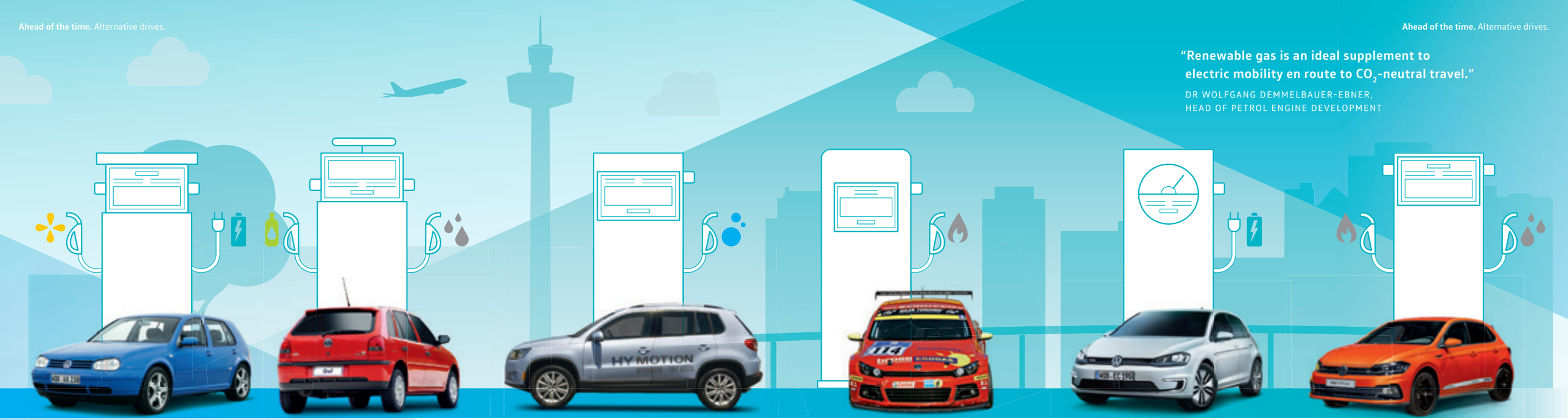
1987
GOLF ELEKTRO HYBRID
The economy Golf: fuel consumption almost two-thirds lower than a standard Golf Mk2 with a diesel engine was the proud boast of this test vehicle from 1987 – only 2.5 litres of diesel and 16.3 kilowatt-hours of electrical energy over a distance of 100 kilometres. The technical highlight was the layout of the 1.6-litre diesel engine, connected on a shaft with the 7-kW asynchronous motor and a five-speed manual gearbox. Drivers could choose between purely electric driving and the option 'driving with diesel from 60 km/h'. Three different battery systems (nickel-cadmium, lead-gel and sodium-sulphur) were on trial and located in the luggage compartment.

1991
CHICO
Clever and small: Volkswagen presented this supermini prototype with a hybrid drive at the Frankfurt International Motor Show in 1991. Only 3.15 metres in length, the Chico had a 25 kW/34 PS two-cylinder petrol engine with a displacement of 0.6 l and a 6-kW electric motor. Conceived as a 2+2 seater, the Chico featured technical refinements such as a Head-up Display and a digital cockpit. Three driving modes were possible: electric, conventional or combined. Thanks to this technology and the aerodynamically optimised body design, a range of 400 kilometres was possible.

Ahead of the time. Alternative drives.

"Renewable gas is an ideal supplement to electric mobility en route to CO_2-neutral travel."

DR WOLFGANG DEMMELBAUER-EBNER,
HEAD OF PETROL ENGINE DEVELOPMENT



2002

GOLF 'HIGHBRID'

Wood in the tank: this concept vehicle based on the Golf Mk4 relied on a combination of TDI technology and an electric motor in conjunction with the automatically-shifting dual clutch gearbox (DSG). Its unique feature: the energy source for the three-cylinder TDI was 'SunDiesel', a synthetic fuel produced from wood waste and other biomass. In contrast to fossil diesel oil, biodiesel is largely CO_2-neutral. Another positive aspect was that the Golf 'Highbrid', capable of speeds up to 196 km/h, only needed 3.8 litres per 100 kilometres.

2003

GOL 'TOTAL FLEX'

Fully flexible: unveiled in 2003, the Gol 'Total Flex' runs on pure ethanol, petrol or any desired mixture of the two fuels – entirely in line with the customer's preferences. The centrepiece of the technology is a sensor developed by Volkswagen that continually measures the current mixing ratio of the fuel. In Brazil, alcohol has already been in use as a fuel since the 1970s. There at least 22 per cent of ethanol is added to the petrol (E22). It was back in 1979 that Volkswagen launched the Sedan 1300, the first model on the market designed to run purely on ethanol.

2008

TIGUAN HYMOTION

The mobile power plant: in 2008, the Tiguan Hymotion sees a new version of the Hymotion drive concept come into operation. A technically optimised high-temperature fuel cell transforms gaseous hydrogen into electrical energy, which is then used to drive a 100-kW electric motor. To cope with peaks in power demand, a buffer battery is able to store additional energy and make it available for short spells. This battery is also charged by braking energy. With only 3.2 kilograms of hydrogen, the Tiguan HyMotion test vehicle travels approximately 230 kilometres and achieves a top speed of 140 km/h.

2009

SCIROCCO GT24-CNG

The 24-hour natural gas racer: in 2009, Volkswagen Motorsport drove the 207 kW/282 PS Scirocco GT24-CNG to a class victory in the category for alternative drives at the legendary 24-hour race on the Nürburgring. Driven by highly compressed methane gas, the Scirocco landed in an outstanding 17th position in the overall rankings – thus finishing ahead of many more powerful petrol-engined vehicles. Incidentally, Cup-Scirocco models powered by eco-friendly organic natural gas appeared in the Scirocco R-Cup, held between 2008 and 2014.

2013

E-GOLF

Zero emissions as standard: the e-Golf[1] is the first Volkswagen model produced in high volume with a purely electric drive. It offers all the benefits of the best-selling compact car, combined with a zero-emission and practically silent driving experience. The model update of the Golf Mk7 in 2017 also led to modification of the e-Golf: the output of the synchronous electric motor rose from 85 kW/115 PS to 100 kW/136 PS while the range now extends up to 300 kilometres. Using quick charging technology (CCS), the lithium-ion battery can be charged to 80 per cent of its capacity in only 20 minutes.

2017

POLO TGI

Uncompromising in space and range: the Polo TGI[2] is the youngest member in the fleet of Volkswagen natural gas models, which also includes the Golf[3], Golf Estate[4], eco up![5], eco load up![6] and Caddy[7]. The Polo TGI contains a dynamic 1.0-litre turbocharged engine that can run on natural gas or premium petrol and delivers 66 kW/90 PS of power. Its special feature is that the gas tanks are designed as a space-saving underfloor solution.This retains the full interior space of the Polo. And in combination with the petrol tank, it can travel up to 1,310 kilometres.

[1] e-Golf – electrical energy consumption in kWh/100 km: 12.7 (combined); CO_2 emissions combined in g/km: 0; efficiency class: A+.
[2] Polo TGI – natural gas fuel consumption (CNG), kg/100 km: urban 4.2 – 4.1 / extra-urban 2.7 – 2.6 / combined 3.2 – 3.1; CO_2 emissions combined (natural gas (CNG)), g/km: 87 – 85; petrol consumption, l/100 km: urban 6.2 / extra-urban 4.1 – 4.0 / combined 4.9 – 4.8; CO_2 emissions combined (petrol), g/km: 112 – 110; efficiency class: A+.
[3] Golf Natural Gas Trendline, Golf Natural Gas Comfortline – natural gas fuel consumption (CNG), kg/100 km: urban 4.8 – 4.4 / extra-urban 3.1 – 3.0 / combined 3.6 – 3.5; CO_2 emissions combined (natural gas (CNG)), g/km: 98 – 95; petrol consumption, l/100 km: urban 7.3 – 6.6 / extra-urban 4.6 / combined 5.6 – 5.3; CO_2 emissions combined (petrol), g/km: 127 – 122; efficiency classes: A, A+.
[4] Golf Estate Natural Gas Comfortline, Golf Estate Natural Gas Trendline – natural gas fuel consumption (CNG), kg/100 km: urban 4.8 – 4.4 / extra-urban 3.1 – 3.0 / combined 3.6 – 3.5; CO_2 emissions combined (natural gas (CNG)), g/km: 98 – 95; petrol consumption, l/100 km: urban 7.3 – 6.6 / extra-urban 4.6 / combined 5.6 – 5.3; CO_2 emissions combined (petrol), g/km: 127 – 122; efficiency class: A+.
[5] eco up! – natural gas fuel consumption (CNG), kg/100 km: urban 3.7 / extra-urban 2.5 / combined 2.9; CO_2 emissions combined (petrol), g/km: 82; efficiency class: A.
[6] eco load up! – consumption of natural gas (CNG), kg/100 km: urban 3.7 / extra-urban 2.5 / combined 2.9; CO_2 emissions combined (petrol), g/km: 82; efficiency class: A.
[7] Caddy, Caddy Maxi 'edition TGI', – natural gas fuel consumption (CNG), kg/100 km: urban 5.4 – 5.2 / extra-urban 3.9 – 3.6 / combined 4.5 – 4.1; CO_2 emissions combined g/km: 122 – 113; efficiency class: A, A+.

THE **FAMILY** OF TOMORROW.

ELECTRIC MOBILITY IS THE FUTURE. IT IS RELIABLE, ECONOMICAL AND NATURALLY ENVIRONMENTALLY FRIENDLY. WITH THE ZERO-EMISSION I.D. FAMILY BASED ON THE ALL-ELECTRIC ARCHITECTURE, VOLKSWAGEN IS ENTERING A NEW ERA OF ROAD TRAFFIC.

FROM
2020
THE FIRST VOLKSWAGEN I.D. MODELS WILL BE COMING ONTO THE MARKET.

We are family – I.D. BUZZ[1], I.D.[1] and I.D. CROZZ[1] (from l to r) and joining them from March 2018: the I.D. VIZZION[1] (page 39). From compact electric vehicle in the Golf class to fully automated premium class saloon, the I.D. model family offers a broad spectrum. And an exciting preview of the future.

I.D.
Starting off a completely new fleet of innovative electric vehicles is the visionary I.D.[1], which is set to go into production in late 2019. The zero-emission compact vehicle has an output of 125 kW/170 PS and can cover up to 600 kilometres on a single battery charge. The concept behind the I.D. is to guarantee ride comfort, safety and sustainability. From 2025, like the other models of the I.D. Family, it is intended to drive fully automated on command ('I.D. Pilot').

I.D. CROZZ
The year 2020 will then see production of the second family member: the I.D. as a Crossover Utility Vehicle (CUV), the I.D. CROZZ[1] combines the benefits of SUV and coupé. The sporty zero-emission all-rounder has a range of up to 500 kilometres per battery charge and, with an overall output of 225 kW/306 PS, can accelerate up to 180 km/h. Regardless of the air outside, a new ventilation system (CleanAir system) ensures top quality air on board.

I.D. BUZZ
Following in 2022 is the I.D. BUZZ[1] electric van, offering maximum versatility with seating for up to eight and two luggage compartments. The electric all-wheel drive with two motors produces a total output of 275 kW/374 PS and the range is up to 600 kilometres. The 'microbus of the future' has a Head-up Display that projects information via augmented reality into the driver's field of vision. In addition, a touchpad turns the classic steering wheel into a multifunctional 'steering pad'.

Ahead of the time. Outlook on the future.

The intelligent vision of the future with a new feeling towards driving and lifestyle: the concept vehicle drives, steers and navigates independently.

I.D. VIZZION
In 2018, the Volkswagen brand is presenting an autonomously driving automobile for the very first time: the I.D. VIZZION[1] stands for a new dimension of safety, comfort and design. The concept vehicle is designed at Level 5, the maximum stage of development for automated driving – and will travel exclusively autonomously. A 'digital chauffeur' assumes control with a wide range of assistance systems – without steering wheel or visible controls – which can be operated by speech or gesture control. Thanks to artificial intelligence, it will for the first time be capable of learning. With a system output of 225 kW/306 PS, the I.D. VIZZION with electric all-wheel drive achieves a range of up to 665 kilometres. Travelling automatically and fully connected, the lounge on wheels gives its passengers a priceless gift: time that they can freely organise during the trip. The car of the future beyond tomorrow.

I.D. VIZZION[1]: the avant-garde premium class saloon of the next generation is steering fully electrically and autonomously towards the future.

[1] I.D., I.D. CROZZ, I.D. BUZZ and I.D. VIZZION – concept vehicles are not offered for sale, and therefore Directive 1999/94 EC does not apply.

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