

# DRIVEN BY THE FUTURE.



Volkswagen



**VOLKSWAGEN PIONEERS  
OF E-MOBILITY.**

# WE'VE BEEN CHARGED UP FOR MORE THAN 40 YEARS.

**A history of electric mobility at Volkswagen?** You might be forgiven for thinking that there's not much to say on this front. But in actual fact, there is: Volkswagen had already embarked on in-depth research into alternative drive technologies in the early 1970s.

The first results of this research to be rolled out was the Type 2 electric van developed in 1972 – a second-series camper van converted to an electric drive. And not long after, the compact top-selling Golf was zipping around the country emission-free, boosted by the price shock experienced by drivers at German petrol stations as a result of the oil crisis. Initially just a test vehicle, there were small production runs of the Golf CitySTROMer that gave Volkswagen valuable insights into the development of electric drives.

All of this knowledge and experience flowed into our first large-scale production vehicle with a purely electric drive system – the latest e-Golf<sup>1</sup>. With a range of 300 kilometres, recuperation and quick-charging technology and state-of-the-art connectivity systems on board, the zero-emission vehicle epitomises pioneering technology in a familiar guise.

And the future remains exciting. That's because Volkswagen is already working flat out on the next generation of electric models. The I.D.<sup>2</sup> and I. D. BUZZ<sup>3</sup> concept vehicles give an idea of how they will look in future. They not only set new standards in terms of their drive technology, but will also provide a completely new kind of digital experience – including fully automatic driving.

## 4

### ELECTRIC TIMES

There are so many stories to tell about electric mobility at Volkswagen. Read for yourself.



## 8

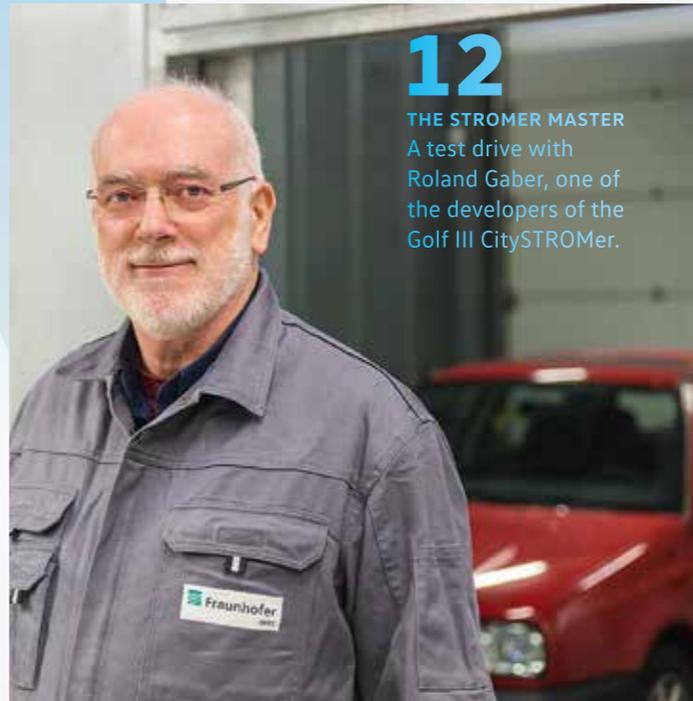
### DEVELOPMENT

Electricity doesn't just flow like that into an electric drive system. A visit to the early Volkswagen developers.

## 12

### THE STROMER MASTER

A test drive with Roland Gaber, one of the developers of the Golf III CitySTROMer.



## 16

### MOTOR SPORT WITH AN 'E'

Racing – in a Golf II CitySTROMer? Racing driver Hagen Arlt talks about an electrifying time.



## 20

### FACTS AND FIGURES

THE LENGTH OF THE COPPER WIRE IN THE MOTOR OF A GOLF BLUE-E-MOTION

# 2.1

 KILOMETRES

## 22

### VOLKSWAGEN HYBRID CONCEPT VEHICLES

Since the 'future research' division began its work at Volkswagen in 1970, the question has been: 'What if ...?'

## 24

### RUNS AND RUNS AND...

Volkswagen has been building production electric cars ever since the Golf CitySTROMer. An overview.



<sup>1</sup> e-Golf – power consumption in kWh/100 km: 12.7 (combined), CO<sub>2</sub> emissions in g/km: 0 (combined), efficiency class: A+.  
<sup>2</sup> I. D.: The vehicle is not yet available for sale. It currently doesn't have general type approval and is therefore not governed by EU Directive 1999/94/EC.  
<sup>3</sup> I. D. BUZZ: The vehicle is not yet available for sale. It currently doesn't have general type approval and is therefore not governed by EU Directive 1999/94/EC.

# ELECTRIC TIMES.



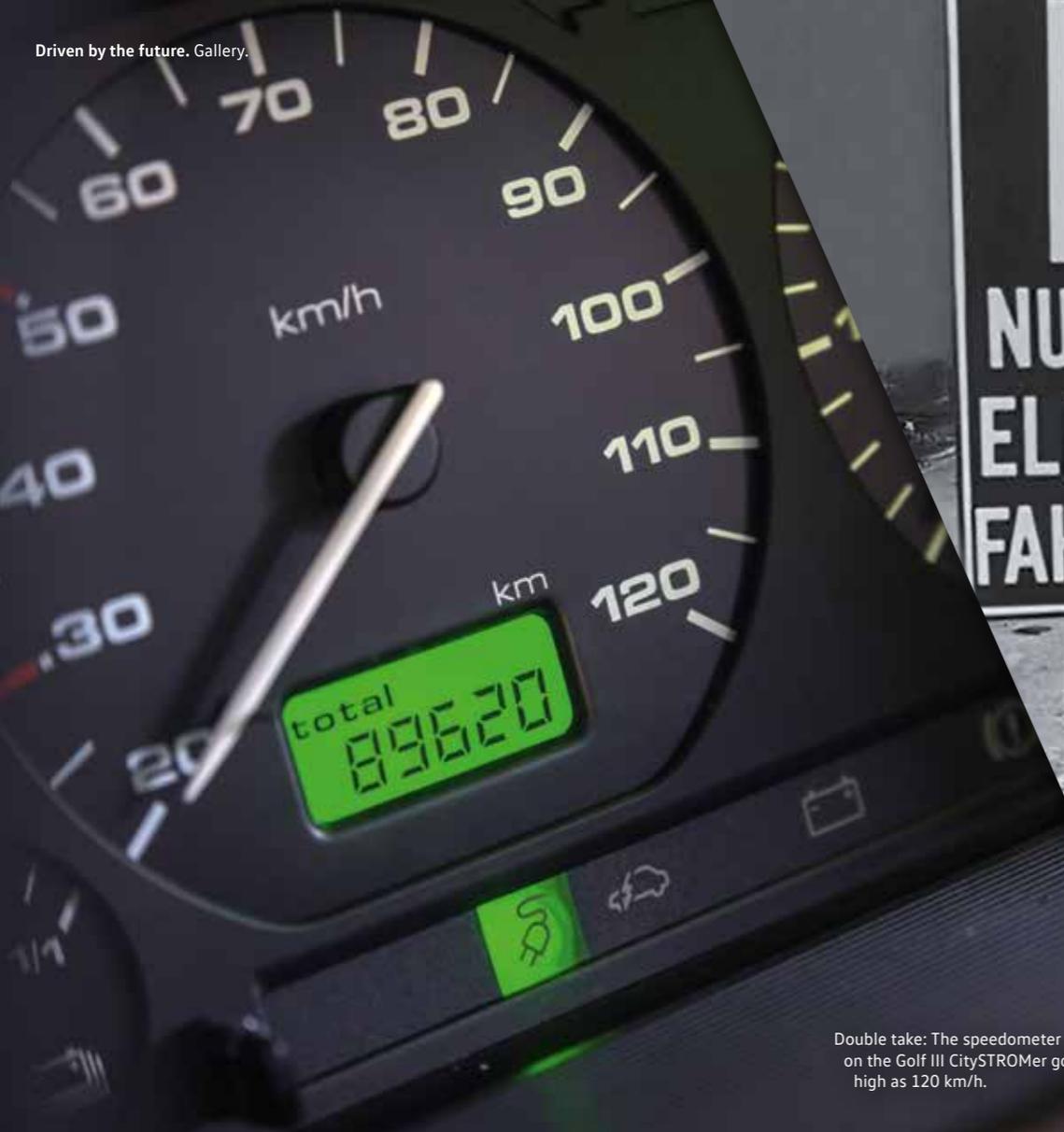
In the spotlight: November 1976, NDR television studios in Hamburg. Carlo von Tiedemann (left), famous presenter of the show Die aktuelle Schaubude, interviews Dr Adolf Kalberlah from Volkswagen's 'future research' division about New York's yellow electric taxi van.

Full of e-power: Racing driver Hagen Artt in 1990 in the Golf II CitySTROMer he had optimised. The lowered chassis with semi-slicks and the lightweight plastic windows are particularly striking.



Electric rarity: Just a few models of the Jetta II CitySTROMer were built. It successfully competed in e-motor sport, like here at the Austro Solar in 1989.





Double take: The speedometer scale on the Golf III CitySTROMer goes as high as 120 km/h.



Electric parade: The first Golf I CitySTROMer cars were used in 1981 as part of a long-term trial at RWE. For the first time, Volkswagen had released an electrically powered car in a small production run that wasn't meant for general sale.



Feasibility at a glance: Volkswagen cars and vans with electric drive systems pose for the camera in 1983. From l. to r.: LT, T3, T2b, Golf with twin-shaft hybrid drive, Polo 86C.

# ELECTRIC PIONEERS.

VOLKSWAGEN ESTABLISHED THE 'FUTURE RESEARCH' DIVISION IN 1970. JUST TWO YEARS LATER THE FIRST VOLKSWAGEN TRANSPORTER WITH AN ELECTRIC DRIVE SYSTEM WAS UNVEILED. AN ELECTRIFYING TIME JOURNEY.

The hands glide slowly, almost reverently across the large photos of the Elektro Golf, the Transporter with electric drive system and the Chico hybrid concept car. 'We have always led the way,' says Dr Adolf Kalberlah, former head of the 'future research' division at Volkswagen.

No wonder. Kalberlah, a doctor of electrochemistry, still has a high opinion of the electric car. 'In 1970 we started with just ten men, but by 1972 the first Volkswagen Transporter with an electric drive system was on the road!' There is an appreciative nod from Willi Josefowitz, one of Kalberlah's close colleagues at the time. 'The batteries fitted perfectly under the loading bed and could be removed like a drawer with the aid of a forklift truck,' he recalls.

'We assumed there would be an increased amount of interest in the electric drive system among retailers and businesses whose main radius of activity was in towns and cities. Furthermore, the range of around 50 kilometres most closely suited their movement profile,' explains Kalberlah. 'Between 1973 and 1975 we had already tested 70 Elektro Transporters together with the utility company RWE.' These 70 vehicles were built at the commercial vehicle plant in Hanover.



1 Still electrified by the alternative vehicle drive system to this day: Dr Adolf Kalberlah, former head of the 'future research' division at Volkswagen.

2 So simple: The first Elektro Golf from 1976 with the idea of a charging cable incorporated in the parking meter.

3 The crucial technical simplification came in 1987 with the single-shaft electric hybrid drive system on the Golf II test car. This photo from the time shows Dr Adolf Kalberlah and a model of the engine and non-synchro transmission.

4 So many memories: Willi Josefowitz (left) and Dr Adolf Kalberlah in conversation.





A bright yellow T2 Bulli with rear seats arranged opposite each other and electric hybrid drive system provided a prestigious interlude as city taxi for the Museum of Modern Art (MoMA) in New York. 'It was the first Volkswagen with a hybrid drive system,' stresses Kalberlah. The spectacular yellow cab then made it before the television cameras with Dr Kalberlah on the then very popular evening show known as Die aktuelle Schaubude with cult presenter Carlo von Tiedemann. This special Bulli was subsequently used in the Lower Saxony town of Bad Harzburg – as an environmentally friendly taxi for visitors.

## 'IN 1970 WE STARTED WITH JUST TEN MEN, BUT BY 1972 THE FIRST VOLKSWAGEN TRANSPORTER WITH AN ELECTRIC DRIVE SYSTEM WAS ON THE ROAD!'

### DR ADOLF KALBERLAH

**1** Big appearance: The first Volkswagen to feature a hybrid drive system was a 1976 yellow Bulli, used as a city taxi in New York. Back in Germany, the vehicle appeared on Die aktuelle Schaubude with presenter Carlo von Tiedemann (left) and developer Dr Adolf Kalberlah.

**2** 'The batteries fitted perfectly under the T2 loading bed and could be removed like a drawer with the aid of a forklift truck,' says Willi Josefowitz, a long-standing employee in the 'future research' division at Volkswagen.

**3** Key moment: Dr Adolf Kalberlah (left) from Volkswagen hands over the first Volkswagen Elektro Transporter to Hans-Georg Müller, managing director of GES, in 1972.

'The big sensation then came in 1977 when the Volkswagen Elektro Transporter was unveiled at the IAA – as an officially available production vehicle!' Kalberlah's eyes still sparkle today at the very idea. "'The Volkswagen Elektro Transporter – zero litres per 100 kilometres" was the highly memorable slogan after the oil crisis,' recalls Willi Josefowitz. 'Yet fewer customers than expected bought the quiet, clean T2. Around 20 vehicles were sold.'

One year previously, in 1976, Volkswagen had also proven the feasibility of the electric drive system and demonstrated its expertise in the car sector with the Elektro Golf. 'The Elektro Golf initially remained a one-off. It wasn't until 1981 with the first Golf I CitySTROMer that between 20 and 25 electrically powered Golf cars went to RWE for testing purposes,' says Josefowitz. The Mark II version of the Golf CitySTROMer from 1985, of which 70 were made, was also used solely for field testing. The Golf III CitySTROMer became the first production electric car between 1992 and 1996, featuring an AC rather than a DC motor. A total of 120 cars were sold.

In 1983 the hybrid drive system picked up pace – on a car! Firstly in the form of a Mars Red Golf I with twin-shaft electric hybrid drive system. 'We had always favoured the hybrid for long journeys, due to its range, and the purely electrically powered cars for the city and surrounding areas,' says Kalberlah. Technical simplification came in 1987 with the single-shaft electric hybrid drive system on the Golf II.

The fleet test with 20 Golf cars featuring the single-shaft hybrid then began in 1991 in Zurich. And in the autumn of the same year, the minicar known as 'Chico' was unveiled at the IAA in Frankfurt. Its straight-twin petrol engine and the additional electric motor proved economical and reliable and made the car fun to drive. It remained a concept car, but only just.

For Dr Adolf Kalberlah and Willi Josefowitz, it is the best feeling knowing that they paved the right way for electric mobility. Reason enough to take this opportunity to place two of Volkswagen's electric pioneers in the spotlight.

Electrically powered, of course.

# I'VE FILLED THE CAR.

ROLAND GABER FROM NORTH HESSE STILL DRIVES A GOLF III CITYSTROMER TO THIS DAY. HE ORIGINALLY HELPED TO DEVELOP IT.

Roland Gaber takes a wander to fill up the car – to the garage with a coffee cup in his hand. As quick as a flash, the front number plate flap is opened like something out of James Bond, the spiral cable with plug is pulled out and then plugged into the socket. The engineer is asked how long it will take. 'A full charge takes not quite an hour. A quick charge takes 30 minutes.' Enough said: Roland Gaber's car is a Golf III CitySTROMer, electrically powered by a 20 kW electric motor. A total of 120 models were built between 1993 and 1996; 50 of them are still on the road every day – with the original drive technology, after more than 20 years.

Roland Gaber is an electrical engineer and now works at the Fraunhofer Institute in Kassel, in the field of concomitant technical research. He previously worked at Siemens Kassel in the division specialising in automotive technology and electric drive systems for vehicles, where the drive technology for the Golf III CitySTROMer was developed, among other things. Gaber developed the AC technology for the electric Golf III. He gives it a try: turns the ignition key, puts his foot on the accelerator, eases off the clutch and the CitySTROMer purrs into motion.

'My grandfather and my father were both master millers and even back then the waterwheel at the family business powered a generator that produced electricity,' explains the engineer. When Volkswagen approached Siemens with the CitySTROMer project, it immediately sparked Gaber's imagination. As Siemens office manager at the Volkswagen plant in Kassel, he formed the link between both companies. The 'powerhouse' for the CitySTROMer came from a converted machine drive system ('Simodrive').



The tricolour quietly purrs: the Gaber family on an electric outing through the picturesque countryside in north Hesse, naturally in various Golf III CitySTROMers from their own fleet. Range is not an issue – driving in the 'Stromer' soon becomes a rather pleasing habit.

'My grandfather and my father were both master millers and even back then the waterwheel at the family business powered a generator that produced electricity.'

ROLAND GABER



A plentiful supply of power is generated by the huge solar panels outside the Fraunhofer Institute in Kassel, to where engineer Roland Gaber commutes daily from his home town. Even in the rain, if necessary, but always in the Golf III CitySTROMer with original drive technology.

**A FULL CHARGE TAKES AN HOUR;  
30 MINUTES LESS WITH A QUICK CHARGE**

Son Jonas and daughter Luisa Gaber follow us in two other CitySTROMers. Luisa drives 20 kilometres to work every day in her car. She is now good at estimating the range of the Golf: 'You know how far you've driven and you plan the charging times accordingly. You get the hang of it eventually.' It is important to check how far you intend to drive and whether there is the time and opportunity to charge the car, adds Jonas Gaber, who says that he has never been stranded as a result of running out of power. The CitySTROMer drives just like a 'normal' Golf III. One question that is more interesting now than ever before relates to the range of electric cars. Gaber smiles as he recites the combined cycle of the Golf according to his own estimation: 'North Hesse - 70 kilometres. Lüneburg Heath - 100 kilometres. Eifel - well ... 50 kilometres.' Not bad for technology from 1995 that still works perfectly today. But what about spare parts? 'I bought up all the parts specific to the CitySTROMer at the time to ensure that the car will stay on the road for years,' says Gaber.

**YOU SOON LEARN HOW TO HANDLE THE SPECIAL NATURE OF THE CITYSTROMER**

We are purring our way to the Fraunhofer Institute, far from the gates of the city. Roland Gaber works here as an engineer in the field of e-mobility. Gate open, Golf in: the front end of the CitySTROMer dips slightly as the front wheels grip the rollers of the vehicle test stand.

'This is where we perform the NEDC\* tests with new vehicles. We can test every road condition - for instance, mountain driving, flat roads and downhill inclines,' explains Gaber. Today, by way of exception, an 'old' vehicle is on the test stand. He sets up the Golf on the test stand and observes the parameters on a monitor: motor output on the wheel and on the shaft, power loss on the drivetrain, the torque. Gaber gives a satisfied nod; the efficiency factor is okay. What about Gaber's personal carbon footprint? 'At home, I generate 100 per cent of my electricity, hot water and heating from regenerative energy sources - for the home and all of my CitySTROMers. I feed any surplus power into the grid - and when I'm on the road, I get almost exactly the same amount of power from other charging stations.' Well, that's electricity. It works.

\*NEDC (New European Driving Cycle)



1 Luisa, Roland and Jonas Gaber (from l. to r.) have all long since got used to electric driving.

3 Under the bonnet: Roland Gaber has been 'married' to his many different CitySTROMers for decades.

2 Golf on the test stand: Engineer Roland Gaber at work at the Fraunhofer Institute. Only today he has 'parked' his own car indoors by way of exception.

4 Never in a flap: The Golf III CitySTROMer carries around its direct connection to the power grid at all times - neatly housed under the front number plate.

# ELECTRIC DRIVER.

Speech is silver, driving is often golden: In his personally enhanced CitySTROMer – with lightweight components and lowered chassis, among other things – racing driver Hagen Arlt won one trophy after the other. The subject still electrifies him to this day.

## HOW RACING DRIVER HAGEN ARLT MADE MOTOR SPORT HISTORY IN THE GOLF CITYSTROMER.

The man is still electrified. 'The Golf's tailgate is made entirely of plastic, as are the windows. None of my rivals noticed,' winks racing driver Hagen Arlt, 75, tapping a finger on the wing of 'his' Golf II CitySTROMer, which is emblazoned with sponsor stickers. It is some time ago, 1986, that Hagen Arlt outpaced every racing rival in the field with this version of the 'Golf in sheep's clothing'.



Always a good connection: The Golf II CitySTROMer and charging cable formed the characteristic logo of the 'Grand Prix Formula E 1990'.



## 'ELECTRIC CARS IN MOTOR SPORT? I CAME WITH A SMILE AND LEFT WITH THE UTMOST RESPECT!'

Arlt was competing in quite exceptional electrified vehicles back then: 'They were 25 years ahead of their time!' he says. From a racing perspective, Arlt wasn't exactly an unknown quantity when he was approached in 1984 by utility company RWE to compete in races with electric vehicles: the man from Düsseldorf, who was a toolmaker by trade, had been racing privately throughout his life. He competed in the German Circuit Racing Cup at places like Zandvoort, Zolder and the Nürburgring. 'Then I raced in the European Cup between 1980 and 1985 in the Scirocco I and Audi 80 GTE.' But in 1984 it was all about electric cars. In motor sport? 'I came with a sceptical smile on my face and ultimately left with a great deal of respect!' says Arlt.

The rules were clear: drive according to regularity rules for one hour, complete three laps at high speed and finish the race with the legendary quarter-mile sprint – all in a single battery charge.

**'THE CARS WERE 25 YEARS AHEAD OF THEIR TIME'**

As an experienced racing driver with an excellent network, Arlt got to grips with the Golf CitySTROMer. In addition to the extensive lightweight construction measures (plastic windows and tailgate; even the bonnet's internal reinforcements were removed!), 'Doctor Arlt' prescribed a lowered chassis with sport-tuned dampers and semi-slicks – basically smooth tyres with slight grooves on the treads – and lined up on the starting grid for the annually held 'Grand Prix Formula E' between 1986 and 1993. Besides competing at the local driving centre in Veltheim, there were also races in Milan, Lucerne, Turin and Emmen Airfield. And there were trophies to be won: for classes, categories and overall victories. 'Of course, it was all totally niche back then,' says Arlt, recalling this pioneering time. 'All the teams drove cars made by different manufacturers and were sponsored by a wide range of battery manufacturers.'

An incredible 53 batteries were fitted in Arlt's electric racing Golf. 'Everything was cooled by a specially made cooling system that pumped distilled water through thick hoses at high speed,' says Arlt, showing us the original car, which is now an exhibit at the 'Museum Strom und Leben' in the historical substation in Recklinghausen, right next to one of around 25 Golf I CitySTROMers delivered by Volkswagen to RWE for testing purposes on an everyday

1 Driven to laughter: Racing driver Hagen Arlt 30 years after his Grand Prix wins in the original RWE CitySTROMer.

2 White was always a winner in the 1980s, even on bumpers and the radiator grille ...



basis. 'At speed, they had a maximum range of 50 kilometres, but the range was greater in urban traffic,' recalls Arlt.

Still in the front of 'his' Mark II racing STROMer is the electric motor from 1986, which also experienced a rapid evolution. 'It was capable of 36 kW at the start, 46 kW the following year and 56 kW the year after that ...' reports Arlt, who is still (or perhaps once again) impressed. 'And take a look at the spoiler up here on the tailgate – this alone increased the speed by an incredible 15 km/h! I got a bit worried, however, when my professional racing companion unexpectedly loosened the wheel bearings. I hurtled around those bends, I can tell you ...' Pearls of racing sweat almost return to Hagen Arlt's face, before he breaks into a smile once again ...

When Arlt finally sits behind the wheel, his eyes fall on the small display in the instrument cluster, with a scale ranging from 1 to 6 and a green area in the middle. 'The needle should be pointing here when racing,' explains Arlt. 'This was a kind of rev counter for the electric motor – if you drove it at 6, the circuit breaker would shut off the entire motor for ten minutes – so restraint was the order of the day!' The electric motor was also cooled by bags full of dry ice – a pioneering solution that was later replaced by an electric fan.

Yet for all his fascination with electric motor sport, he never allowed the racing team to state the values they calculated for optimal power consumption in kilowatts, because he found the unit rather abstract. 'What's that in litres?' cites Hagen Arlt, smiling as he leaves the museum to go home.

3 Memories of an electrifying racing career, now carefully archived at the 'Museum Strom und Leben' in Recklinghausen.

4 Powerhouse: The DC electric motor on the Golf II could deliver a top speed of 140 km/h.

# 70

T2 ELEKTRO TRANSPORTERS:

Tested between 1973 and 1975 in conjunction with RWE, Vehicles built at the Hanover plant

SMALL-SCALE PRODUCTION OF THE GOLF III CITYSTROMER

# 120

MODELS

MAXIMUM POWER

ELEKTRO GOLF I (1976):  
**20 KW / 27 HP**

I. D. BUZZ<sup>2</sup> CONCEPT CAR (2020): UP TO  
**275 KW / 374 HP**

LENGTH OF THE COPPER WIRE IN THE MOTOR OF THE GOLF BLUE E-MOTION

# 2.1

KILOMETRES

BATTERY TYPE:  
**Elektro Golf I: Lead-Acid**  
**e-Golf<sup>1</sup>: Lithium-Ion**

KERB WEIGHT OF THE T2 ELEKTRO TRANSPORTER (1972):

# 2.2

TONNES

BATTERY CHARGING WITH CCS (COMBINED CHARGING SYSTEM):

# 20

MINUTES TO REACH

# 80

PER CENT CAPACITY

MAXIMUM RANGE

ELEKTRO GOLF I (1976):  
**APPROX. 50 KM**

I. D.<sup>3</sup> CONCEPT CAR (2020):  
**UP TO 600 KM**

WEIGHT OF THE BATTERY:

T2 ELEKTRO TRANSPORTER (1972):  
**850 KG**

E-GOLF<sup>1</sup> (2013):  
**318 KG**

# ACCELERATION

CITYSTROMER I (1981): 0-50 KM/H IN

E-GOLF<sup>1</sup> (2016): 0-100 KM/H IN

APPROX. **13** s

**9.6** s

<sup>1</sup> e-Golf – power consumption in kWh/100 km: 12.7 (combined), CO<sub>2</sub> emissions in g/km: 0 (combined), efficiency class: A+.  
<sup>2</sup> I.D. BUZZ: The vehicle is not yet available for sale. It currently doesn't have general type approval and is therefore not governed by EU Directive 1999/94/EC.  
<sup>3</sup> I.D.: The vehicle is not yet available for sale. It currently doesn't have general type approval and is therefore not governed by EU Directive 1999/94/EC.

# HYBRID ENERGY.

The drive system provides the basis for motorised motion and the inspiration for researchers and developers to create innovative concepts. The results of such innovation can be seen here in the form of selected concept cars from Volkswagen.



1987

## GOLF ELEKTRO HYBRID

The Golf Elektro Hybrid unveiled in 1987 consumed almost two thirds less fuel than a production Golf diesel: the concept car used just 2.5 litres of diesel per 100 kilometres, plus 16.3 kilowatts of electrical energy. Its technical highlight was the arrangement of the 1.6 l engine with catalytic converter, linked to a shaft with the 7 kW non-synchro motor and a five-speed gearbox. There was a choice between driving using only the electric drive system and driving with diesel at a speed of 60 km/h or higher.

The car had three different battery systems (nickel-cadmium, gel cell and sodium-sulphur), which were housed in the boot.



1991

## CHICO

The 1990s gave us a whole host of vehicles featuring an organic design. The 2+2-seater Chico is the perfect example.

At the same time, Volkswagen experimented with the alternative hybrid drive, which is why the Chico – especially championed by the then chairman Carl H. Hahn – was given a two-cylinder combustion engine capable of 34 horsepower and a 6 kW electric motor that could also be connected as a booster.



2002

## GOLF IV HIGHBRID

The timeless milestone-design Golf IV also served as a model for testing technical innovations. Accordingly, Volkswagen unveiled the Golf 'Highbrid' in 2002. The fully fledged five-seater consumed just 3.8 litres of SunDiesel per 100 kilometres and featured hybrid technology with an additional electric motor and a DSG.

Woodchips produced from trees removed by the thinning method – gasified in a multistage process and converted into liquid fuel – provided the special diesel for powering the 'Highbrid'.



2007

## SPACE UP! BLUE

A Samba Bulli? Almost! Reinterpreted by the space up! blue cool, at any rate. What initially look like the legendary windows in the roof of the space up! blue cool are, in fact, the solar cells that supply up to 150 watts of power to the twelve lithium-ion batteries in the 61-horsepower motor.

The space up! blue goes from 0 to 100 km/h in 13.7 seconds and has a top speed of 120 km/h. It has a range of 100 kilometres when driven purely electrically. Yet the concept car with the sizeable wheelbase and doors with opposing hinges and no B-pillars is the world's first car to have an additional on-board high-temperature fuel cell. This allows the spacious little car to travel a further 250 kilometres with 3.3 kilos of hydrogen. That's really massive!



2008

## GOLF V TDI HYBRID

The combination of hybrid and TDI technology used on a Golf V concept car – exhibited at the 2008 Geneva Motor Show – produced just 89 grams of CO<sub>2</sub> per 1,000 metres.

The car was powered by a three-cylinder 1,200 cc TDI engine with common-rail fuel injection – delivering 75 horsepower – and a 27-horsepower electric motor, which also served as an alternator and starter motor. When braking (through recuperation) or in coasting mode, it charged the nickel-metal hydride battery in the boot. In terms of looks, this efficient version of the Mark V scored extra points with aerodynamic modifications at the front and rear and special streamlined alloy wheels.



2011

## NILS

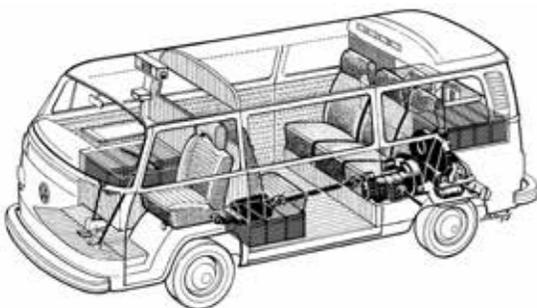
'The bubble car is back!' ran the headlines in the trade press when Volkswagen presented NILS, its concept vehicle for commuters, at the IAA in 2011. The electrically powered one-seater with gull-wing door is 3.04 metres long, 1.39 metres wide and 1.20 metres high. It has a range of 65 kilometres.

NILS's lithium-ion batteries can be charged in just two hours. A power rating of 20 hp (34 hp temporarily) is sufficient for a sprint from 0 to 100 km/h in eleven seconds and a top speed of around 130 km/h.

## VOLKSWAGEN T2 ELEKTRO-TRANSPORTER (1972)

# PIONEER WITH AN E.

Volkswagen began conducting research into purely electrically powered vehicles back in the early 1970s. The first fruit of this labour was a T2 Transporter in 1972. The project was developed in conjunction with Bosch, Varta and RWE. The Elektro Transporter was powered by a DC motor fitted in the rear of the vehicle and delivered a continuous power rating of 16 kW (22 hp). Lead batteries were used as the power source. They were fitted in the floor of the vehicle and weighed 850 kilograms – more than a Beetle at the time. Due to the necessary reinforcement given to the floor assembly and chassis, the T2 Elektro Transporter weighed in at a good 2.2 tonnes. Volkswagen built this T2 as a production model over a period of several years in a total production run of about 120 vehicles, available with various bodies.



1 The T2 Elektro Transporter had to be connected to a charging unit for several hours to charge the batteries. Alternatively, the entire set of batteries could be changed.

2 The Elektro T2 was available with various bodies – as a flat-bed truck, panel van or eight-seater bus.



### T2 ELEKTRO TRANSPORTER TECHNICAL DATA

MOTOR:	ELECTRIC MOTOR, REAR AXLE
MAX. RATING:	32 KW/44 HP
ACCELERATION:	0-50 KM/H IN APPROX. 12.0 S
TOP SPEED:	75 KM/H
BATTERY:	LEAD-ACID/23.8 KWH
RANGE:	50-80 KM



## ELEKTRO-GOLF I (1976)

# THE DRIVING FORCE.

**Did you know** that just two years after the debut of the Volkswagen Golf, the bestselling compact car was already being built with an electric drive system? However, the project launched in 1976 involved just a few test vehicles, built in reaction to the oil crisis that had only recently been overcome and a growing awareness of the scarcity of oil reserves. Technically, the first e-Golf was really simply built: in place of the 75-horsepower petrol engine was a DC electric motor mounted on the production four-speed gearbox. An on-board charger made it possible to charge the 16.6-volt lead batteries via a normal 220-volt plug socket, which took around twelve hours.



**1** The first e-Golf was 'filled up' with electricity via a charging cable and socket. The charging socket was fitted in place of the filler cap for the fuel tank.

**2** A small 'E' below the model name indicated the special status of this first-generation Golf.

**3** The dimensions of the lead battery were expansive. The power store was built into the area below the boot floor.



### ELEKTRO GOLF I TECHNICAL DATA

MOTOR:	ELECTRIC MOTOR, FRONT AXLE
MAX. POWER:	20 KW/27 HP
ACCELERATION:	0-50 KM/H IN APPROX. 13.0 S
TOP SPEED:	80 KM/H
BATTERY:	LEAD-ACID/13.4 KWH
RANGE:	APPROX. 50 KM



Inexpensive driving pleasure: One hour's parking, including battery recharging, cost just 50 pfennigs back then.



A modern multifunctional parking meter monitored the charging process.

## GOLF I CITYSTROMER (1981)

# SILENT IN THE CITY.

Based on the Elektro Golf I, this pilot project was produced in 1981 in conjunction with the GES ('Gesellschaft für elektrischen Straßenverkehr', or the Electric Road Transport Corporation), a company established by the utility company RWE. Twenty CitySTROMERs were initially trialled in a fleet test and were also used privately by RWE employees. A total of around 25 vehicles of this type were built as part of a small-scale production run. The CitySTROMer is considered one of the first electric vehicles suitable for everyday use. The car had room for four people and weighed in at one and a half tonnes with its lead batteries. Its range was around 60 kilometres; with recharging it could cover around 100 kilometres a day.



### GOLF I CITYSTROMER TECHNICAL DATA

MOTOR:	ELECTRIC MOTOR, FRONT AXLE
MAX. POWER:	24 KW/33 HP
ACCELERATION:	0-50 KM/H IN APPROX. 13.0 S
TOP SPEED:	100 KM/H
BATTERY:	LEAD-ACID / 11.4 KWH
RANGE:	APPROX. 60 KM



1 The electric Golf I was used as a fleet car at the Essen-based utility company RWE. The car's range was sufficient for the densely populated Ruhr region.

2 An icon for the E-Golf: Racing legend Hans-Joachim 'Strietzel' Stuck got behind the wheel of the CitySTROMer for demonstration drives.





## GOLF II CITYSTROMER (1985)

# THE WHITE FLEET.

The second generation of the CitySTROMer was based on the Golf Mark II and was unveiled in 1985. The technology already tried and tested on the previous model was largely used for the drive system. The charging cable was located behind a small flap in the radiator grille. The CitySTROMer II was also a vehicle completely suitable for daily use, built in a small-scale production run of 70. These were initially reserved for the well-known energy producers for testing purposes. The CitySTROMers were mainly used in the area of customer service to gain further practical insights into how they performed in everyday use. The cars were subsequently sold on to private individuals.



### GOLF CITYSTROMER II TECHNICAL DATA

MOTOR:	ELECTRIC MOTOR, FRONT AXLE
MAX. POWER:	23 KW/31 HP
ACCELERATION:	0-50 KM/H IN APPROX. 13.0 S
TOP SPEED:	100 KM/H
BATTERY:	LEAD-ACID/11.4 KWH
RANGE:	APPROX. 60 KM



1 Volkswagen collaborated with the technology firm ABB to develop the drive control system for the CitySTROMer.

2 The second generation of the CitySTROMer was also tested in the fleets of utility companies. Pictured is a vehicle used by the Hanover-based company HASTRA.

## GOLF III CITYSTROMER (1993)

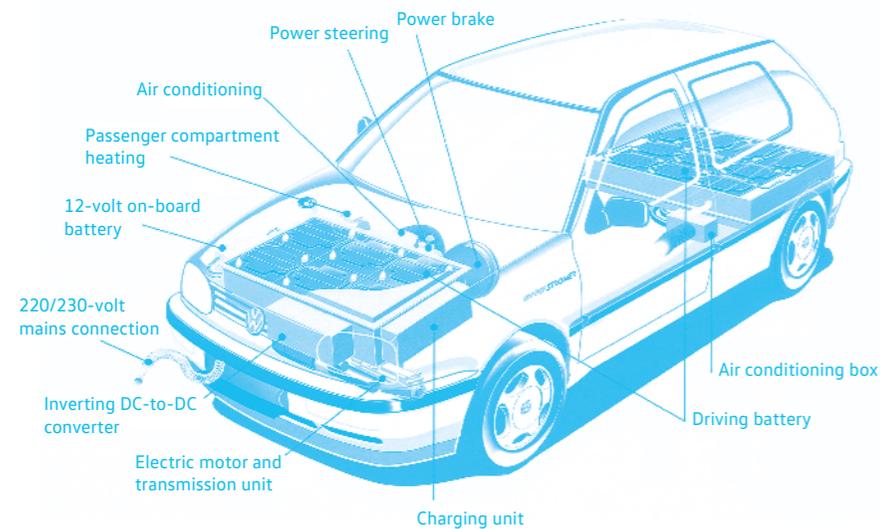
# A STEP FORWARD.

When the Golf Mark III was released, a new version of the electric car was built in collaboration with Siemens and was available to purchase for the first time in 1993. A total of 120 cars were built until 1996. Ranges of up to 90 kilometres were possible on city journeys at a constant speed of 50 km/h – a remarkable figure back then, particularly in view of the extra 300 kilos of weight attributable to the battery, whose capacity had increased to 180 Ah. It took one and a half hours to charge the battery to 80 per cent. Even though the CitySTROMer was capable of achieving only a fraction of the efficiency levels of modern electric vehicles, mainly due to the storage and charging technology available at the time, the innovations such as braking energy recuperation – now standard throughout the industry – nonetheless command respect.



### GOLF III CITYSTROMER TECHNICAL DATA

MOTOR:	ELECTRIC MOTOR, FRONT AXLE
MAX. POWER:	20 KW/27 HP
ACCELERATION:	0-50 KM/H IN APPROX. 13.0 S
TOP SPEED:	100 KM/H
BATTERY:	LEAD-ACID/17.3 KWH
RANGE:	70-90 KM



The batteries on the CitySTROMer III are divided between the engine bay and the boot. A normal 220-volt socket is used for charging, which is located beneath the radiator grille.



GOLF VI BLUE-E-MOTION (2010)

# THE NEXT GEN-E-RATION.



The Golf Blue-e-Motion unveiled by Volkswagen at the Berlin e-mobility summit in 2010 marked a real quantum leap in terms of range and driving performance. The vehicle is based on the sixth generation of the Golf and was built in a pre-production run as part of a fleet trial. Compared with its electric predecessors, the Blue-e-Motion symbolises the dawning of a new era of emission-free driving at Volkswagen: with state-of-the-art lithium-ion technology, recuperation mode for recovering braking energy, three different driving profiles for controlling the vehicle's dynamism and range, and a quick-charging system using a high-voltage current, this prototype anticipated many of the innovative features later found on the current production e-Golf<sup>1</sup>.



**GOLF VI BLUE-E-MOTION TECHNICAL DATA**

MOTOR:	ELECTRIC MOTOR, FRONT AXLE
MAX. POWER:	85 KW/115 HP
ACCELERATION:	0-100 KM/H IN 11.8 S
TOP SPEED:	140 KM/H
BATTERY:	LITHIUM-ION/26.5 KWH
RANGE:	150 KM



**1 All Golf:** The cockpit of the Blue-e-Motion differs only negligibly from the models with conventional drive technology.

**2 Solar cells** on the sunroof collect additional energy, which is used to cool the lithium-ion battery and the vehicle interior.

**3 Major progress:** With direct current the battery on the Golf Blue-e-Motion can be charged to 80 per cent of its capacity in just 20 minutes at special charging stations.

<sup>1</sup>e-Golf – power consumption in kWh/100 km: 12.7 (combined), CO<sub>2</sub> emissions in g/km: 0 (combined), efficiency class: A+.

E-GOLF<sup>1</sup> (2013)

# ZERO EMISSIONS IN SERIES.

The e-Golf based on the Golf Mark VII is the first mass-produced Volkswagen model with a purely electric drive system. Its powerful synchronous electric motor delivers 270 Newton metres of torque as well as commanding performance on the road. Like the drive system, the lithium-ion battery is an in-house development and is fitted in the floor of the vehicle to save space. The power source can be charged to 80 per cent of its capacity in just 20 minutes at a charging station equipped with the CCS (Combined Charging System). When the Golf VII model was updated, the e-Golf was also overhauled: its range is now up to 300 kilometres, while the electric motor is now capable of producing 136 horsepower (100 kW). The torque and acceleration figures were also improved.



**E-GOLF (2013) TECHNICAL DATA**

MOTOR:	ELECTRIC MOTOR, FRONT AXLE
MAX. POWER:	85 KW/115 HP
ACCELERATION:	0-100 KM/H IN 10.4 S
TOP SPEED:	140 KM/H
BATTERY:	LITHIUM-ION/24.2 KWH
RANGE:	190 KM



1 The new e-Golf not only looks good, but also feels good: The high-quality look of the interior features the 'Iridium Max' trim and leather on the steering wheel, gear knob and handbrake lever. The 9.2-inch infotainment system with gesture control comes as standard.

2 The front features strikingly designed LED daytime driving lights in the typical C-design and the blue trim that extends as far as the headlights.

The new e-Golf celebrated its world premiere in November 2016. Compared to its predecessor, the zero-emission vehicle has more power and a much better range.

**E-GOLF (2017) TECHNICAL DATA**

MOTOR:	ELECTRIC MOTOR, FRONT AXLE
MAX. POWER:	100 KW/136 HP
ACCELERATION:	0-100 KM/H IN 9.6 S
TOP SPEED:	150 KM/H
BATTERY:	LITHIUM-ION/35.8 KWH
RANGE:	300 KM



I.D.<sup>1</sup> AND I.D. BUZZ<sup>2</sup> CONCEPT VEHICLES (2016/2017)

# WE MAKE THE FUTURE REAL.



Volkswagen is entering a new automotive age – and the first forerunners of this coming era are already here: the I.D. and I.D. BUZZ concept vehicles provide a glimpse of the next generation of electric mobility.

The I.D. will be Volkswagen's first purely electric production vehicle in the compact class when it is built in 2020. On board will be the technical features of the future, including a powerful electric drive system with a range of up to 600 kilometres, inductive quick-charging function, an innovative space and control concept and state-of-the-art assistance systems. And from 2025 the I.D. will drive completely autonomously – you sit back and the I.D. pilot will drive fully automatically.

The I.D. BUZZ unveiled in 2017 is a purely electric concept van with all-wheel drive. In terms of looks, the I.D. BUZZ, planned for release in 2020, is based on the Microbus concept from 2001 and the classic T1. Two compact electric motors on the front and rear wheels ensure commanding road performance with up to 374 horsepower (275 kW). Its variable space concept guarantees supreme travel comfort. And from 2025 the I.D. BUZZ will also drive its passengers around fully automatically.



1 The I.D. also breaks new ground in terms of design: Instead of B-pillars, front and rear doors form an enclosed structure.

2 The old and familiar seating arrangement has had its day in the I.D. BUZZ: The driver's cab and passenger area fuse to create an open-plan interior that can be used in a completely new way.



#### I.D. TECHNICAL DATA

MOTOR:	ELECTRIC MOTOR, REAR AXLE
MAX. POWER:	125 KW/170 HP
BATTERY:	LITHIUM-ION
RANGE:	400 – 600 KM



#### I.D. BUZZ TECHNICAL DATA

MOTOR:	2 ELECTRIC MOTORS, FRONT AND REAR AXLE
MAX. POWER:	UP TO 275 KW/374 HP
BATTERY:	LITHIUM-ION
RANGE:	UP TO 600 KM

38 <sup>1</sup> I.D.: The vehicle is not yet available for sale. It currently doesn't have general type approval and is therefore not governed by EU Directive 1999/94/EC.  
<sup>2</sup> I.D. BUZZ: The vehicle is not yet available for sale. It currently doesn't have general type approval and is therefore not governed by EU Directive 1999/94/EC.



Volkswagen AG  
Berliner Ring 2  
38440 Wolfsburg  
Germany

Responsible for content:  
Volkswagen product communication / Volkswagen Classic  
Picture credits: Volkswagen Aktiengesellschaft, RWE historical archive,  
Volkswagen AutoMuseum Foundation  
Private archives: Hagen Arlt, Georg Fischer, Adolf Kalberlah

© 2017 Volkswagen AG