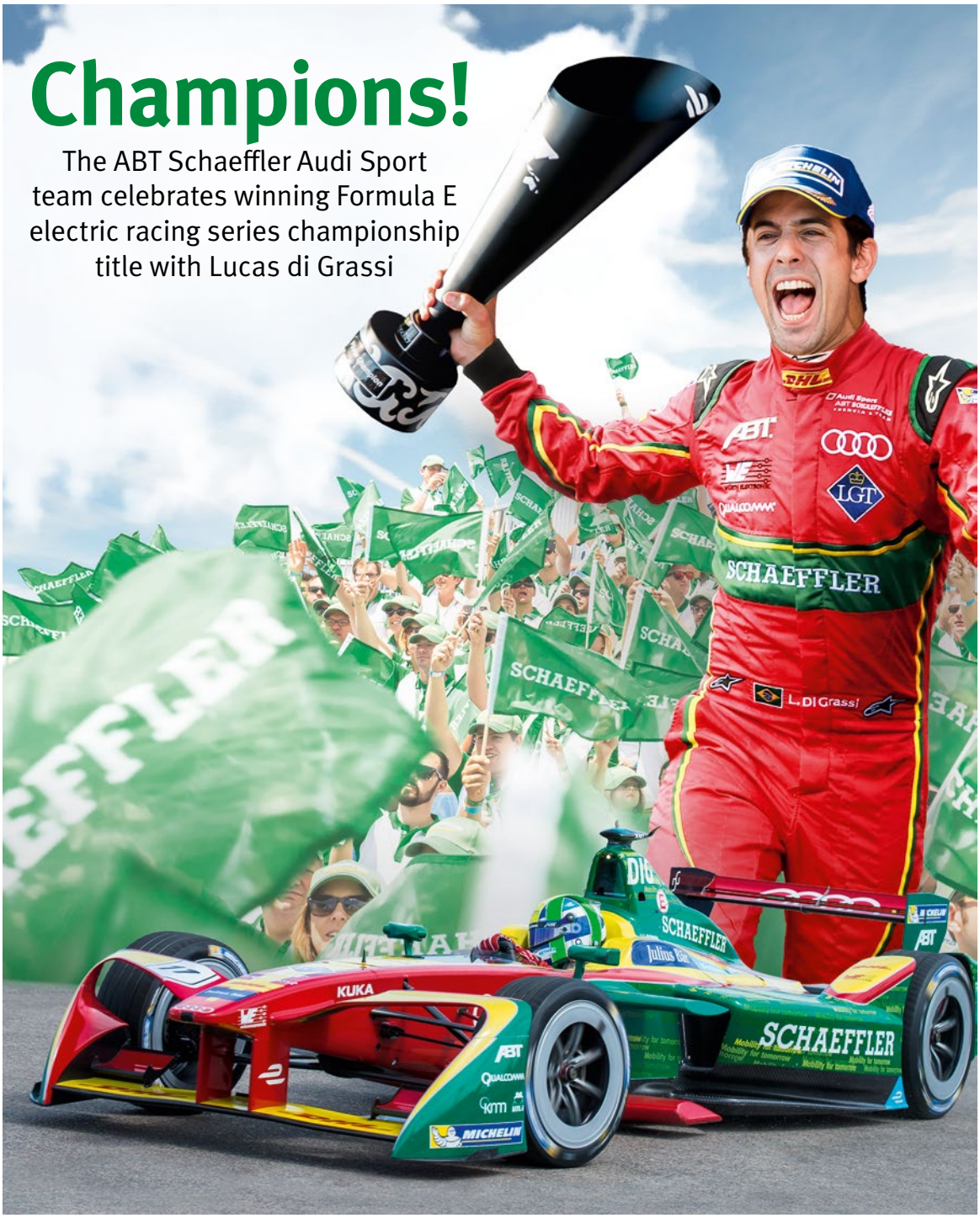
FACT SHEET XXL
FORMULA E 2016/2017
ABT Schaeffler Audi Sport

SCHAEFFLER

Champions!

The ABT Schaeffler Audi Sport team celebrates winning Formula E electric racing series championship title with Lucas di Grassi



Editorial

Jörg Walz
Vice President
Communications and
Marketing Schaeffler
Automotive

Cutting edge technologies, discipline, team spirit, courage, determination, experience and fortune – this and much more finally brought our ABT Schaeffler Audi Sport squad the long-awaited Formula E championship title. Schaeffler has been exclusive technology partner to the team since the creation of this innovative racing series. We undertake pioneering work in the field of electromobility and provided the key component in the championship winning race car – the drivetrain for the ABT Schaeffler FE02.

Formula E was mocked occasionally at its birth. Virtually silent racing cars – that can't possibly be motorsport. In the meantime, the majority of critics have fallen silent. The series offers not just thrilling racing in the center of megacities around the globe, it is now moving increasingly into the focus of automobile manufactures and the global public away from trackside. Because it is in touch with the latest trends. We are proud to be a crucial part of this exciting project once again in the forthcoming years.

A review of the previous three seasons, everything you need to know about the technology, our team and our drivers as well as short reports covering every race of the season past are found on the following pages. Have fun!

Content

Electrifying Team ABT Schaeffler Audi Sport

Welcome to the future!

Electric, in city centers throughout the world – this is Formula E. Forget everything that you knew about motorsport before now, and experience the world of the first fully-electric international racing series

Formula E simultaneously offers various unique motorsport features. The most obvious: in contrast to conventional combustion engines (as used in the DTM) or hybrid powertrains (as used in the WEC) the race cars are powered exclusively by electricity. Development of the electric motor as well as the gearbox and relevant control software is free. Schaeffler is responsible with the team for the entire drivetrain. From the outset a successful combination that was ultimately crowned with the 2016/2107 championship title. The energy is supplied by a near 320 kilogram battery, which is standard for all teams, located at the rear of the car.

Second unique feature: Formula E does not stage its races on permanent race tracks, but exclusively on temporary circuits in the cities. In this way, motorsport comes to the fans and not vice versa. The unusual and attractive venues are made possible by the low noise level of the cars and zero emissions. Even the electricity required to charge the batteries is produced directly on location using an Aquafuel glycerin generator. The venues are unique in the motorsport world: Buenos Aires, Paris, New York, London and Beijing are just a few examples of the megacities on whose roads Formula E cars race.

Manufacturer involvement on the increase

Electromobility plays an increasingly larger role in the automotive sector. An ever growing number of manufacturers use the opportunity to present their own brands in a "charged" environment like Formula E. In the coming 2017/2018 season, Audi takes over the defending champion's entry and changes the name to Audi Sport ABT Schaeffler. In the subsequent season, BMW also enters Formula E as works team, Porsche and Mercedes-Benz follow a year later. ■

A *vision* becomes *reali ty*

Successful concept Even in its debut season, Formula E impresses every pessimist and sceptic with eleven thrilling races – here Daniel Abt in Miami – in Asia, South and North America and Europe

2014/2015 season

Electricity and motorsport – this concept has appeared every now and again. More than 100 years ago, it wasn't at all clear that the combustion engine would lead the race. The first car that broke the 100 km/h barrier was the "La Jamais Contente" from 1899 – a rolling battery with a torpedo-shaped design and e-machine. In recent years, hybrid racecars competed at Le Mans, like the Panoz Q9 GTR-1 Hybrid from 1998 and the Audi R18 e-tron quattro and Porsche 919 hybrid each winning on three occasions. Formula E goes one step further in its debut 2014/2015 season: for the first time a pure electric powered single-seater race series is held worldwide in the biggest megacities on this planet, with a Fédération Internationale de l'Automobile FIA title in which high-profile teams and drivers compete against one another. ABT and Schaeffler from day one have been doing pioneering work in this racing series that will establish itself as a widely noticed sports stage and development laboratory for electric mobility. ■

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1 **First time** In June 2014, the Audi Sport ABT Formula E team completes its first test kilometers for the forthcoming season in Donington, England. The still entirely "naked" racer uses a standard chassis (Spark/Dallara), standard motor (McLaren) and standard electronics

2 **What a start** Lucas di Grassi wins the first ever Formula E race. Following his victory in Bejing, the Brazilian also celebrates five more times on the podium. In a thrilling title fight, which runs all the way to the final, he must ultimately settle for third overall

3 **Clearly visible** Schaeffler is an integral partner of the project

4 **Here's to a good cooperation** In mid-August, about one month before the season starts, ABT announces the cooperation with Schaeffler as exclusive technology partner. Schaeffler Chief Technology Officer Prof. Peter Gutzmer (left) and team boss Hans-Jürgen Abt upon signing the contract

Final standings drivers' championship

P	Driver	Pts
1	Nelson Piquet junior (BR) NEXTEV TCR	144
2	Sébastien Buemi (CH) Team e.dams Renault	143
3	Lucas di Grassi (BR) Audi Sport ABT	133
4	Jérôme D'Ambrosio (B) Dragon Racing	113
5	Sam Bird (GB) Virgin Racing	103
6	Nicolas Prost (F) Team e.dams Renault	88
7	Jean-Éric Vergne (F) Andretti Autosport	70
8	António Félix da Costa (P) Amlin Aguri	51
9	Loïc Duval (F) Dragon Racing	42
10	Bruno Senna (BR) Mahindra Racing	40
11	Daniel Abt (D) Audi Sport ABT	32

Final standings teams' championship

P	Team	Pts
1	Team e.dams Renault	232
2	Dragon Racing	171
3	Audi Sport ABT	165

Scha effler inside

Runner-up Lucas di Grassi (left) missed the championship title by just two points. Here in Paris he celebrates one of his three victories of the season

2015/2016 season

1

2

3

1 **New race car** Presentation of the new ABT Schaeffler FE01 race car with Schaeffler Chief Technology Officer Prof. Peter Gutzmer, the two drivers Lucas di Grassi and Daniel Abt as well as team boss Hans-Jürgen Abt (from l to r). Resplendent in the background the new ABT Schaeffler Audi Sport team logo

2 **Local cheers** In Berlin of all places and in front of his home crowd Daniel Abt finishes second to claim his best Formula E result so far

3 **Schaeffler know-how** As the team's exclusive technology partner, Schaeffler develops a unique electric motor and shapes the race car's complete drivetrain comprised of motor and transmission

4 **Winner di Grassi and Abt third in Long Beach** For the first time in Formula E, both ABT Schaeffler Audi Sport team drivers stand together on the podium

Final standings drivers' championship

P	Driver	Pts
1	Sébastien Buemi (CH) Renault e.dams	155
2	Lucas di Grassi (BR) ABT Schaeffler Audi Sport	153
3	Nicolas Prost (F) Renault e.dams	115
4	Sam Bird (GB) DS Virgin Racing	88
5	Jérôme D'Ambrosio (B) Dragon Racing	83
6	Stéphane Sarrazin (F) Venturi Formula E Team	70
7	Daniel Abt (D) ABT Schaeffler Audi Sport	68
8	Loïc Duval (F) Dragon Racing	60
9	Jean-Éric Vergne (F) DS Virgin Racing	56
10	Nick Heidfeld (D) Mahindra Racing	53

Final standings teams' championship

P	Team	Pts
1	Renault e.dams	270
2	ABT Schaeffler Audi Sport	221
3	DS Virgin Racing	144

Season two sees the dawning of a new era. Although the familiar chassis and standard battery are used, the rule makers make drivetrain development free. From now on, the teams use their own versions of E-motors, transmissions and power electronics. E-mobility pioneer Schaeffler contributes the expertise for the drivetrain in the new ABT Schaeffler FE01 race car. The motor power in practice is increased from 170 to 200 kW and from 150 to 170 kW in the race – the additional energy that the driver can deploy via the FanBoost is increased to 100 kilojoules. Lucas di Grassi and Daniel Abt again occupy the monoposto cockpits. ■

4

In the fast lane

Show colors The ABT Schaeffler FE02 is sporting the Schaeffler motto “Mobility for tomorrow.” At the company’s home event in Berlin, hundreds of employees cheer on from the grandstands

Formula E has long since developed into an established force in motorsport. Even better still: in July 2017, with Audi, BMW, Mercedes-Benz and Porsche four big German automobile manufacturers announce their works entries. In 2016/2017, the governing body leaves the proven technical and sporting aspects as good as untouched. ABT Schaeffler Audi Sport competes for the third successive time with the driver-duo Lucas di Grassi and Daniel Abt. With twelve races, the calendar includes more events than ever before. ■

1 **The goal of our dreams** At the highly dramatic season finale in Montreal, Lucas di Grassi dislodges defending champion Sébastien Buemi from the championship lead and becomes Formula E champion

2 **Visit from on high** Georg F. W. Schaeffler, Shareholder and Chairman of the Supervisory Board of Schaeffler AG, keeps his fingers crossed on location for the ABT Schaeffler Audi Sport team at the penultimate race weekend in New York

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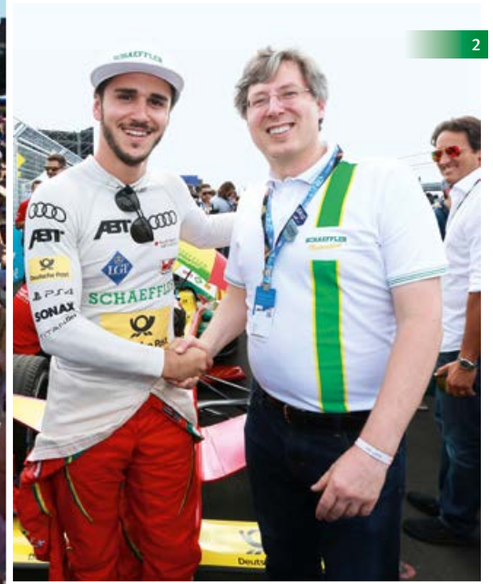

2

Final standings drivers’ championship

P	Driver	Pts
1	Lucas di Grassi (BR)	181
	ABT Schaeffler Audi Sport	
2	Sébastien Buemi (CH)	157
	Renault e.dams	
3	Felix Rosenqvist (S)	127
	Mahindra Racing	
4	Sam Bird (GB)	122
	DS Virgin Racing	
5	Jean-Éric Vergne (F)	117
	TECHEETAH	
6	Nicolas Prost (F)	93
	Renault e.dams	
7	Nick Heidfeld (D)	88
	Mahindra Racing	
8	Daniel Abt (D)	67
	ABT Schaeffler Audi Sport	
9	José Maria Lopez (RA)	65
	DS Virgin Racing	
10	Stéphane Sarrazin (F)	36
	TECHEETAH	

Final standings teams’ championship

P	Team	Pts
1	Renault e.dams	268
2	ABT Schaeffler Audi Sport	248
3	Mahindra Racing	215

High-tech for the *race track*

The ABT Schaeffler FE02 is a purebred racer packed with high-tech. While most of the components, including the battery and the entire aerokit, are identical for all contenders, Schaeffler and ABT have developed the entire powertrain

Steering wheel

Standardized steering wheel with paddles for shifting and recuperation, controls for various engine settings and a display for all key information

Aerodynamics

Adjustable front and rear wing

Battery

Developed by Williams Advanced Engineering, charging time: approx. 45 minutes

Tires

18-inch wheels with Michelin control tires (same tread as for production cars)

Brakes

Hydraulic dual-circuit braking system, adjustable brake force distribution

Suspension

Optimized suspension with increased stiffness and improved kinematics

Powertrain

Electric motor ABT Schaeffler MGU 01+, three-speed transmission

Dimensions

***Length** 5,000 mm*
***Width** 1,800 mm*
***Height** 1,250 mm*
***Weight** min. 880 kg including driver*

Power output

***Practice and Qualifying** 200 kW (270 hp)*
***Races** 170 kW (231 hp) plus FanBoost*

Chassis

Specification carbon fiber-aluminum chassis from Dallara

Video
The powertrain of the ABT Schaeffler FE02

Top team performance
ABT Schaeffler Audi Sport is in contention for victory in every race

Well *equipped*

The basic concept for the powertrain of the ABT Schaeffler FE02 remains identical to last year. For the 2016/2017 season, the engineers focused on improving many details

ABT Schaeffler Audi Sport heads off on the Formula E tour around the world with a powertrain that has been improved in many aspects. ABT Schaeffler MGU01+ – even the name makes it clear that the powertrain is based on the combination of the electric motor and transmission from the successful season two model.

2,225

kilometers have been covered by the team in the twelve races of the 2016/2017 season

The engineers of the exclusive technology partner, Schaeffler, have focused on further improving the torque and drive efficiency. Moreover, the weight has been further reduced. The transmission features three gears and has also been further optimized in its efficiency and gearshift times.

Looking ahead

At the start of the fourth season in December 2017 in Hong Kong a new era dawns for the team after being taken over by Audi. At the German home event in Berlin in June 2017, the automobile manufacturer and Schaeffler agreed a three-year cooperation to further develop the drivetrain. “The saying ‘Never change a winning team’ is probably never more pertinent than it is today,” explained Prof. Peter Gutzmer, Vice Chairman of the Board and Chief Technology Officer of Schaeffler. “We are already in the middle of testing for the next season.”

A strong team in the *cockpit*

In Lucas di Grassi and Daniel Abt the squad of Hans-Jürgen Abt has its dream team filling the cockpits of the two Formula E race cars. The experienced Brazilian and youngster Daniel Abt are not only fast and technically adept but perfectly harmonize with each other off the race track as well

Lucas di Grassi # 11

Highlights

2005	1st in Macau GP
2006	Formula 1 Test
2007	2nd GP2 series, Formula 1 test driver
2008	3rd GP2 series, Formula 1 reserve driver
2009	3rd GP2 series, Formula 1 reserve driver
2010	Formula 1
2013	3rd in Le Mans 24 Hours
2014	2nd in Le Mans 24 Hours, 4th WEC
2015	4th in Le Mans 24 Hours, 3rd FIA Formula E
2016	3rd in Le Mans 24 Hours, 2nd FIA Formula E
2017	1st FIA Formula E

Vita

Date of birth	August 11, 1984
Place of birth	São Paulo (BR)
Domicile	Monaco (MC)
Height	1.79 m
Weight	75 kg

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@LucasdiGrassi
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Daniel Abt # 66

Highlights

2007	2nd ADAC Kart Championship
2008	8th ADAC Formula Masters
2009	1st ADAC Formula Masters
2010	2nd ATS Formula 3 Cup
2011	4th FIA Formula 3 International Trophy, 7th Formula 3 Euro Series
2012	2nd GP3 series
2013	GP2 Series
2014	GP2 Series, FIA Formula E
2015	1st in Le Mans 24 Hours (class), 11th FIA Formula E
2016	19th ADAC GT Masters, 7th FIA Formula E
2017	8th FIA Formula E

Vita

Date of birth	December 3, 1992
Place of birth	Kempten (D)
Domicile	Kempten (D)
Height	1.79 m
Weight	70 kg

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A tradition *of innovation*

Hall of Fame Success not only in single-seater racing

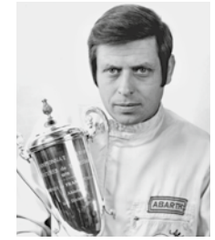
ABT Sportsline – the world's leading tuner of vehicles from the Volkswagen Group and successful motorsport team in the DTM. Together with Schaeffler, the Allgäu-based squad enthusiastically tackles a new motorsport challenge in Formula E

ABT Sportsline is one of the most successful motorsport teams in Germany and Europe. Its history in racing dates back almost 70 years and began with initial victories scored by Johann Abt in the 1950s. The first recorded success took place in a dirt track race, followed by victories and titles in touring car, sports car and formula racing. 2009 has gone down in the company's history as the most successful year to date: Timo Scheider won the DTM, Christian Abt the ADAC GT Masters in the Audi R8 and youngster Daniel Abt was victorious in the ADAC Formula Masters. Previously, in 2007, Schaeffler and ABT had jointly celebrated success as well: with the logos of LuK, INA and FAG on his A4, Mattias Ekström won his DTM title number two.

Founded as a smithy in 1896, the ABT company has been continually developing ever since. Just one thing has never changed: the family still runs the company with about 170 employees and partners in 50 countries around the world. CEO Hans-Jürgen Abt now represents the fourth generation at the helm. For ABT Sportsline, the commitment in Formula E also marks a return to the roots, as the team celebrated success in formula racing as far back as in the early 90s – among others, with Ralf Schumacher in the cockpit back then. ■

Moments

1970



Johann Abt († 2003), *father of Hans-Jürgen and Christian Abt, becomes European Touring Car Champion*

1999

*The **STW Championship** marks the first major title for Christian Abt and the team*

2007

*Sporting the logos of the **Schaeffler Group, Mattias Ekström** becomes DTM champion*

2009

***Christian Abt, Timo Scheider and Daniel Abt** clinch three titles in a single year*

2017

***ABT, Schaeffler and Lucas di Grassi** win the Formula E title*

On and off the *race track*

A Formula E season is a world tour. All the information, facts, results and anecdotes from the nine race weekends as well as a glance at the respective mobility situation at the venues

Setting an example Hong Kong

More than seven million people scurry around the densely-packed precincts of Hong Kong. And yet, according to a study by the American business consultancy Arthur D. Little, the city is leading the way in urban mobility

Urban planners and builders in Hong Kong face many obstacles such as mountains, valleys and bodies of water, as well as extreme climatic fluctuations and cash-strapped residents. 7.1 million people live in an area covering just 1,100 square kilometers – that's 6,400 people per square kilometer. By comparison, the ratio in Hamburg is around 2,300. Moreover, around 50 million tourists visit Hong Kong every year.

A perfect local public transport system

Only eight percent of the population use bikes or private cars. In most large European cities, the proportion of cars amounts to 40 to 70 percent. The number of cars per capita in Hong Kong is one of the lowest of the study with 73 per 1,000 inhabitants. In Western Europe and the USA the ratio is around 500 vehicles. The solution to the traffic chaos threat is an almost perfect system of local public transport (LPT).

The star of local public transport is the subway. In congested areas, the next station is no more than five minutes away on foot. The closely-meshed network of the public bus system is reinforced by a range of private providers – minibuses. The vans do not run to a fixed timetable and their routes stretch predominantly from one side of the city to the other. A shout lets the driver know when passengers want to hop on or off.

But even an exemplary example of urban mobility like Hong Kong also has its weak points – namely car sharing, bike sharing and cycle paths. The fact that the push bike is almost non-existent as a means of transport is again due to the high population density. Sidewalks and roads are packed with people, taxis and buses. Bike paths don't exist. Many Hong Kong Chinese don't even know how to ride a bike as it was never part of their upbringing at home or at school. ■

64%

of people use public transport – or 92 percent including pedestrians

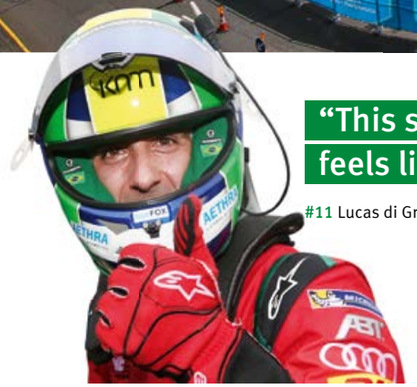
5 minutes

on foot to the next station in Hong Kong's congested urban center. At peak hour, the trains run every 90 seconds on ten lines

Mastered Hong Kong is a pioneer in overcoming challenges in urban mobility

R 1 *October 9, 2016* *Hong Kong*

Rollercoaster opener



“This second place feels like a win”

#11 Lucas di Grassi

Exciting races in megacities and fans who stand shoulder to shoulder with their idols – Formula E celebrates a successful opening in Hong Kong. Just as the previous season ends, the current one starts with the “eternal fight” between reigning champion Sébastien Buemi and Lucas di Grassi. After qualifying things don’t look much like a head-to-head duel. Di Grassi stranded 19th on the grid due to a mishap, Buemi tackles the race from fifth place. A safety car phase towards the middle of the race opens the opportunity for teams to deploy different strategies regarding the mandatory pit stop. Di Grassi is the first driver to be called into the pits. A good decision. In the second half of the race, the Brazilian sprints up to second place. Team mate Daniel Abt was more unlucky: on the first lap he was hit by several competitors and was consequently called into the pits by the stewards to repair the rear wing. Later he must retire his car early. ■

Race

P	Driver	Time
1	S. Buemi (CH)	53m 13.298s
2	L. di Grassi (BR)	+2.477s
3	N. Heidfeld (D)	+5.522s
4	N. Prost (F)	+7.360s
5	A. Félix da Costa (P)	+17.987s
6	R. Frijns (NL)	+21.161s
7	J. D’Ambrosio (B)	+28.443s
8	O. Turvey (GB)	+30.355s
9	M. Engel (D)	+30.898s
10	S. Sarrazin (F)	+31.734s

Laps 45
Pole position N. Piquet jr., 1m 03.099s
Fastest race lap F. Rosenqvist, 1m 02.947s
#FanBoost J. Lopez, S. Buemi, L. di Grassi

12

races make up the 2016/2017 Formula E season. In the first two seasons it was eleven and ten respectively

“That was not the start to the season I was hoping for”

#66 Daniel Abt

Hong Kong Central Harbourfront Circuit

1,860 m
Track length

A city of *contrasts*

With the express train to Casablanca or by horse-drawn carriage through the pedestrian zone – mobility in Marrakesh, "The Pearl of the South", offers many facets

The Kingdom of Morocco has the most developed railway network in North Africa. Marrakesh, the country's fourth-largest city with just under a million inhabitants, has an important function with its central location. The clean, state-of-the-art traditionally oriental styled railway station is a real highlight. Though the timetable can change spontaneously, the trains can take people in all directions around the country, which is about the size of Spain, even faster.

In Marrakesh, locals and tourists have a wide range of opportunities to travel. The urban bus network is widely branched and cheap to use. It is recommended to negotiate a price with a taxi driver beforehand.

Adventurers plunge themselves into Marrakesh's traffic with rental cars. Cyclists, mopeds and cars creep along at walking pace. Outside of the center it is possible to travel faster. But be careful when driving in the dark: there is often a lack of road lighting in the countryside, and not all road users travel with headlights here.

Decent Alternatives

The most traditional means of transport in Marrakesh are the horse-drawn carriages. Especially in the angular alleyways of Medina, the old town, the agile horse and cart proves to be not only a tourist attraction but convenient transport too. ■

"The Red City" Approximately one million inhabitants live in Marrakesh, which is located just south of the High Atlas mountain range

18.50 €
(200 Moroccan dirhams) is the cost of an hour's carriage ride through the old town of Marrakesh

1,907 km
is the total length of the railway network in Morocco. In Germany it is 41,896 kilometers

R 2

November 12, 2016

Marrakesh

Points for Daniel Abt

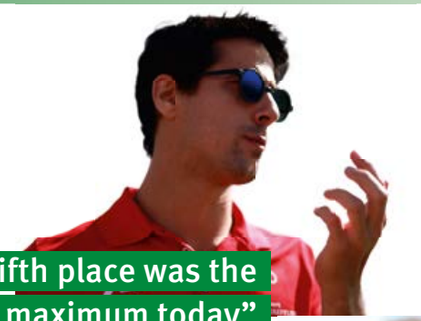
At the Formula E premiere in Africa, Daniel Abt scores his first points of the third season. After qualifying in a good sixth position, the German also finishes the race in sixth place – around five seconds behind his team mate. With twelfth place in qualifying, Lucas di Grassi initially fails to show his full potential. In the race, however, he is one of the main protagonists and picks off his previously better placed rivals one-by-one to leave them trailing in his wake. Within the 33 race laps he moves up to fifth place and in doing so cements second place in the drivers' classification. Formula E bids farewell for a near three month winter break. ■

5

continents now host a Formula E event. After North America, South America, Europe and Asia, Africa was added thanks to the event in Marrakesh

"We'll attack again after the winter break"

#66 Daniel Abt



"Fifth place was the maximum today"

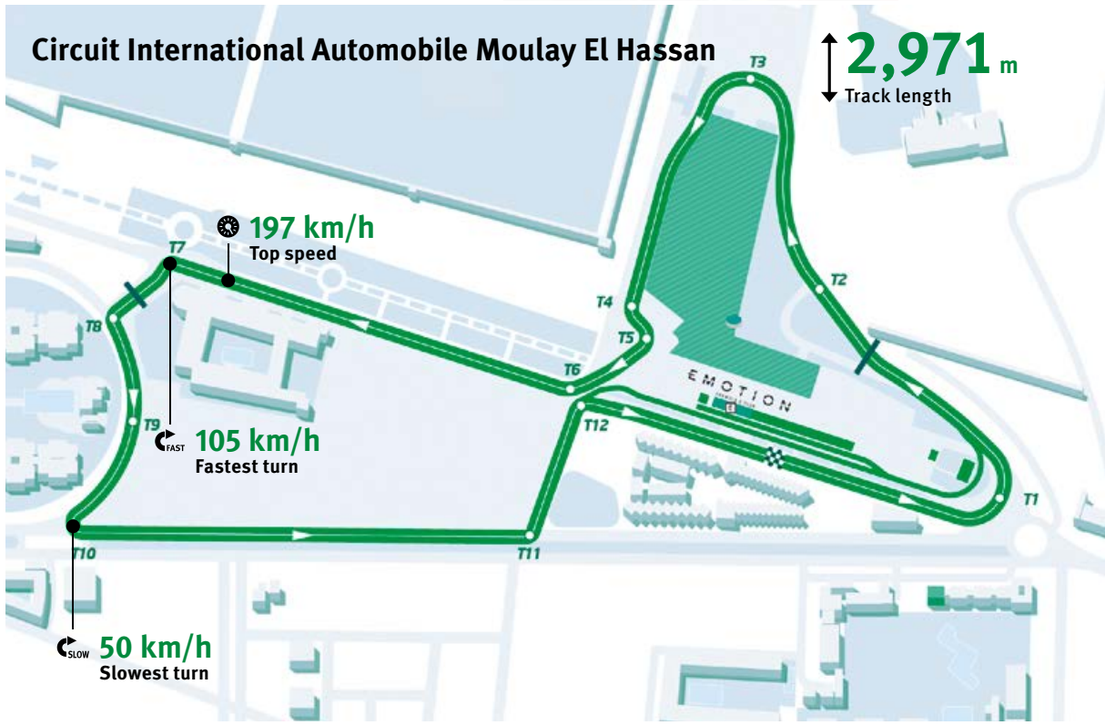
#11 Lucas di Grassi

Race

P	Driver	Time
1	S. Buemi (CH)	47m 40.840s
2	S. Bird (GB)	+2.547s
3	F. Rosenqvist (S)	+7.195s
4	N. Prost (F)	+11.586s
5	L. di Grassi (BR)	+13.771s
6	D. Abt (D)	+18.233s
7	O. Turvey (GB)	+21.710s
8	J. Vergne (F)	+28.011s
9	N. Heidfeld (D)	+33.699s
10	J. Lopez (RA)	+33.863s

Laps 33
Pole position F. Rosenqvist, 1m 21.509s
Fastest race lap L. Duval, 1m 22.600s
#FanBoost D. Abt, S. Buemi, L. di Grassi

Circuit International Automobile Moulay El Hassan



Centerpiece Located in the heart of Buenos Aires is Avenida 9 de Julio, one of the main traffic arteries of Argentina's capital

Moving *forward*

Argentina's capital Buenos Aires impresses with a flexible approach to urban mobility

40,000

taxis operate in Buenos Aires – clearly more than in New York City (12,000), the place commonly presumed to have the largest fleet

25 cents

is the cost of a bus or train ticket in Buenos Aires, expressed in euros

A population of 2.9 million does not exactly make Buenos Aires rank among the world's most populous cities. Notably, though, the "Porteños," as the citizens of Argentina's capital call themselves, live in an area of merely 202 square kilometers. Consequently, with a population density of 14,308 residents per square kilometer, Buenos Aires surpasses megacities such as São Paulo (7,400) and Mexiko City (6,000).

Traffic in the "capital of tango" is typical of metropolitan areas: chaotic and noisy. Tourists are well-advised to avoid getting actively involved in it in rental cars. The city buses called "Colectivos" offer the best means of public transportation. The 150 lines operated by private companies are heavily frequented due to cheap tickets, an extensive network and scheduled all-night service. On the downside, the city suffers from considerable air and noise pollution which is actually in stark contrast to its name – Buenos Aires – which means "good air." A public transit alternative to avoid the ubiquitous traffic jams is the "Subterráneos" subway system that was opened in 1913 and operates six lines covering a total distance of 52.3 kilometers. Graffiti and sculptures enhance the natural drabness of quite a few metro stops. Tourists should beware, though, that none of the cars are air conditioned.

Enhancement of urban lifestyle

The risk of getting lost while trying to move around Buenos Aires has been minimized by the "BA Cómo llego" app. The navigator indicates the optimum route on a smartphone. New in the city, though relatively widespread already, are rental bike stations. However, exploring the surroundings on a bicycle takes a little courage as not every street has bike lanes. ■

R 3

February 18, 2017 — *Buenos Aires*

Good *fight*

“That was a very good race, even though it was only third place after the pole position”

#11 Lucas di Grassi

3 *Buenos Aires is, in addition to Berlin, the only venue to have appeared on the race calendar in all three Formula E seasons*

After his strong performance in the Buenos Aires ePrix, Lucas die Grassi consolidates his position as number two in the drivers’ field. At noon he is delighted about his first pole position of his Formula E career. In the race, the Brazilian initially wins the start, but drops back to fifth place in the following laps. With his team’s perfect pit stop and an overtaking maneuver, he still claims third place and a podium finish. Daniel Abt’s grid positon for the race is significantly worse: after the German touched the barriers in qualifying, the mechanics must put in a night shift to repair the ABT Schaeffler FE02. Due to the mishap only 16th on the grid is possible. With his courageous race Abt moves up to ninth place and adds another two points to his account. ■

Race

P	Driver	Time
1	S. Buemi (CH)	45m 45.623s
2	J. Vergne (F)	+2.996s
3	L. di Grassi (BR)	+6.921s
4	N. Prost (F)	+8.065s
5	N. Piquet jr. (BR)	+9.770s
6	L. Duval (F)	+35.103s
7	D. Abt (D)	+35.801s
8	J. D’Ambrosio (B)	+36.335s
9	O. Turvey (GB)	+37.111s
10	J. Lopez (RA)	+38.206s

Laps 37
Pole position L. di Grassi, 1m 09.404s
Fastest race lap F. Rosenqvist, 1m 09.467s
#FanBoost L. di Grassi, S. Buemi, D. Abt

“An action-packed crazy race, great fun”

#66 Daniel Abt

A picturesque view Behind the skyline of Mexico City towers the mighty Popocatépetl volcano

Creative minds needed

In terms of mobility, there's one thing that prevails in Mexico City – chaos. But there's hope: initial strategies are beginning to alleviate the megacity's major problem

José Castillo once described the urban portrait of Mexico City as huge, looking pretty chaotic and certainly being selfish. The Mexican Harvard professor is a renowned expert in the fields of urban planning and mobility. Together with his team he has developed a system that gathers and analyzes real-time traffic data in Mexico City, for which he received the prestigious Audi Urban Future Award in 2014 that recognizes mobility solutions for cities.

But in the case of Mexico City, a single good idea is not enough. 20 million people live in the metropolitan area and nearly nine million in the core of the city. More than four million passenger cars, 120,000 taxis, 28,000 buses and tens of thousands of trucks travel daily in and around Mexico's capital – these are the facts. And the result: it takes the 300,000 commuters nearly three hours per day to get to work in the business districts, according to the "IBM Commuter Pain Index." This means every one of them spends about a month per year caught in a traffic jam. There are no alternatives to passenger cars available to commuters. As a result of the privatization of the Mexican railroad system, service on all passenger train lines from and to Mexico City was discontinued in 1996.

By contrast, the situation in the center looks better. Local residents and tourists can choose from a variety of options available in a well-developed public transit system: radio taxis, buses or the metro with a total of 195 stations.

Unusual approaches

So, what options are available now to master the great chaos? According to José Castillo, there is no single, all-encompassing solution, as mobility is made up of numerous factors for which equally diverse solutions must be found and coordinated. A very creative project was launched last year. The nearly five kilometer long cable car service "El Mexicable" with its two cableways and 190 cars carries some 3,000 passengers per hour across Ecatepec de Morelos, one of the most populous districts of Mexico City. Whereas other big cities are on a desperate hunt for additional parking space, Mexico City has more than enough. The total of 6.5 million parking places for passenger cars account for 42 percent of the entire developed area. The government now intends to reduce them, particularly at locations where public transit has been well-developed. ■

6 km/h
is the average speed at which vehicles travel on major traffic arteries during rush hour in Mexico City

320
There are vehicles per 1,000 residents in Mexico City. At the moment, the registration rate of new vehicles is twice as high as the birth rate

3
Schaeffler has production sites in Mexico. The most recent one in the state of Puebla was inaugurated at the end of 2015

R 4 *April 1, 2017* *Mexiko City*

Di Grassi and Abt *furioso*

In Mexico, the ABT Schaeffler Audi Sport team experiences an emotional roller coaster. In qualifying Daniel Abt appears to take the second pole position of his Formula E career. Don't celebrate too early: the stewards subsequently determine the tire pressure is slightly too low in the profiled all weather race tires and move the German to the back of the grid. Lucas di Grassi, who starts from 15th, is also found towards the back of the field. In the race, the Brazilian initially survives a shocking moment when he is hit by another car and must pit to change the rear wing. Last place. The team calls him in for the pit stop already on the 18th of 45 laps. Afterwards, di Grassi demonstrates his superb handling of the car and energy management to cross the finish line in first place. Daniel Abt produces an equally impressive comeback drive: the tragic qualifying hero scores important points for seventh place after starting 18th. ■

25

The number of positions made up by Lucas di Grassi and Daniel Abt in Mexico

"Points were the goal – we achieved this and reduced our losses as a result"

#66 Daniel Abt

"The best race of my career"

#11 Lucas di Grassi

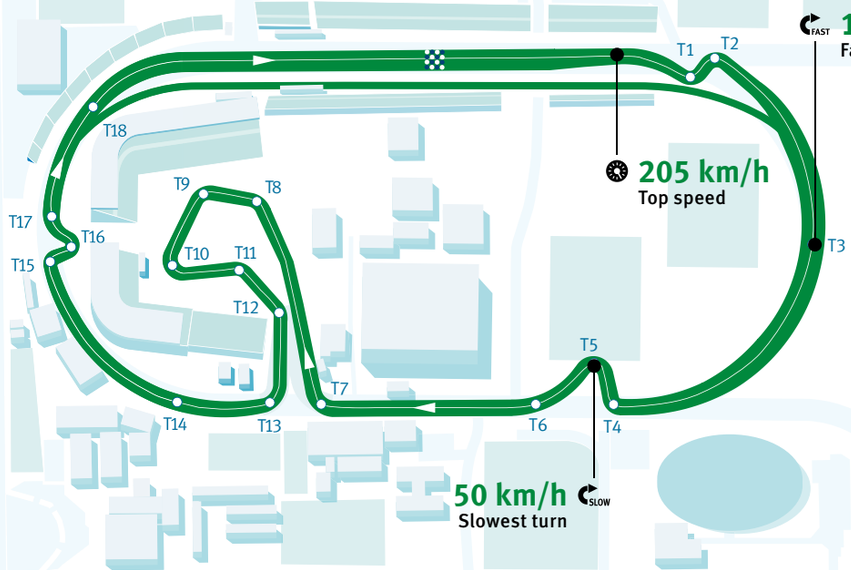
Race

P	Driver	Time
1	L. di Grassi (BR)	56m 27.535s
2	J. Vergne (F)	+1.966s
3	S. Bird (GB)	+7.480s
4	M. Evans (NZ)	+9.770s
5	N. Prost (F)	+9.956s
6	J. Lopez (RA)	+10.631s
7	D. Abt (D)	+11.694s
8	A. Carroll (GB)	+13.722s
9	N. Piquet jr. (BR)	+14.156s
10	E. Gutiérrez (MEX)	+15.717s

Laps 45
Pole position O. Turvey, 1m 02.867s
Fastest race lap S. Buemi, 1m 03.102s
#FanBoost S. Buemi, L. di Grassi, D. Abt

Autódromo Hermanos Rodríguez

2,093 m
Track length



Small and precious

Monaco's traffic suffers from lack of space. The best way to get around is on foot. Those who can afford it use boats and helicopters

The Côte d'Azur in deepest blue, the sun shining bright – Monaco can literally be called a paradise. The yellow press likes to refer to it as a "haunt of the rich and famous." After the Vatican, the principality on the French Mediterranean coast is the smallest state in the world, covering an area of a mere two square kilometers. So, it's no wonder that all of the hot spots can best be reached on foot. Five bus lines and numerous taxis are available as well. However, with 19,000 inhabitants per square kilometer, the principality also has the highest population density in the world. Consequently, traffic conditions in Monaco, particularly during rush hour, are extremely tense – so, it's a "haunt of the fastest" only on the Formula 1 and Formula E race weekends. Especially during these major events, the streets are frequently clogged although traffic conditions for passenger cars and trucks are generally tense. So, it's advisable to just park your own car immediately after arriving in Monaco, especially since the city-state has a rule of only admitting vehicles registered in Monaco itself or in the French Departement Alpes-Maritimes to the oldest and – in terms of population – smallest district Monaco-Ville.

There are several ways to travel to and from Monaco: on the highway, by train or – obviously for those enjoying the privilege – on a luxury yacht berthed in one of the most important marinas, Port Hercule or Port de Fontvieille. Very popular with the wealthy population as well is the helicopter shuttle from the nearby Nice airport.

An insider's tip from Lucas di Grassi

Lucas di Grassi is a proud resident of Monaco. The Brazilian campaigner of Team ABT Schaeffler Audi Sport lives a mere 100 meters away from the finish line of the Formula E race. He, too, advises against exploring the place he now calls home using motorized vehicles. "Traffic here may really be chaotic at times. So, why not explore the area on your own two feet? There's so much to see and experience. Whenever I'm in a hurry I just grab my longboard because I can even get around on it a lot faster than by bus or taxi." ■

2,000 euros

per day is the price of a berth for a 100-meter yacht at Port Hercule in the high season

80

public elevators, moving walkways and escalators help overcome elevation gain in Monaco

Electrically mobile Monégasque Lucas di Grassi knows how to quickly get from A to B in the principality

Also conceivable as a means of transportation in Monaco At CES 2017 in Las Vegas, Schaeffler showcased the prototype of an electric kickboard

R5

May 13, 2017 *Monaco*

Good results in the *principality*

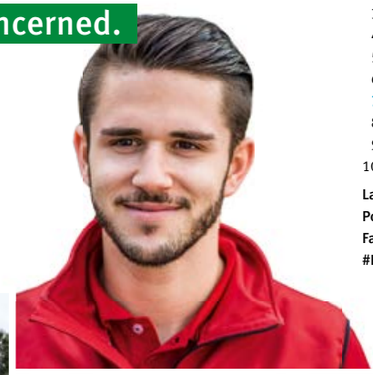
1,765

meters long is the Circuit de Monaco and is therefore the shortest track on the 2016/2017 Formula E race calendar

In his adopted home Monaco, Lucas di Grassi stages a thrilling duel with his rival Sébastien Buemi in the Formula E title fight. In qualifying the Brazilian and Swiss are almost on an equal footing. Buemi takes pole position from di Grassi by only two and a half tenths of a second. In the race the fans in the packed grandstands enjoy equally nail-biting action. For 51 laps the two opponents battled hard. At the checker di Grassi is beaten by a mere 0.32 seconds – the closest finish in the entire Formula E season. Daniel Abt also has nerves of steel: starting from ninth place, the youngster keeps a cool head in the opening lap turmoil to finish seventh at the finish for the third time in succession. ■

“It’s great to see that we are on the pace as far as speed is concerned. It’s reassuring”

#66 Daniel Abt



Race

P	Driver	Time
1	S. Buemi (CH)	51m 05.488s
2	L. di Grassi (BR)	+0.320s
3	N. Heidfeld (D)	+13.678s
4	N. Piquet jr. (BR)	+19.074s
5	M. Engel (D)	+19.518s
6	F. Rosenqvist (S)	+19.599s
7	D. Abt (D)	+20.430s
8	E. Gutiérrez (MEX)	+32.295s
9	N. Prost (F)	+35.667s
10	M. Evans (NZ)	+38.410s

Laps 51
Pole position S. Buemi, 53.313s
Fastest race lap S. Bird, 53.822s
#FanBoost S. Buemi, L. di Grassi, S. Sarrazin

“That was a fantastic battle again today – both in qualifying and the race”

#11 Lucas di Grassi

Comme ci, *comme ça*

Cars in abundance in spite of a first-rate public transportation network – Paris, the capital of France, is a place where mobility's curses and blessings exist side-by-side

La ville de l'amour The Seine in front and the Eiffel Tower in the background – Paris is world-famous for panoramas like this one

To a driver who is unfamiliar with the city, Paris poses a challenge. Obscure routing of streets, traffic jams galore, huge traffic circles and practically no parking places. Plus, there's the continually clogged "Boulevard Périphérique." The 35-kilometer ring road routes traffic around Paris and into the metropolis – and is undersized in spite of its eight lanes (in both directions).

Traffic in Paris not only puts a strain on the nerves of those caught in it but, above all, on the environment. In winter 2016, a huge cloud of smog robbed the "city of love" of its charm. Motorized traffic in Paris and the 22 surrounding communities was restricted for several days. Only vehicles with license plate numbers ending in specified digits were allowed to be used.

Those who'd like to contribute their fair share to environmental protection in Paris use public transportation. The world-famous Métro is the ideal way to get around. 16 lines carry more than five million people per day back and forth between some 300 stations. Two lines are even operated automatically without a driver. Above ground, the bus network covering the entire urban center is the Métro's counterpart. The open-top hop-on hop-off double-decker buses that can be used to explore Paris are more of a tourist attraction than an effective means of transportation. Street cars provide another alternative.

Paris is a paradise and role model in terms of vehicle sharing as well. A public bike rental system has been in existence since 2007, with stations to be found practically every 300 meters. The same principle applied to automobiles is called "Autolib'," which makes 3,000 electric cars available for rent in the Paris metropolitan area. No less a figure than the mayor of Paris herself has declared war on the automotive madness in her city. Anne Hidalgo would like to create more room for pedestrians and cyclists and intends to achieve this by cutting individual transportation on the two main axes traversing the city from east to west in half.

A top-tier activist

Environmental pollution is archaic, according to Hidalgo. At the end of last year, she had a 3.3-kilometer section of the street on the right bank of the Seine River closed to traffic. These and other actions have been successful, according to the city administration, which says the number of vehicles traveling in the center has dropped from 43,000 to 36,000. The introduction of an electric tram bus between Gare de Lyon and Pont du Garigliano to the tune of 35 million euros is another one of Hidalgo's forward-thinking projects. ■

1–2 M

vehicles per day use Boulevard Périphérique, one of the world's most heavily traveled roads

18,000

bicycles at 1,300 stations are available to customers of the Paris bike sharing system "Vélib'"

R 6

May 20, 2017

Paris

Zéro points

When Formula E makes its second outing in Paris, the team gets caught out by the set-up and suffers a setback in the title fight. For the first and last time this season both Lucas di Grassi and Daniel Abt score no points. For many laps, the German at least looks on course to score a few points in France. Abt makes some fantastic overtaking moves to move up from 16th on the grid to sixth place before an error with the battery management system stops his car half a lap before the finish while following the safety car. Misadventure, misfortune and mishap for di Grassi: difficult qualifying and 13th on the grid, a collision in the race, a drive-through penalty and finally an accident that leads to early retirement. ■

“Forget it and look forward”

#11 Lucas di Grassi

43

points is the deficit between Lucas di Grassi and championship leader Sébastien Buemi – never in this season is it larger

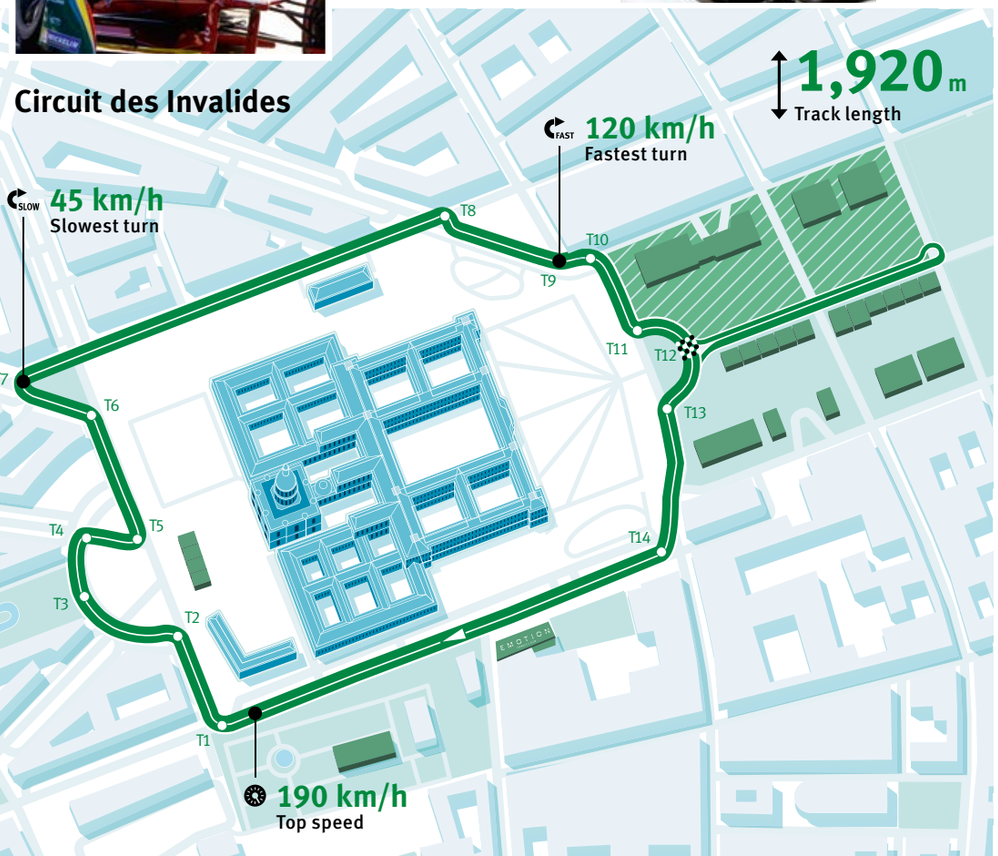
“I’ve seen a lot, but I couldn’t believe what happened today”

#66 Daniel Abt

Race

P	Driver	Time
1	S. Buemi (CH)	59m 41.125s
2	J. Lopez (RA)	+0.707s
3	N. Heidfeld (D)	+2.043s
4	F. Rosenqvist (S)	+2.621s
5	N. Prost (F)	+3.521s
6	R. Frijns (NL)	+7.999s
7	N. Piquet jr. (BR)	+32.420s
8	T. Dillmann (F)	+32.929s
9	M. Evans (NZ)	+33.369s
10	S. Sarrazin (F)	+34.051s

Laps 49
Pole position S. Buemi, 1m 02.319s
Fastest race lap S. Bird, 1m 02.422s
#FanBoost S. Buemi, L. di Grassi, D. Abt



Typically German

Germans are said to be tidy and thorough: a stereotype which, at least, is confirmed when looking at urban mobility in Berlin, the country's capital that has a reputation of being a very lively place

With a population of about 3.5 million, Berlin "only" ranks in position 58 of the world's cities with at least one million inhabitants – but within Germany, the federal capital is the country's major metropolis, followed in second place by the port city of Hamburg with a population of about 1.8 million. In terms of mobility, Berlin is at the republic's forefront in several respects as well.

1.7 million registered vehicles travel on Berlin's public road network covering a total of 5,400 kilometers, with 77 kilometers of federal "autobahns" alone being routed through the city: a heavy burden on humans and nature. The city has taken a constructive approach particularly to addressing the latter issue: by imposing speed limits. In Berlin, in terms of direction of travel, there are 164 kilometers of main traffic arteries where speed at night is limited to 30 km/h for noise protection. On an additional 372 kilometers, the maximum permissible speed is 30 km/h during the day for safety reasons. This means that 17 percent of the main streets and roads have speed limits of 30 km/h at least some of the time. Transportation Senator Regine Günther would like to introduce additional 30 km/h zones in order to further reduce harmful emissions.

In spite of the large number of passenger cars in the city, Berliners cover four in ten distances on foot or on bicycles. Accordingly, non-motorized ways of getting around town are highly important. Since 2001, 340 new pedestrian crossing installations such as "zebra-marked" crosswalks have been created in Berlin. Cyclists by now are able to use more than 1,000 kilometers of bikeways. These actions have produced a measureable effect, as residents are now running more of their errands on foot than by car in downtown Berlin.

Those preferring to be "chauffeured" in Berlin use public transportation. Verkehrsverbund Berlin-Brandenburg (VBB) with some 30,000 square kilometers is one of Europe's largest transportation associations in terms of area covered. Regional trains, commuter trains, the subway, streetcars and buses have more than 3,100 stops and a network length of some 1,900 kilometers – which roughly equates to the distance between Berlin and Moscow.

Prompting transformation

New Mobility Berlin – this is the name of a promising initiative. The project analyzes and supports the rollout of e-mobility solutions in Berlin's neighborhoods in combination with new types of space utilization concepts and mobility offerings. The objective is to sustainably upgrade residential areas by means of innovative mobility concepts. Residents are to be motivated to deregister their cars and to instead use a mix of car sharing, cargo bicycles, pedelecs and similar types of transportation. Berliners have already had opportunities to familiarize themselves with these alternatives during various weeks dedicated to the promotion of this campaign. ■

Panoramic view The Television Tower on Alexanderplatz on the right, and the Berlin Cathedral on the river Spree in the background on the left

€ 300 M
per year on road construction and on maintenance and energy costs incurred for the city's road network

20
production sites and four research and development centers are operated by Schaeffler in Germany

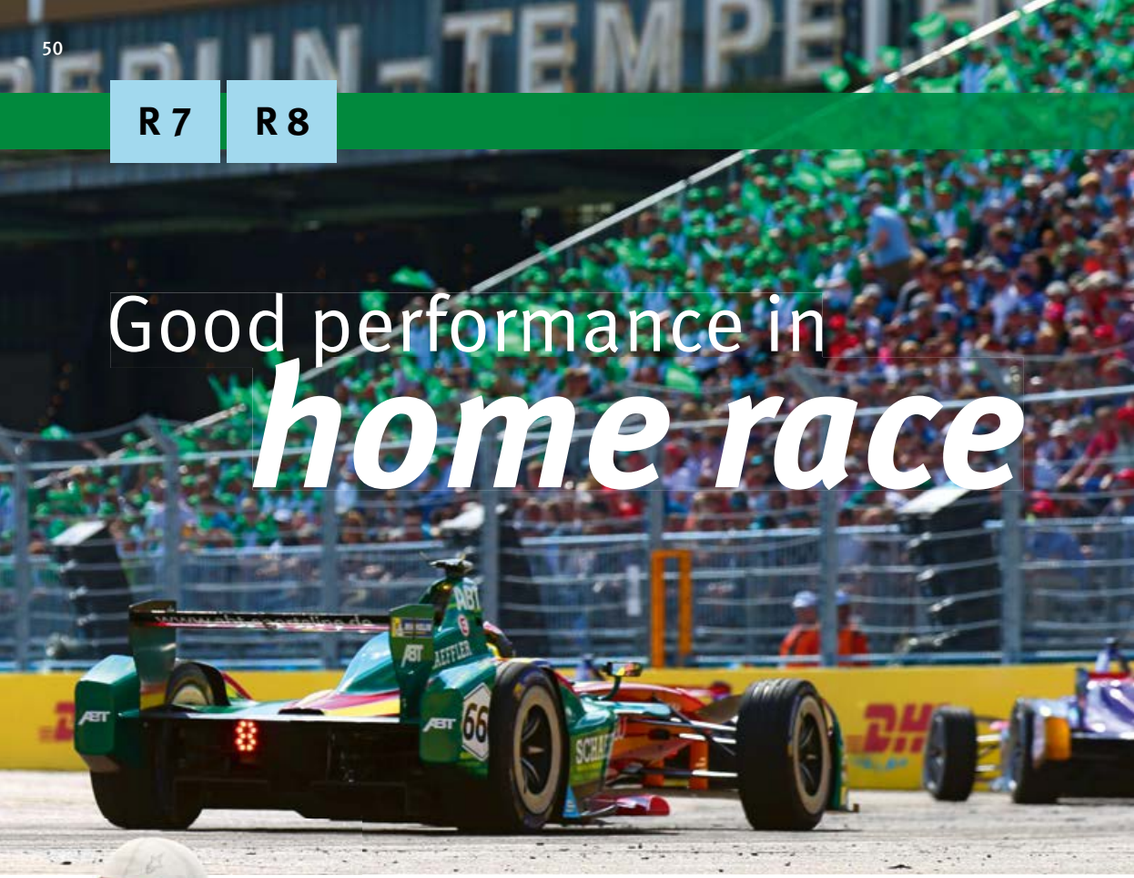
3
errands per day on average are run by every Berliner in public areas, with about 70 minutes spent in traffic

R 7 R 8

June 10/11, 2017

Berlin

Good performance in home race



“I’m delighted about two good races and plenty of points”

#66 Daniel Abt

Cheering fans, autographs by the hundred, selfie requests, here a slap on the back, there a hello – home race feeling in Berlin. A very special event for the technology group Schaeffler. Thousands upon thousands of fans – including 400 Schaeffler employees in their own grandstand – enjoy thrilling overtaking moves and fantastic comeback drives. And all this in two races. Lucas di Grassi celebrates twice on the winners’ podium after claiming a second and a third place despite having broken fibula – an injury he sustained just before a benefit football match. Team mate Daniel Abt enjoys his strongest weekend of the season to date with sixth and fourth in front of his home crowd. ■

2

Formula E action for the second time around the Berlin airport Tempelhof. In the previous season, a race track was constructed in the center of the German capital

Race 1

P	Driver	Time
1	F. Rosenqvist (S)	53m 19.661s
2	L. di Grassi (BR)	+2.232s
3	N. Heidfeld (D)	+4.058s
4	J. Lopez (RA)	+13.638s
5	N. Prost (F)	+19.068s
6	D. Abt (D)	+19.799s
7	S. Bird (GB)	+20.065s
8	J. Vergne (F)	+20.689s
9	M. Engel (D)	+39.030s
10	O. Turvey (GB)	+40.985s

Laps 44
Pole position L. di Grassi, 1m 08.312s
Fastest race lap M. Evans, 1m 10.224s
#FanBoost L. di Grassi, D. Abt, S. Buemi

Race 2

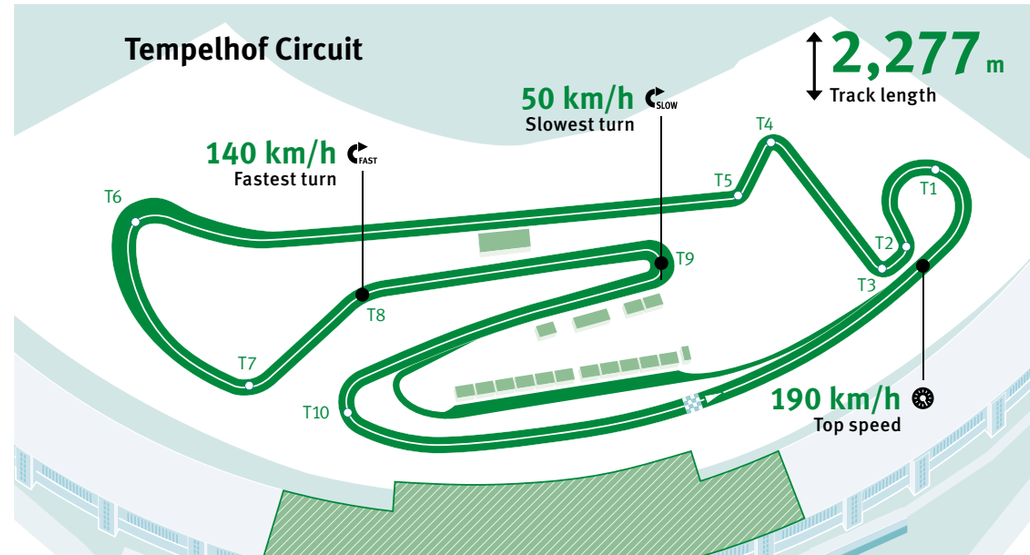
P	Driver	Time
1	S. Buemi (CH)	56m 02.155s
2	F. Rosenqvist (S)	+7.195s
3	L. di Grassi (BR)	+10.862s
4	D. Abt (D)	+13.631s
5	J. Lopez (RA)	+20.324s
6	J. Vergne (F)	+20.751s
7	S. Bird (GB)	+21.959s
8	N. Prost (F)	+22.155s
9	O. Turvey (GB)	+34.949s
10	N. Heidfeld (D)	+35.814s

Laps 46
Pole position F. Rosenqvist, 1m 08.208s
Fastest race lap M. Engel, 1m 09.509s
#FanBoost S. Buemi, L. di Grassi, D. Abt

“I think that together with Mexico the atmosphere in Germany is the best”

#11 Lucas di Grassi

Tempelhof Circuit



New York, *New York*

The Statue of Liberty, Central Park, the Manhattan skyline, Wall Street – New York City is a city of superlatives. In terms of mobility, though, the "Big Apple" is confronted with similar issues as other megacities. An innovative idea is to provide some relief

The Globalization and World Cities Research Network (GaWC) in its most recent index of the world's most important cities awarded the highest possible rating of Alpha++ to New York, making it the only one to have received it besides London. So, the 8.5 million residents, near-20 million in the metropolitan area and the 50 million tourists per year can consider themselves lucky. In New York, many people seek to enjoy a wide variety of activities in many different places. A well-functioning range of transportation is a requirement for this. In terms of local public transportation, the U.S. megacity deserves top ratings. The Subway is fast and air conditioned, and the fares are very low. Some 6,000 cars operating on 27 lines carry 4.5 million passengers per day back and forth between nearly 500 stations. The Subway's counterpart above ground is an equally well developed system of bus services. Two million passengers per day use the 4,000 buses operating on 235 lines.

A classic in the streets and practically a symbol of the city is the "Yellow Cab," a taxi that can be spotted by its unmistakable yellow color. 13,000 vehicles are registered with the New York City Taxi & Limousine Commission, which is an agency of the city's government. Cab drivers have to take their passengers to any desired destination within the five boroughs of Manhattan, Brooklyn, Queens, Bronx and Staten Island as well as Nassau County, Westchester County and Newark Airport. The New York Water taxi, though, is more of a tourist attraction than a serious means of transportation, taking visitors on sightseeing tours of hot spots such as the Brooklyn Bridge and Statue of Liberty by ship.

Avoiding collapse

Like those in practically any big city, the public streets in New York are bursting at the seams from an avalanche of passenger cars. Accommodating more and more vehicles in less and less space – Mayor Bill de Blasio views autonomous mobility as the solution to this major challenge. Small, electric vehicles that are practically in motion all the time are intended to help reduce petroleum consumption and CO_2 emissions, and counteract the scarcity of space. At the same time, they enhance the effectiveness and efficiency of mobility, as privately owned passenger cars are practically just parked 90 percent of the day. According to a survey, autonomously driven taxis would cover the same passenger transportation requirements with only 70 percent of the taxis currently needed.

Once upon a time …

The traffic scenario of a big city, dominated by electric vehicles – the future of mobility being worked on today was reality in New York as far back as 120 years ago. In 1896, silent, lightweight and, unlike horse-drawn carriages, odor- and emission-neutral, e-taxis would chauffeur tourists and residents from A to B. The vision of a clean city was a viable one at that time – albeit only until shortly after the turn of the century. The fleet of electric vehicles grew on a much larger scale than the required battery exchange stations, resulting in unreliable service. The cost-efficient internal combustion engine outstripped the electric motors. ■

A mega metropolis at its best:
50 million tourists visit New York per year

$ 90,000–100,000

of income per year are necessary to lead a normal life with some variety in New York, which makes the city one of the most expensive places to live in the world

8

manufacturing locations and three research and development centers are operated by Schaeffler in the United States

$ 2.50

is the fare per single trip on the New York Subway. Passengers pay with the "MetroCard," a plastic magnetic stripe card

R 9 **R 10**

July 15/16, 2017 *New York*

Catch up

Electrifying suspense in the “Big Apple”: Formula E is the first ever single-seater series to bring motorsport into the very heart of New York. The fans around the Brooklyn Circuit are not disappointed. In two eventful races, Lucas di Grassi reduces, in the absence of Sébastien Buemi, the gap in the drivers’ standings from 32 to just ten points. The championship leader competes at the same time in the World Endurance Championship (WEC) at the Nürburgring. In the first race, di Grassi moves up from tenth on the grid to take fourth, a day later the Brazilian battles from ninth to fifth position. Daniel Abt roles to a halt through no fault of his own while running third half a lap before the finish on Saturday.

“We didn’t have the speed this weekend to win races. But we made the best out of the opportunities that came our way”

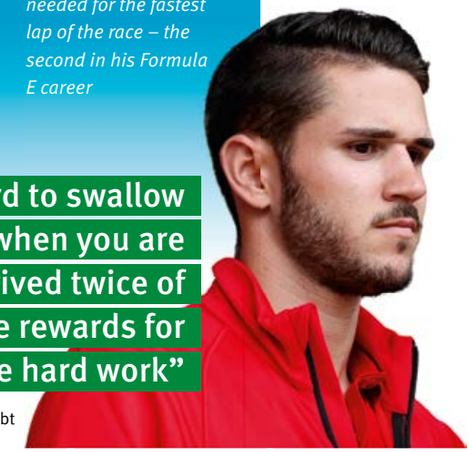
#11 Lucas di Grassi

1m 03.898s

was all Daniel Abt needed for the fastest lap of the race – the second in his Formula E career

“It’s hard to swallow when you are deprived twice of the rewards for all the hard work”

#66 Daniel Abt



Race 1

P	Driver	Time
1	S. Bird (GB)	52m 29.275s
2	J. Vergne (F)	+1.354s
3	S. Sarrazin (F)	+4.392s
4	L. di Grassi (BR)	+6.155s
5	L. Duval (F)	+8.428s
6	O. Turvey (GB)	+8.952s
7	P. Gasly (F)	+9.321s
8	N. Prost (F)	+10.036s
9	R. Frijns (NL)	+11.019s
10	A. Carroll (GB)	+12.073s

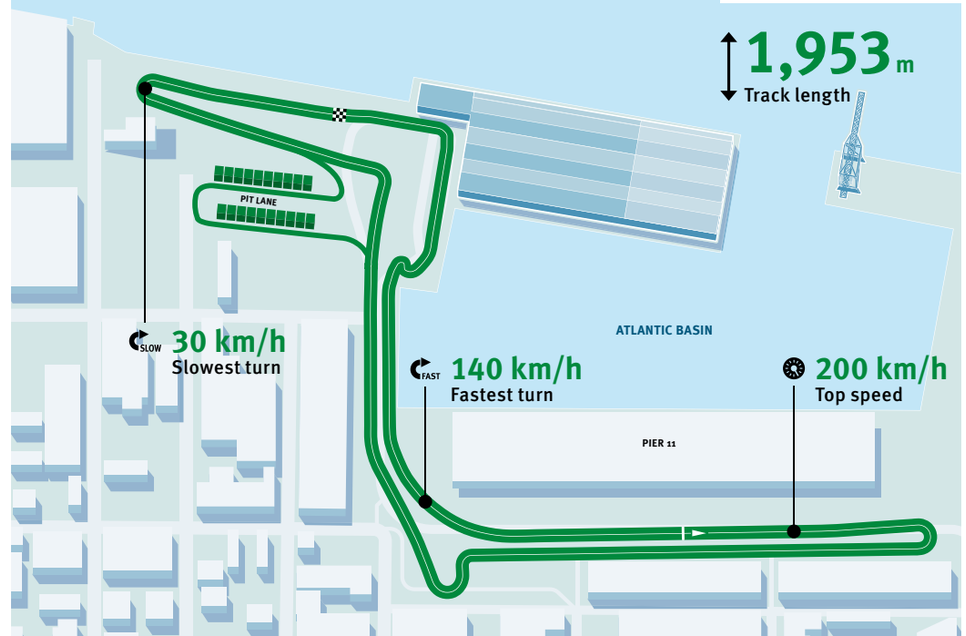
Laps 43
Pole position A. Lynn, 1m 03.296s
Fastest race lap M. Engel, 1m 03.883s
#FanBoost D. Abt, J. Vergne, L. di Grassi

Race 2

P	Driver	Time
1	S. Bird (GB)	58m 09.388s
2	F. Rosenqvist (S)	+11.381s
3	N. Heidfeld (D)	+12.319s
4	P. Gasly (F)	+12.355s
5	L. di Grassi (BR)	+23.451s
6	N. Prost (F)	+30.470s
7	T. Dillmann (F)	+41.862s
8	J. Vergne (F)	+52.292s
9	R. Frijns (NL)	+1m 00.475s
10	J. D’Ambrosio (B)	+1m 12.659s

Laps 49
Pole position S. Bird, 1m 02.285s
Fastest race lap D. Abt, 1m 03.898s
#FanBoost N. Heidfeld, D. Abt, L. di Grassi

Brooklyn Circuit



Scenic setting A view of Montreal's skyline across the Saint Lawrence River. Formula E stages its races in the heart of the city, not on the Formula 1 circuit on its outskirts

Ready for the *future*

In terms of urban mobility, Montreal, in addition to exemplary public transportation, has a plan to promote electric vehicles and a well-developed network of bicycle paths

2nd place

In the current "Future of Urban Mobility" index published by Arthur D. Little, Montreal ranks behind New York as North America's second-most advanced city in terms of mobility

1

***Schaeffler has** plant in Canada, in Stratford, while Montreal is home to a distribution partner, Schaeffler Canada Inc.*

With an area of nearly ten million square kilometers, Canada is the second-largest country in the world, after Russia. However, being home to only 36.5 million people and having merely two cities with more than one million inhabitants, the North American country is one of the least densely populated nations. For comparison: the United States is a few thousand square kilometers smaller but has ten times as many inhabitants and nine cities with a population of more than one million.

Montreal is regarded as one of Canada's most interesting cities. The French-speaking metropolis is located in the south-west of the province of Quebec on the Île de Montréal. Due to its location on an island, Montreal can only be reached by land via 24 bridges and three tunnels. In urban transit, the subway, Metro Montreal, operated by Société de transport de Montréal (STM), stands out in particular. Seven lines covering a total distance of 69 kilometers provide daily service to 1.1 million passengers, making Metro Montreal the most heavily frequented subway in Canada. An equally well developed bus network complements local public transportation. Daily, 1.4 million commuters use the 197 daytime and 23 nighttime lines of the city. Places in the metropolitan area can be reached on five lines of the suburban "trains de banlieue" system.

In terms of passenger car traffic, Quebec has assumed a pioneering role. The Climate Change Action Plan launched in 2013 provides for a 20-percent reduction of greenhouse gas emissions by 2020 versus 1990. Subsidies to encourage the use of electric vehicles, among other things, are to help achieve this aim. The government has appropriated 420 million dollars for this purpose, targeting the number of fully electric and plug-in-hybrid vehicles to have reached 100,000 within the space of three years and as many as 300,000 by 2026.

A paradise for bikes

Passenger car or local public transportation – in most big cities, people have only this limited choice to get from A to B. In Montreal, though, there's another viable option: the bicycle. In the "Copenhagenize Bicycle-friendly Cities" index, Montreal has been ranking in the top 20 for many years without fail. Since 2009, its bicycle path network has been extended from 400 to 750 kilometers. The city is also home to "BIXI Montréal," a continually growing bike rental service. One in two Montreal residents uses a bicycle at least once a week, according to the "Vélo Quebec" non-profit organization. ■

R 11 **R 12**

July 29/30, 2017 *Montreal*

Dreams *fulfilled*

Exciting races, pure drama, happy end for the ABT Schaeffler Audi Sport team and Lucas di Grassi – the final of the 2016/2017 Formula E season proves to be one hundred percent worthy of the name. Arriving with a deficit of ten points, di Grassi turns the tables in his favor. On Saturday the first bang: pole position for the Brazilian, while his title rival Sébastien Buemi only starts from twelfth place. Thanks to a comfortable lights to flag victory, di Grassi scores 25 points and takes the lead in the standings. In the twelfth and final race of the season a seventh place is enough for him to secure the championship spoils. In the final analysis, di Grassi's lead over Buemi is 24 points. As a result, to win the title the ABT Schaeffler driver can even do without the 22 points from New York. Team mate Daniel Abt also impresses with fourth and sixth positions in Canada. ■

20

The number of times – and therefore the most frequent of all Formula E drivers – Lucas di Grassi stood on the podium. This corresponds to a rate of 60 percent in 33 race starts

"Thanks to everybody: family, friends, team and partners. I think it was my best season so far with great battles and races"

#66 Daniel Abt

"We had three fabulous years packed with emotions and unforgettable moments – with this title a dream now comes true"

#11 Lucas di Grassi

Race 1

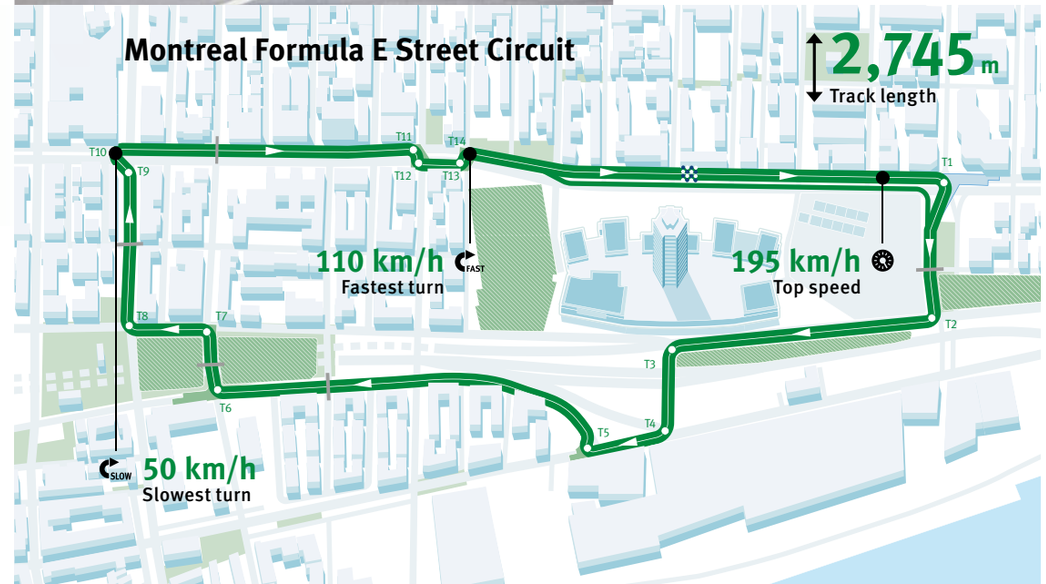
P	Driver	Time
1	L. di Grassi (BR)	56m 55.592s
2	J. Vergne (F)	+0.350s
3	S. Sarrazin (F)	+7.869s
4	D. Abt (D)	+8.592s
5	S. Bird (GB)	+8.913s
6	N. Prost (F)	+10.058s
7	M. Evans (NZ)	+10.457s
8	R. Frijns (NL)	+15.836s
9	F. Rosenqvist (S)	+16.764s
10	T. Dillmann (F)	+19.320s

Laps 35
Pole position L. di Grassi, 1m 22.869s
Fastest race lap L. Duval, 1m 24.536s
#FanBoost L. di Grassi, J. Vergne, S. Buemi

Race 2

P	Driver	Time
1	J. Vergne (F)	54m 12.606s
2	F. Rosenqvist (S)	+0.896s
3	J. Lopez (RA)	+4.468s
4	S. Bird (GB)	+7.114s
5	N. Heidfeld (D)	+21.933s
6	D. Abt (D)	+24.444s
7	L. di Grassi (BR)	+24.855s
8	S. Sarrazin (F)	+26.038s
9	J. D'Ambrosio (B)	+28.282s
10	T. Dillmann (F)	+28.591s

Laps 37
Pole position F. Rosenqvist, 1m 22.344s
Fastest race lap N. Prost, 1m 23.444s
#FanBoost L. di Grassi, D. Abt, S. Buemi



Eternal ice? Formula E made a strong and spectacular statement in Greenland against global warming

> **“I was shocked to see how the landscape changes through global warming”**
>
> **Lucas di Grassi**
> Formula E champion in the ABT Schaeffler Audi Sport team (right) together with Formula E CEO Alejandro Agag

Unknown territory The Formula E car is lowered onto the glacier

Spectacular statement against climate change

In an unparalleled event, Formula E, Schaeffler and Lucas di Grassi have made a strong statement against global warming. In his Formula E car, the Brazilian turned laps on a glacier in Greenland

“Global warming is an issue that affects us all. The electric mobility can and will continue to play an important role against climate change in the future,” says Schaeffler’s CTO, Prof. Peter Gutzmer. “We regard Formula E with its innovations and new ideas as a driving force for mobility of the future and hence we were pleased to support this spectacular event.”

In conjunction with the Greenland government and environmental activists as well as teaming up with other partners such the Monegasque Prince Albert Foundation and the University of Southampton, the event required careful planning so that it could be implemented with the least possible input. Stunning images have attracted huge interest worldwide with around three million visitors on YouTube alone. The images also provided footage for a 48-minute documentary which was premiered on the occasion of the international climate change conference held in Marrakesh at the same time as the ePrix.

Global warming challenge

“The Greenland region is such a peaceful place. I was shocked to see how the landscape changes through global warming,” says Lucas di Grassi. “This experience gives me a completely new understanding of the challenge we face and what Formula E can contribute.” ■

#ProjectIce

Let’s talk about *tech*

How does the battery work, why is data analysis so important? What are the buttons for on the steering wheel? In the series “Tech Talk” ABT Schaeffler Audi Sport gives answers and a look behind the scenes of Formula E and the team

Basics

Philosophy, regulations and changes for the 2016/2017 season

#What makes Formula E so special?
Formula E is the world's first all-electric motor racing series. Its objective is to demonstrate the potential of sustainable mobility. With the competitive spirit inherent to engineers, teams and drivers in motorsport, sustainable and ambitious racing is contested in major cities around the world witnessed by a wide public. Based on a race car that was designed by renowned racing companies such as Dallara, Williams, McLaren and Michelin for the 2014/2015 debut season, the technical scope for development afforded to teams, suppliers and manufacturers has gradually expanded each season.

#What are the basics?
Formula E races are contested on specially designed street courses in some of the world's biggest cities. Visitors are treated to an extremely entertaining support program, which brings them closer to the drivers and their vehicles, for instance in the eVillage of the paddock, than has been the case until now in traditional motor racing. Currently, about halfway into the race the drivers switch to a second race car with a fully charged battery. In both halves of the race competitors must not only pay attention to turning the fastest lap times, but also watch energy consumption. For the race, each car has 170 kW of power (ca. 231 hp) and 28 kWh of energy available. In free practice and qualifying 200 kW (272 hp) is permitted.

#What is FanBoost?
Formula E fans can vote for their favorite driver via the social media platforms Twitter and Instagram, in the Formula E app and on the Formula E homepage www.fiaformulae.com, "earning" the race drivers an additional power boost in the second half of the race. The three drivers with the most votes receive an extra 30 kW, which they can call up individually at the press of a button. Votes can be cast until six minutes into the race. FanBoost is without equal in worldwide motor racing.

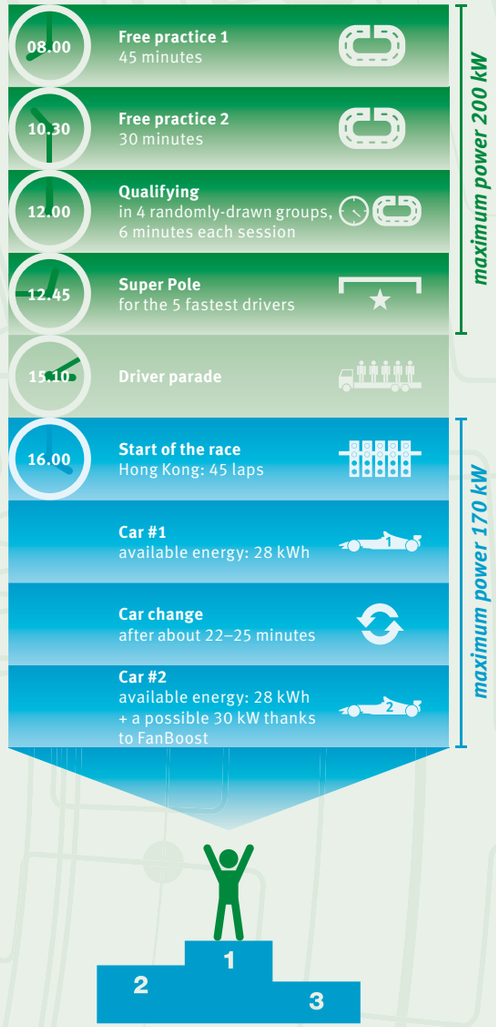
#Why is Schaeffler involved in the FIA Formula E series?
Formula E is the perfect platform for the worldwide technology group, Schaeffler. Prof. Peter Gutzmer, as Schaeffler's Chief Technology Officer responsible for the Formula E campaign, says: "Electric mobility as a whole, which includes hybrid solutions and electric driving, will largely determine the future of mobility, especially in the world's big cities. For years, Schaeffler has supplied innovative technologies, products and concepts towards mobility for tomorrow. For us, Formula E is a key commitment and is ideal for our company and our engineers."

#What is Schaeffler's role with ABT Schaeffler Audi Sport?
Schaeffler and ABT Sportsline are responsible for the development of the entire powertrain – namely, the electric motor and transmission with the rear suspension including software and wiring. For the inaugural season, the entire grid fielded identical cars. In season two, the governing body gave teams the freedom to individually configure and develop their own powertrains. This is precisely the field in which Schaeffler's technological expertise can be utilized in the ABT Schaeffler Audi Sport team.

#How does the future of Formula E look?
A key factor for Schaeffler's involvement in Formula E is the long-term, sustainable strategy of the FIA World Automobile Association. Right now, Formula E is the ideal platform for research and development at Schaeffler. The ongoing latitude, details of which have already been approved for season five such as an increased power output of 250 kW in practice and 200 kW in the race, provides clearly defined objectives. Sustainability, another important topic for Schaeffler, is also defined in this roadmap. It is the guiding principle towards an ecologically balanced footprint in Formula E with solutions for an automotive future based on renewable energy.

#What's new in the 2016/2017 season?
A new front wing … 150 kW instead of 100 kW energy recovery, thus 50% more recuperation via a mechanical brake in the electric motor … new and lighter control tires from Michelin which offer more energy efficiency in the rolling resistance and heat up faster … only one extra point for the fastest lap (instead of two) … Roborace, a demonstration of completely autonomous race cars … Jaguar joins the Formula E action. ■

Race day



Electric powertrains

High Voltage

Electrifying world class motorsport

#What makes Formula E as a racing series with electric drive so special?

It is the first professional global racing series that exclusively uses electric drive. As a result, the races can take place in the city centers of large metropolises, for which racing series using combustion engines would not be granted a permit.

#How does a battery work?

Atoms consist of neutrons and positively charged protons in the nucleus. The outer shell of the atom consists of negatively charged, orbiting electrons. By means of a chemical reaction, a deficiency of electrons is produced at the positive pole of a battery, and an excess at the negative pole. This state, called voltage and measured in volts, does not "please" the nucleaus of the atom, the ion or the electrons. The electrons begin to move from the minus pole to the positive pole in order to restore a balance a current starts to flow. The more the electrons move, the stronger the current, which is measured in amps. On the positive pole, electrons are always cleared away so that the voltage is maintained. A depleted battery loses voltage and, as a result, will not work anymore.

#What kind of batteries are used?

They are produced by Williams Advanced Engineering (WAE), a sister company of the Williams Grand Prix Formula 1 racing team. Lithium-ion batteries are being used, just like conventional smartphone batteries – but with an elaborate cooling system for each individual cell. For comparison: the pure lithium-ion cells of the Formula E battery weigh 200 kg (total battery 320 kg), which corresponds to the batteries in 300 laptops or 4,000 smartphones. The resultant engine performance in Formula E is limited to 200 kW (272 hp) in the qualifying, while a maximum of 170 kW (231 hp) is currently allowed in the race. The maximum voltage of the battery is about 700 volts, the usable energy is limited to 28 kWh. A very simple comparison: 280 individual 100 watt incandescent bulbs can be illuminated with the amount of energy in the battery of a fully charged Formula E race car for one hour. Or you could drive with this on a usual motorcycle with 28 kW power (equivalent to about 38 hp) for exactly one hour at "full throttle." Compared to gasoline, this corresponds to the energy volume of about three liters. The greatest challenges in the design of the Formula E batteries are their cooling, durability and robustness for use in racing cars that are exposed to many forces. In addition, Williams must ensure that equality of opportunity is ensured by "equal" batteries for all drivers at all times. In two years' time (2018/2019), McLaren Applied Technologies, a sister company of the F1 racing team McLaren, will supply the new generation of batteries. These are supposed to provide twice as much energy with the same dimensions and thus make the usual vehicle change in the middle of the race obsolete.

#How are the batteries charged?

In line with the philosophy of Formula E, to see electric mobility as an essential step towards a more environmentally conscious and sustainable use of energy on our planet, the energy for race cars on the race track comes from a sustainable source of energy. This is achieved by the British company Aquafuel Research Ltd., which has modified conventional diesel generators to be transported in containers to the races around the world and deliver the electricity for the 40 racing cars with virtually zero-emission glycerol as the source of energy. Aquafuel has a patent on this principle. In fact, it has been shown that the transparent and tasteless glycerin not only protects the generators better, but also burns more efficiently. The battery of a Formula E racing car is fully charged in this way within roughly 45 minutes.

#Is there energy recovery?

Yes, the motor in the back can also be used as a generator. Now 150 kW of energy recovery is possible – up to now it was 100 kW. A strategic tool that drivers can use with an intelligent driving style.

#Which kinds of electric drives are available in Formula E?

As the exclusive technology partner, Schaeffler developed the powertrain for the ABT Schaeffler FE02 together with ABT Sportsline. The ten Formula E teams have opted for different solutions. ABT Schaeffler Audi Sport combines an electric motor with a three-speed transmission. However, there are also teams that use only one or two gears and thus two electric motors or a "larger" one.

#Is Schaeffler researching and developing other electromobile drives?

With more than 85,000 employees in 50 countries worldwide, Schaeffler is one of the world's leading companies in drive technology. Electromobility includes purely electric driving as well as hybrid solutions as a combination of two drive technologies. Schaeffler, with a wide product range, offers a large variety of solutions for the automotive industry, ranging from micro hybrid (12 volts), mild hybrid (48 volts) to high-voltage (›200 volts) concepts in the form of full or high-voltage plug-in hybrids and range-extender variants.

This is how it works ...

An electric motor

The electrical energy of the battery is converted into mechanical energy to power the rear wheels via drive shafts. While there are different types of electric motors, they all use power from a magnetic field. The rotor and/or stator are fed with electric current, which generates this magnetic field. Now the current in the stator is always switched precisely in a way that causes its magnetic field with the North and South Poles to behave in exact opposition to the rotor's magnetic field, thus repelling the stator – and causing the rotor to turn a little farther. Afterwards, plus and minus on the rotor are reversed, and the rotor and stator repel once more. A major difference in the drivability of electric motors versus internal combustion engines lies in their torque characteristics. An electric motor always delivers full torque immediately when starting from rest – which is one reason why particularly starting from rest and accelerating an electric vehicle comes as a pleasant surprise to any rookie. Formula E race cars accelerate from zero to 100 km/h in about three seconds.

Sustainability

Motorsport with a clear focus on the *future*

#How is sustainability defined?

Hans Carl von Carlowitz may be regarded as the originator of the term. According to von Carlowitz, a mining administrator, the amount of wood cut in a forest should be limited to that which the forest could naturally regenerate – a maxim he advocated as far back as in the 17th century. The verb "to sustain" means to "keep up or prolong," so in a broader sense, the principle of sustainability ensures that a natural system is preserved for a long time. Applied to present-day political, economic and environmental activities, this translates into striving for conditions in which future generations will not be disadvantaged in fulfilling their needs compared to those living today. Based on this, there are various approaches to defining sustainability, all of which have in common that it is always focused on the present and the future and that resources should be protected – particularly those that are not renewable.[1]

#How does Formula E position itself in terms of sustainability?

Formula E has set itself the goal of being a role model for sustainability and to enhance public awareness of this topic. As the world's first fully electric racing series, it is a pioneer in motorsport. "The future of transport and mobility is electric, autonomous and connected," says Alejandro Agag, the CEO of FIA Formula E. "This is a revolution. Formula E is going to shape the way we are going to drive our cars in the future." Formula E, in a manner of speaking, defines itself as a high-tech laboratory in which world-class international companies drive innovations in concert and in competition with each other in order to accelerate the development and production of clean forward-thinking technology. Formula E's philosophy is "think global and act local." The popularity of Formula E might help boost sales of electric vehicles by an additional 77 million in the next 25 years, according to a study by Ernst & Young.

#What are further aims?

Formula E aims to become the world's first CO_2-neutral racing series. Even at this point, it has received multiple sustainability awards. The 2016 finale in London was certified according to ISO 20121 – the highest standard for sustainability in the events sector. The few large-scale events to have achieved this include the 2012 Olympics in London, the 2016 Olympics in Rio, the French Open tennis tournament and the 2016 UEFA European Championship in France. All races are intended to progressively become certified according to this standard. ■

[1] Sources: www.nachhaltigkeit.info, Wikipedia

Sustainability in Formula E

Sustainability as the central driver and promotion of eco-conscious "mobility for tomorrow" plays a key role in the series' philosophy and, specifically, in the formulation of its Sporting and Technical Regulations. A few examples are listed below:

Calendar of events and logistics
The calendar of events has been designed so that race cars and equipment can be transported to the majority of the venues by truck, train or ship and only to a few of them by aircraft – a responsibility that has been assumed by logistics partner DHL.

Races in the hearts of cities
Formula E events are held on temporary circuits set up in the hearts of major cities. Motorsport comes directly to the spectators and not vice versa. Formula E actively encourages the use of public transportation to attend the races and provides no dedicated parking facilities.

Vehicle development
The regulations provide for further developments to be made by the participating teams, vehicle manufacturers and technology corporations only in areas where this makes sense. As a result, updates of aerodynamics are prohibited and the racing chassis is identical for all teams. Innovations in the area of the powertrain (electric motor, inverter, transmission and control electronics) as well as the cooling system and rear suspension are definitely required and essential to success as well. Battery management and driving style are particularly important factors. This is where the race drivers can play a part as well, plus provide valuable input to the engineers – also for the development of electric powertrains for road-going vehicles.

Energy
The trackside energy for the race cars comes from a sustainable source. Aquafuel Research Ltd., a UK-based company, has modified conventional diesel generators for this purpose so that they supply the electricity for the 40 race cars with near-zero-emission glycerin as the energy source.

Tires
The specification tire has been designed as a hybrid tire, so that it works on both a dry and a wet track. The tires last for the full race day and are subsequently recycled.

Roborace
During the races, evolutions of fully autonomous race cars are created and presented to the spectators.

Catering
Attention is paid to sustainability in catering activities for race personnel and fans as well, the keywords being: local, seasonal, vegetarian, vegan, organic and fair trade.

Post-race activities
Together with its partner Chargemaster Formula E installs ten charging stations for electric vehicles at every venue that remain in the city.

Sustainability at Schaeffler

A vital component of corporate culture

Long-term profitable growth is not possible without a comprehensive commitment to sustainability – that is why sustainability at Schaeffler is important across the entire value chain, including Research and Development, Purchasing, Production, Logistics, Marketing, Sales and Aftersales. With sustainability anchored in its corporate DNA, Schaeffler has been linking its business success with acting responsibly toward the environment, people and society.

Relationship driver — car

Me and my car

All bets on 52!

#What's the car's name?

Daniel Abt doesn't take pleasure in christening a race car: "Especially when the names are those of women. My race cars have never had any names." So, the German's two ABT Schaeffler FE02 are simply called by the chassis numbers assigned to them by their manufacturer, Spark: 34 and 52.

#Is there a favorite car?

"Absolutely, it's clearly 52," says Daniel Abt, laughing, although he can't really explain the reason for his preference. "It feels like this car handles better and it's easier for me to achieve a fast lap in it – even though I obviously know that, actually, both cars are identical." So it's clear that Chassis 52 is also the car Abt drives in qualifying.

#How painful is it so see the beloved 52 being damaged in a crash?

Accidents in one of the practice sessions above all mean one thing: extremely hard work for the mechanics. That's why they're the ones Daniel Abt thinks of first. "One of the first thoughts that cross my mind after a crash goes to my guys in the pits," he says. Especially in Formula E there's extremely little time between the sessions, plus temperatures are often extreme – and in spite of this they pull it off again and again."

#How can a race driver tell that his car is perfectly prepared?

It's not the car itself, but all the stuff going on around it. "When I arrive at the pits I can immediately sense what the story is," says Daniel Abt. If the mechanics and engineers project cool, professional composure, the racing pro knows everything's in top shape. Another good sign: the way the 34 and 52 look. "Even though, of course, it really says nothing: I get good vibrations when the red and the Schaeffler logos shine and sparkle."

#How comfortable is the car? Can you get bruised in it?

Very much so! "A single-seater is never comfortable – especially if you're pretty tall like I am," says Daniel Abt. Elbows and knees always take a beating. "The car change in Formula E is particularly challenging. Although during the race and because of all the adrenaline I don't notice it, I'll always find a sore on my leg at night that I got in the heat of the action."

#Does the relationship between car and driver continue at home?

If it were up to Daniel Abt, it definitely would. "We have a museum in Kempten but, unfortunately, the only one of my cars in it is my Formula Masters winning car." But the youngster wouldn't be happy just looking at the cars anyway: "The coolest thing would be if every car was ready to run and you could drive around the house a little on weekends," dreams Daniel Abt. ■

Car-Hopping

During a Formula E round a car change is mandatory. The reason is that the capacity of the battery – a little more than 28 kilowatt hours – does not yet suffice for a full race. Timing of the car change is up to the teams but for strategic reasons the pit stop stage is usually within a few laps of the race's midpoint. A minimum time from entering and exiting the pit lane is prescribed to ensure that the drivers are perfectly buckled up. Sensors on the harness will be checking this in the future. The seconds in the pits are show time for two mechanics: they take the steering wheel off and put it back on, adjust the harnesses and buckle the driver up again – all within a few seconds. In the battle for tenths on the track, this may decide the race. Front runners in terms of perfectly timed stops: ABT Schaeffler Audi Sport

Steering wheel

Full control

The cockpit “keyboard”

“The steering wheel itself is identical for all teams – however, we can customize the functions of all the controls and the display,” explains the Brazilian. “Every team, and sometimes even every driver, has their own ideas or wishes in this respect.”

A constant eye on energy consumption

Besides the standard functions found on any motorsport steering wheel, there’s one that’s particularly important in Formula E: the one that helps keep an eye on energy consumption. “The display shows us the respective state of charge and we can manually adjust the number of laps in order to have the maximum amount of energy per lap recalculated,” says di Grassi. Another exclusive feature of a Formula E steering wheel: the paddle to activate the FanBoost. ■

Schaeffler on YouTube
Race drivers explain modern motorsport steering wheels

Control center provides guidance

1 Screen change on display
2 Adjustment to remaining laps
3 Activation of selected functions
4 Team radio
5 Transmission neutral
6 Brake settings
7 Adjustment to remaining laps
8 Reverse gear
9 Speed limiter full course yellow
10 Speed limiter pit lane
11 Output adjustment selector
12 Discretionary function
13 Upshifting
14 Activation of FanBoost (additional power)
15 Downshifting
16 Recuperation

Dr. Simon Opel
Director Special Projects Motorsports at Schaeffler

Dr. Opel, can Formula E races be won thanks to the numerous functions on the steering wheel?
Yes, in Mexico, we just witnessed this with Lucas di Grassi’s sensational victory. He switched cars long before the race’s midpoint, which was far too early to have a chance with the energy left in the battery against his rivals who changed later. Clearly, Lucas profited from another safety car period and from another driver who slowed his immediate rivals. But the key to his victory, besides the strategically bold decision to stop early and our very efficient powertrain, was his wealth of experience and sensitive driving style which he optimized using the functions on the steering wheel.

What did he have to do?
Save energy and recuperate as much as possible. And for this he needs the large number of functions and indicators on his high-tech steering wheel. When he normally applies the brake, the interaction between the brake and recuperation is automatically controlled. However, he has two other influencing factors which he can control on the steering wheel. One is that at the end of the race – when the battery gets very warm – he has to readjust the brake balance (rotary control knob 6) *because the intensity of recuperation changes, which means that the braking effect via the recharging of the battery diminishes. The other – and Lucas masters this perfectly – is that he can manually recuperate at any time without braking* (lever 16).

How small was his margin?
The residual energy was just enough for the celebration donuts …

Energy management

Clever saver

Lucas, after your victory in Mexico, you said that this has arguably been the best race in your career. How did you feel being the hunted on so many laps who even had to fear running out of energy in the end?
Well, this wasn't the first time for me to be in a situation like that – the one at the season opener in Hong Kong was similar. However, thanks to our simulations with the team we were really well prepared for any contingency and had a precise strategy. Plus, I managed to drive very, very efficiently, particularly on the last laps. To some extent, my performance even surpassed the computer's optimum simulation. That really surprised us and – as so often in Formula E – we learned something again. Obviously, the team and I were absolutely euphoric when we held the trophy in our hands.

Could you explain what possibilities in terms of energy management you have as a driver in a race?
Driving very efficiently is of paramount importance. In each of my two race cars, I have exactly 28 kilowatt hours of energy available. Assuming that I have to drive 28 laps on this amount before switching cars this means that I can consume exactly one kilowatt hour per lap. So, now I have to get around the circuit on this energy as fast as possible … This includes a sensitive approach to driving because you can drive fast and waste energy in the process or drive fast while making efficient use of this energy. My car provides me with various ways to influence this. Every braking event produces energy which can be used to charge the battery – this is called recuperation. When I brake using the foot pedal part of the energy is automatically recuperated, about ten percent of the entire braking energy. This ten percent is very important because I can directly use it again for acceleration on the next long straight. In addition, I have a lever on the steering wheel that I use for braking strictly via the electric motor and for very efficient recuperation. Good energy management is a successful combination of driving style, vehicle setup and race strategy.

In Formula E, efficient energy management is totally crucial

How can you practice and perfectly prepare for this?
We prepare before the events because in Formula E practice, qualifying and the race all take place on the same day. Computers assist us with the initial basics. And as drivers we then sit in the team's simulator to fine-tune all the details. It may take two or three days or even longer to optimize the suspension and the powertrain setup in terms of energy management for all possible scenarios.

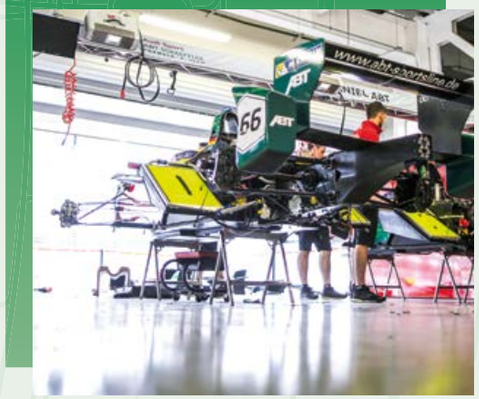
Are your team and your race engineer of any help to you during the race? After all, you have all the data on your display …
They're a big help. During the race, they give me pointers and recommendations precisely for the important items and keep an eye on energy management together with me. This has a major influence on my driving style and the settings I select from the various options on the steering wheel.

As a race driver, doesn't the fact that you have to use energy as efficiently as possible instead of just driving flat-out bother you?
No, it doesn't. Even in conventional race cars – whether they're powered by gasoline or diesel – you only have a limited amount of fuel you can use. This is also the case at Le Mans, for example, where the LMP1 race cars as hybrid vehicles have to efficiently manage a specified amount of electrical energy and fuel energy. And off the race tracks, this applies to personal mobility using road cars as well. We'd like to, and have to, get from A to B as efficiently as possible. In the development of these technologies, Formula E with its regulations and strong focus on energy management is a great help.

This has clarified a lot, but the question remains of how exactly, in this car, you're able to do something that others drivers don't achieve quite as precisely. What's your secret?
If there was one, I'd like to keep it to myself … ■

Efficient powertrain

The development of the highly efficient powertrain in the ABT Schaeffler FE02 is the result of the cooperation between Schaeffler and ABT. The development objectives were to achieve an electric motor delivering high torque and high efficiency in combination with a transmission enabling short shift times for the three gears considered to be the optimum choice. In addition, the development was focused on lightweight design and lowering the center of gravity to the extent possible and on optimum tuning of the power electronics for the interaction of the motor, the transmission, the mechanical and the electric brake via the electric motor (recuperation). Last but not least, system management – i.e. the software – is the key to success in an electric powertrain. Software adjustments are the only modifications the regulations permit during the season.



Data analysis

Chart discussion

The curves displayed on the screen at first glance look like stock charts that sometimes rise briskly, rarely stagnate for long, but frequently drop dramatically. Yet when Daniel Abt and Lucas di Grassi look at these charts the stakes to them are greater than those relating to mundane matters of money. The lines show the steering angle, brake pressure, speed or the position of the "gas" pedal. Plotted in color on a black background, they indicate where the two campaigners of Team ABT Schaeffler Audi Sport either lose or gain time. They can make the difference between victory and defeat.

Wire tapping The data from the car is read after each practice session

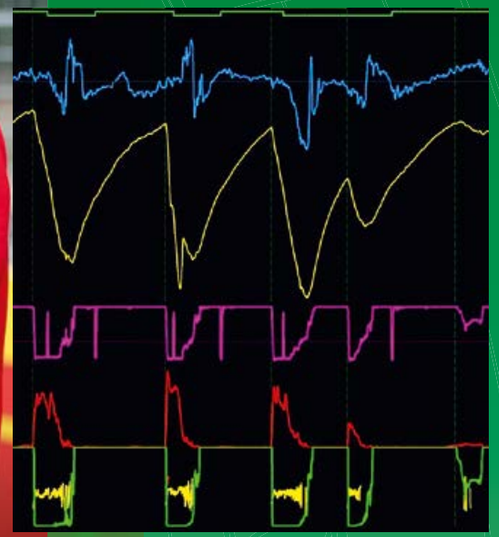
40 megabytes in a race

"We glean about 40 megabytes of data from an entire Formula E race," says system engineer Rui Alves. At that time, though, the data serves only to follow up on the previous and to prepare for the next commitment. "Far more important are the analyses we provide to the drivers between practice sessions," says Alves. For this purpose, the ABT Schaeffler FE02 is quickly connected to a network cable at each pit stop to download the data. The use of telemetry – in other words radio transmission – is only permitted for other readings such as battery temperature.

Projecting the charts either on a laptop screen or plotting them in a printout takes about ten minutes. "Even a quick first glance at the data shows if any major issues like severe over- or understeer occurred," says Alves. In the next step, Daniel and Lucas's best laps are visually superimposed – this allows the drivers to immediately see where their team mate accelerates earlier, brakes later or drives a different line.

"Particularly due to the short time we have on track in Formula E, taking a look at the data is worth a mint," says Daniel Abt and Lucas di Grassi confirms: "Sometimes you're a little lost on a new race track. That's when a direct comparison and a "best of" from our database often help you return to the racing line quickly." ■

This is what the lines mean



The uppermost, green curve shows the respective gear used.

The blue curve shows the steering angle. The greater the upward slope, the more the driver steers to the right, the greater the downward slope, the larger is the steering angle to the left.

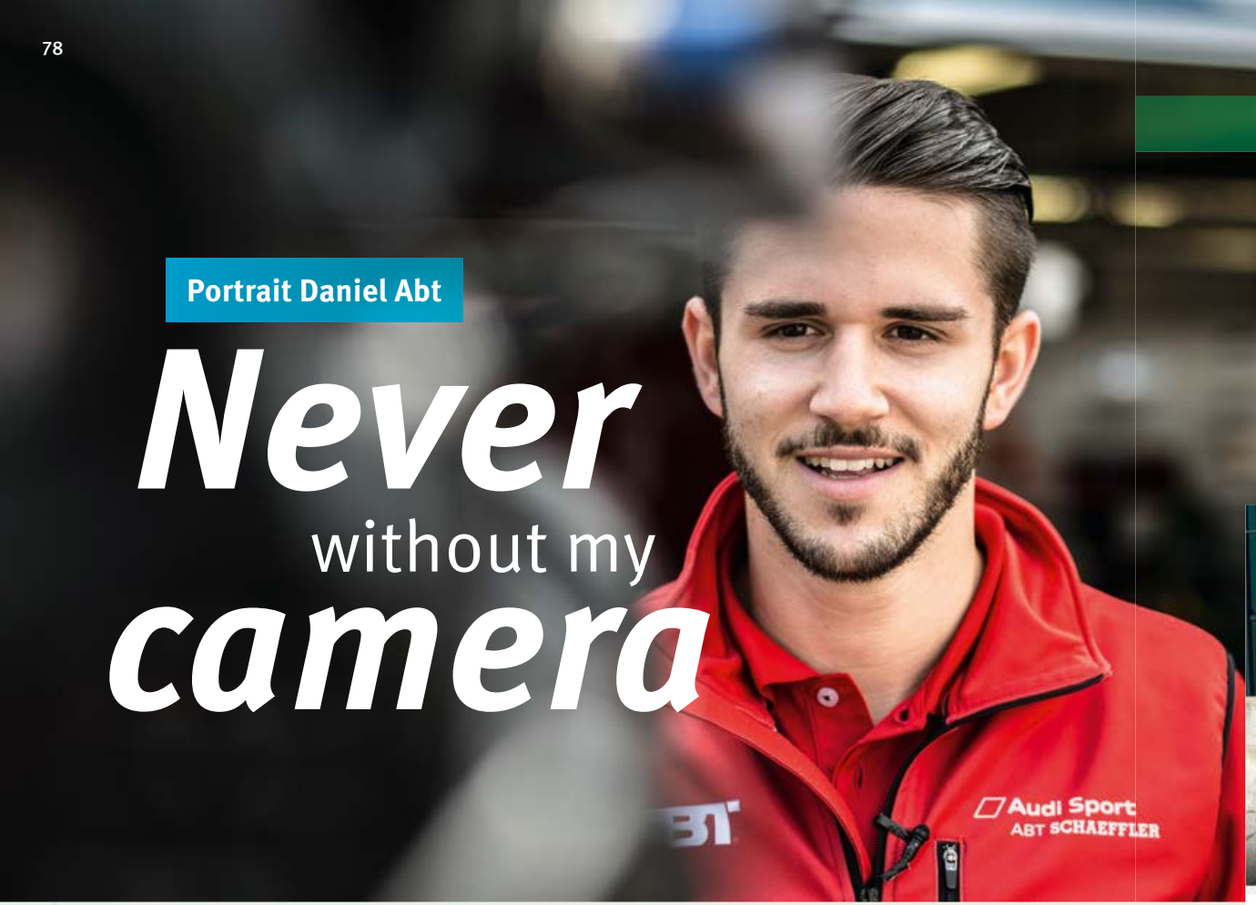
The most important curve: it plots the speed. The greater the upward slope, the faster the car is running.

This curve shows the electric motor's power output. When the curve peaks it reflects maximum output of 200 kW, while the valleys show that energy is being recuperated.

This curve plots brake pressure. When the car is running faster, the driver is able to make heavier use of the brake, as more downforce is being generated and the wheels will not lock as fast. When the driver brakes on entering a turn, brake force decreases.

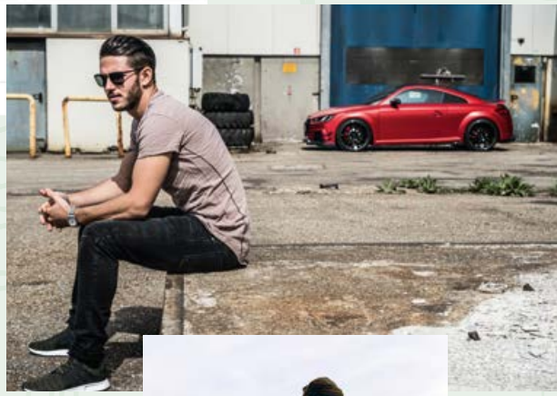
The green curve shows the position of the "gas" pedal. On the largest part of the track, the driver runs flat-out. When the slope of the curve hits rock bottom the driver is coasting to save energy.

This is where brake force distribution to the two brake circuits is depicted. Either the front or the rear one is subjected to a greater load, depending on the direction of the slope.



Portrait Daniel Abt

Never without my camera



Home

For sure, it's where my family and friends are and that means it's not necessarily tied to a particular place. For me, home is where the people are that are important to me. And in my case, that happens to be the Allgäu region – even if I wouldn't mind a different place … *(laughs)*

Friends

For me, the most important thing in life – and I can really get sentimental about that – is being surrounded by really good, close friends. People you can confide in, with whom you can have fun and who are there when things aren't going so well for a change. I think that's something we're all looking for. And I'm really happy to have a few good guys around me …

Always packed in my suitcase

Clearly: my camera! What used to be just a hobby has since turned into a lot more. Now I wouldn't call my YouTube channel my second line of work, but we take it seriously and we're working on it very professionally. I just enjoy taking my followers with me behind the scenes – by the way on Instagram and Snapchat, too. All these projects were inspired by the fact that there is so much more to show than what can be seen on TV. So we can bring people everywhere closer to to the action around the clock and I can share my thoughts with them directly. This is more intense and personal than a "normal" television interview.

My favorite tech toy

High on my list is my new drone, although I don't actually use it every day. My MacBook and my Sony PlayStation are even higher on my list.

From Formula E, this is what I'd like to have in my road car

In Formula E, we're currently showing how sporty electric power can be. Four of our e-motors – one on each wheel – that would be great.

From a road car, this is what I'd like in a Formula E race car

An air conditioning system would be nice now and then. In some races it gets extremely hot in the car.

In terms "mobility for tomorrow," what should Schaeffler invent in this pursuit?

A fully automatic drone that would conveniently fly you to any destination on Earth – that would be a great invention. ■

Portrait Lucas di Grassi

Heavily energized

Home

To me, means being with my family and friends – no matter where.

Why only yellow cars of the Audi brand?

At the moment, they're all yellow. The R8 was originally black, but I had it wrapped. The next RS 6 will be green. The idea behind it: my Brazilian helmet colors.

Toys with electric motors

I've got four or five electric bicycles, plus electric skateboards and hoverboards, and two e-scooters. I'm also developing an e-bike together with partners in Brazil. I'm highly interested in micromobility, just like in artificial intelligence in self-driving cars. I'd like to stay up to speed in these technologies and understand how quality can be improved. I'm involved in Formula E's Roborace project as well.

Is electric mobility underrated?

Not underrated. People are now quickly starting to understand what it's all about. It's a little like in the early days of television. Everyone knew it would become a big thing, but it takes time for a large number of people to change their ways. Fear plays a part in this. You ask yourself: "Is this really better?" But electric mobility will catch on much faster than predicted. Take Formula E for example: I've been involved in it for five years. At first, nobody, for even a second, believed in races with electric cars.

Best Formula E moment

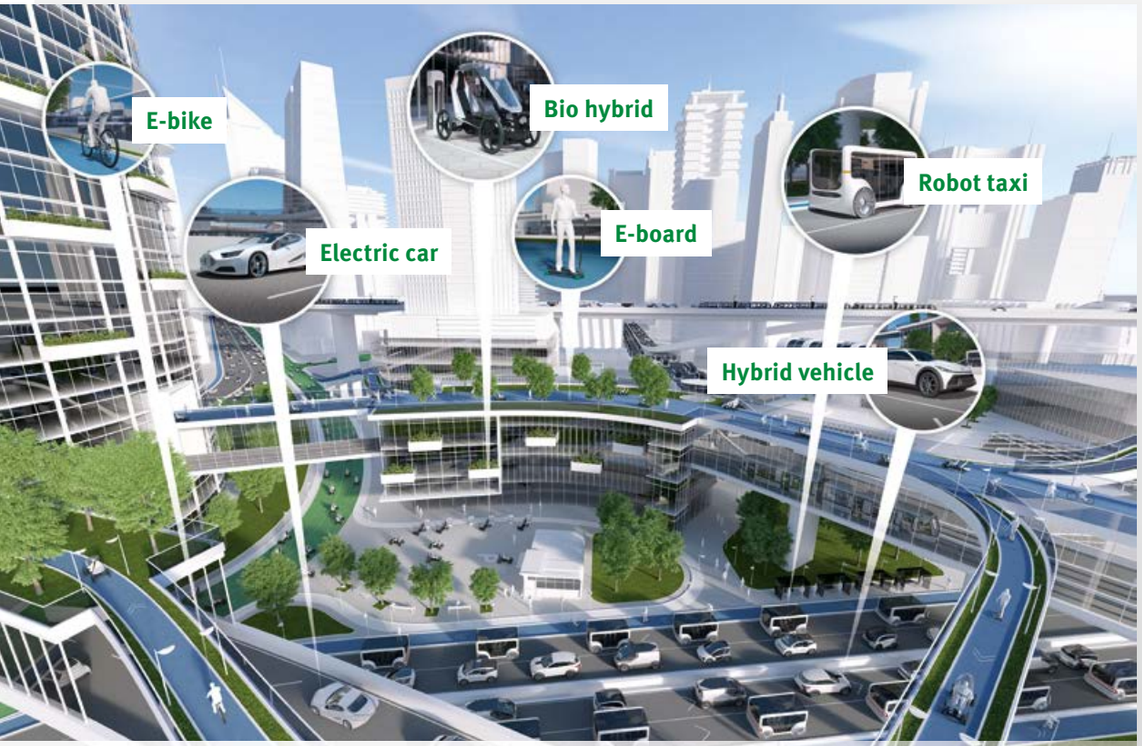
There've been quite a few. Mexico was great: in last place twice in the race and then winning it in the end. My pole in Berlin with a broken leg and an advantage of a thousandth was special, too – even though I didn't know at the time that it was a fracture.

If not a racer, what would you be?

I don't race and then go to the beach. I race, earn money with it and then invest it. So, I'd either be an entrepreneur or an engineer or an inventor. I'm a guy who always seeks competition. I can't lose. That makes me better as a racer and would probably be my character in any other line of work, too. Ultimately, what matters in any of these areas is being the best, being surrounded by the best people and extracting the most out of yourself and your projects. That also distinguishes them from the world of art where everything is subjective. So, I'd never have become an artist.

Talking about "mobility for tomorrow," what should Schaeffler invent for it?

Well in that case, I'd like to have a very efficient hybrid airplane that could fly autonomously or semi-autonomously. ■



Race track ››› Road

An electric circuit

Motorsport has always been a driver of developments that subsequently make their way into production vehicles. This now applies to electrified powertrains as well. In the FIA World Endurance Championship (WEC) with Le Mans as its highlight, high-tech hybrid race cars are pitted against each other and in Formula E, all-electric single-seaters are. For Schaeffler, both racing series have become pioneering test beds for future technologies

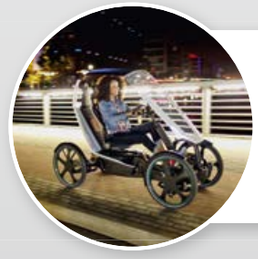
"The commitments in the WEC and in Formula E have been helping us gain a better understanding of the environment and systems of electric mobility," explains Prof. Peter Gutzmer, Schaeffler's Chief Technology Officer. Be it in terms of systems knowledge, the development of new materials, recuperation (recovery of braking energy) or thermal management – these are important findings which also advance the Schaeffler technology group aside from racing with respect to ideas, visions and technologies for networked mobility for tomorrow. Schaeffler has significantly increased the size of its development team for electric vehicle components and new mobility concepts within a short period of time and is working at full stretch on sustainable mobility solutions. Six examples ... ■

E-bike

On bicycle expressways, powerful pedelecs – with Schaeffler hardware and software on board – provide a particularly fast and eco-friendly means of transportation for shorter distances. Branded as SCHAEFFLER VELOSOLUTIONS, the company offers an extensive and innovative product range.
See also: ***www.schaeffler-velosolutions.com***

Electric car

Schaeffler's electric axles (pictured) help make traffic noise in inner cities a thing of the past, moving forward with a wide product range from Herzogenaurach. In this context, Schaeffler has developed an innovative modular system for electric axles in various configurations and build levels.



Bio hybrid

The innovative and compact mobility solution for urban areas not only provides weather protection but, featuring four wheels including an electric pedelec drive, high driving stability and ample stowage space. In spring of 2016, Schaeffler unveiled this design and development concept that met with positive response around the globe.

E-board

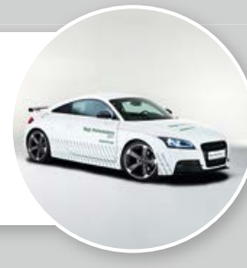
In addition to its handy dimensions, this ideal means of transportation for short distances in urban areas boasts hydraulic brakes and a range of 25 kilometers. At CES in Las Vegas in January 2017, Schaeffler showcased this prototype. Integrated in the board is a battery that drives the rear axle via an electric motor. The e-board is controlled using a stick with an ergonomically shaped handle.

Robot taxi

Self-driving buses with integrated wheel hub motors (pictured) from Schaeffler could provide a means of demand-based zero-emissions short-range public transportation in the future. All the drive components except for the battery are completely installed in the wheel. They include the electric motor, power electronics, the brake and the cooling system. eWheelDrive makes all-new drive concepts possible.

Hybrid vehicle

Hybrid components will continue to make conventional IC engine based powertrains more efficient. Schaeffler offers solutions across the entire range of electrification potential – from the 48-volt hybrid to the plug-in hybrid for various mounting positions to all-electric axles that assist the IC engine or serve as the sole short-term source of propulsion.



1899 Electrifying beginnings

The car picks up speed. ***The first car to exceed 100 km/h:*** *the electric race car "La Jamais Contente" made by Camille Jenatzy. That was 1899, the same year that the Baker Motor Vehicle Company began to build electric cars. Fully electric or hybrid drive from Ferdinand Porsche for the Lohner electric vehicle. The same idea with the Mercedes Eléctrique and Mercedes Mixte. Up to 1939, Detroit Electric models with more than a 100-kilometer driving range. Around the turn of the century there were* ***more electric cars on the road than combustion ones.*** *Only with the improvement of performance, range and gas station networks do petrol-powered vehicles take over.*

1972 The limits to growth

Electric mobility means drive from a fixed electricity supply – trams, trains, trolley buses. But gasoline-power comes under pressure. The 1972 Club of Rome "limits to growth": finiteness of resources. ***1974 oil crisis.*** *The industry responds with* ***rudimentary electric drives:*** *a BMW 1602 for the 1972 Olympics only has 32 kW (43.5 hp). In fleet tests, the electric transporters from Mercedes and VW, equipped with the batteries that were still very heavy in those days and with a capacity of approx. 22 kilowatt hours, merely had a range of 60 to 80 kilometers. And the electric models of Opel, Mercedes and VW in a large-scale project on the German island of Rügen are based on existing cars. This is the wrong path.*

Fast *currents*

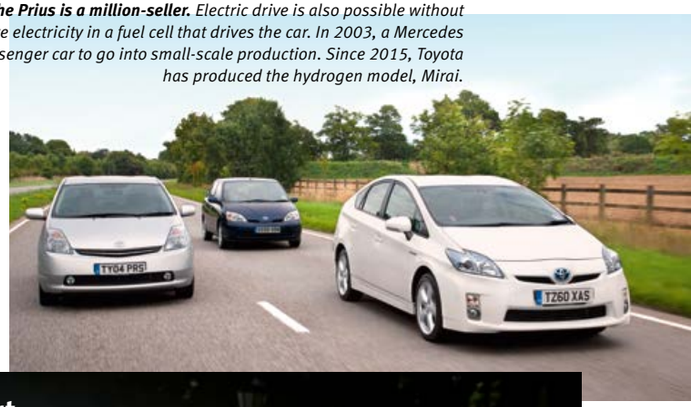
From the early alternative via public transport and back into the automobile: electric cars have enjoyed a rapid history spanning more than 100 years and are only now coming of age

1996 Tailored for the future

Two things are needed: 1) A paradigm shift. In 1996, General Motors is the first major manufacturer to offer a car specifically designed for electric drive. Around 1,100 units of the EV1 are produced. Its cw value: 0.19. It reaches 130 km/h with a range of around 250 km using 26.4 kWh from a nickel-metal hydride battery. 2) A technological leap, based on ***lithium-ion batteries from Sony.*** *With these batteries,* ***Tesla joins*** *the car industry in 2008 with a roadster; 200 km/h top speed, 350-kilometer range. In Japan, the Mitsubishi i-MiEV has been rolling off the assembly line since 2009. Today, there are many electric cars, and Schaeffler is a sought-after partner.*

1997 Attractive alternatives?

The bridging solution comes from the ***hybrid drive*** *using the combustion engine and electricity. Toyota makes the breakthrough in 1997:* ***the Prius is a million-seller.*** *Electric drive is also possible without a battery: hydrogen and oxygen generate electricity in a fuel cell that drives the car. In 2003, a Mercedes A-class F-Cell is the world's first fuel cell passenger car to go into small-scale production. Since 2015, Toyota has produced the hydrogen model, Mirai.*



2009 Motorsport

The milestones of electric mobility in racing: in July 2009, the first victory for a McLaren-Mercedes with hybrid drive in Formula 1. In June 2012, the first Audi win with diesel-electric drive at Le Mans. ***In September 2014, FIA Formula E is launched as the first race series with electric drive. Schaeffler is one of the pioneers with the ABT Schaeffler Audi Sport team.*** *June 2015 heralds the first overall victory of Rhys Millen's electric race car against petrol-powered vehicles at Pikes Peak. September 2016: world record for electric drive by Venturi with 549 km/h in Bonneville.*

Mobility *for tomorrow*

For Schaeffler, innovation has been part of its corporate DNA since the foundation of the company. It is based on lateral and interdisciplinary thinking

Schaeffler is known as an innovative leader delivering a wealth of technologies that make automobiles more fuel-efficient, environmentally friendly, and safer, as well as products for trains, aircraft, wind turbines, and many other industrial sectors. Schaeffler can be found wherever things are in motion – and motion also means mobility. The challenges facing mobility of the future are immense. That's why Schaeffler is committed to its holistic "mobility for tomorrow" concept, geared to finding sustainable solutions for the world of tomorrow. ■

Mobility for tomorrow Under this concept, Schaeffler concentrates on four focus areas: environmentally friendly drive systems, urban mobility, interurban mobility and energy chain

ABT Schaeffler Audi Sport

Three seasons in Formula E

1 *drivers' title*

16 *cities*

5 *continents*

33 *races*

6 *wins*

24 *trophies*

3 *fastest race laps*

4 *pole positions*

258 *laps led*

634 *points*

2,369 *racing laps*

15 *races led*

5,585 *racing kilometers*

28 *#FanBoost*

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