tomorrow

EXPERIENCING TECHNOLOGY WITH SCHAEFFLER

Magnetic metropolis

The quest for fortune in megacities around the world

Pleasant prospects

High tech turns crowded cities into attractive places to live

Issue 2/2018 · Urbanization

SCHAEFFLER

DEAR **READER,**

Get on board and join us on a city tour with the current issue of our technology magazine “tomorrow.” It will take you around the globe on 116 pages. From Mexico City via Washington and Paris to Singapore and on to Tokyo. All of these places are metropolises that keep growing, growing, growing. That is why urbanization is not just the focus topic of this magazine but one that has implications for all people on our planet. By 2050, 70 percent of the world population will be living in cities, according to a UN forecast. An incredible number. And 90 percent of urban growth will happen in Asia and Africa.

In China, Chongqing and its surroundings already cover an area the size of Austria and are home to nearly 30 million people. The planned Jing-Jin-Ji metropolitan region which is to be created by Beijing, Tianjin and the Hebei province growing together in an area of 216,000 square kilometers (83,400 square miles) will be nearly as large as Austria, Hungary and Slovakia combined. 130 million people will be living there. Like people anywhere in the world, they want to be provided for, mobile and comfortable – in ways that are as eco-friendly as possible. Cities like Vienna, Zurich and Auckland are examples of how to accomplish this. These three big cities are supposed to have the highest quality of life in the world, according to a survey. In our big city ranking (starting on page 20) you can look up the richest, safest, most expensive or even dirtiest cities.

That the world has become a city, as the U.S. historian Lewis Mumford wrote in 1961, is the result of a development that began more than 20,000 years ago. That’s how old a fishing village is that Israeli archaeologists discovered near the Sea of Galilee. Locations near water have always been advantageous and a reason why many cities are where they are (read more about the topic of historic urban development in our rubric “in motion” starting on page 34).

For Schaeffler, urbanization, alongside climate change, globalization and digitalization, is one of the four mega trends that will determine the way we’re going to live tomorrow – with respect to technology, society and business. These four mega trends are closely interlinked. And they represent both challenges and opportunities – provided these trends are systematically addressed today. At Schaeffler, we are addressing them. In several of the 20 initiatives of our forward-thinking “Agenda 4 plus One“ program, urbanization plays a key role – be it with respect to modern workplaces, processes and production sites, logistics, IT or sustainability. Our “E-Mobility” initiative in particular ties in with urbanization, focused also on our research and development center for urban mobility in Singapore. Starting on page 14, you can find out what kind of research and development we conduct there and why Singapore is especially well suited for this purpose. Schaeffler has developed two environmentally friendly vehicle concepts – the Bio-Hybrid and the self-driving Mover – for urban areas. Thanks to their modular design they can be used for both local passenger transportation (more on this topic starting on page 88) and logistics supplying the people in modern metropolises (starting on page 98) with goods. We developed these two vehicles with a lot of passion based on many years of expertise. They’re part of our response to the question of how mobility for tomorrow can function in an urban environment.

I’m delighted that you’re taking the time again to experience technology with Schaeffler and hope you’ll enjoy the read of our latest issue of “tomorrow.”

Klaus Rosenfeld
Chief Executive Officer

Ur|ban|iza|tion [ɜːbənəˈzeɪʃən]

The process whereby a society changes from a rural to an urban way of life. It refers also to the gradual increase in the proportion of people living in urban areas.

Source: U.S. National Library of Medicine

global
A glimpse of the world

in motion
Innovations in the course of time

here and now
Living with progress

outlook
Technology for tomorrow

global

A glimpse of the world

» The best time to plant a tree was twenty years ago. The next-best time is now African proverb

GREENER **LIVING**

No question: Urbanites are fond of green surroundings too. For good reason: Finnish scientists have found out that even a ten-minute break in a park clearly reduces a person's stress level. And there's another thing that green spaces reduce: air pollution. A study conducted in the U.S. metropolis Atlanta found that the city's trees filter 9.5 million kilograms (209.4 million pounds) of particulate matter out of the air per year – and of course vast amounts of carbon dioxide. Urban children playing a lot in green spaces, scientists found out as well, have better hand-eye coordination, better learning behavior, greater emotional stability and better concentration. So urban flora is worth a lot – literally speaking. The estimated value of London's green spaces, for example, accounting for a fifth of the urban area, is 100 billion euros. As urban land has always been at a premium, cities, particularly in Asia and Southern Europe, were densified at the expense of green spaces. But where there are buildings there are facades, balconies and roofs that can be "greened." The terraces of the Bosco Verticale twin towers in Milan are planted with 800 trees, 5,000 bushes and 14,000 other plants. On the Tree Tower in Singapore – the name suggests it – 25,000 square meters (269,000 square feet) are planted with greenery. At the Musée du quai Branly in Paris, the "Green Wall" shown here even became a work of art. Urban gardening has evolved into a true global trend now being followed by the next one: urban farming. Fraunhofer Institute for Environmental, Safety and Energy Technology has calculated that on a roof area of 1,000 square meters (10,763.9 square feet) about 45 metric tons (49.6 short tons) of fresh vegetables or fruit could be grown.

URBAN GREEN SPACES

Average per person in m²/sq ft

74/797
Africa

255/2,745
Latin America

39/420
Asia

452/4,865*
Europe

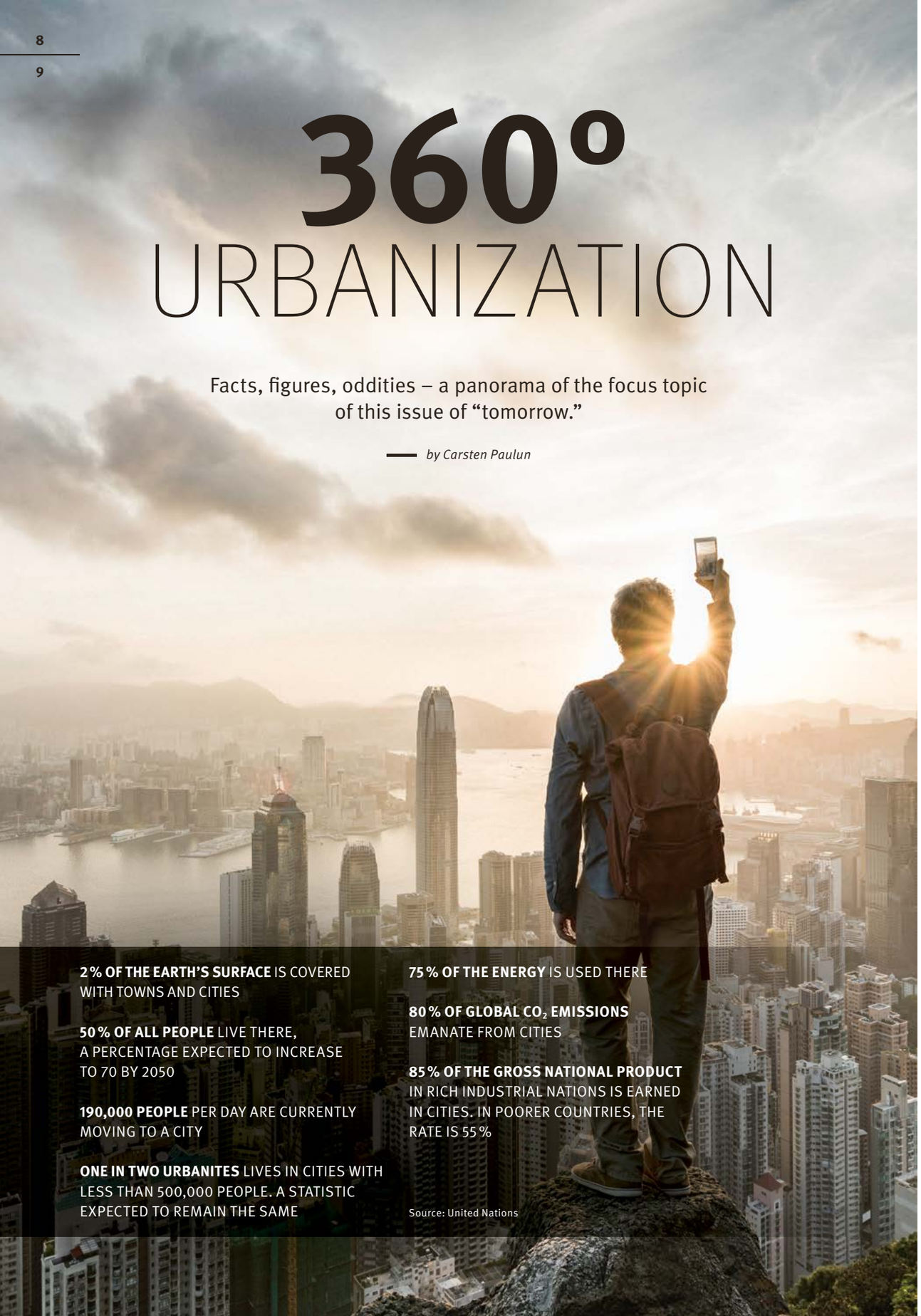
*Western Europe 234/2,518.8, Southern Europe 137/1,474.7, Eastern Europe 158/1,700.7 and Northern Europe 1,278/13,756.3

Sources: Siemens GCI Report, greensurge.eu

360° URBANIZATION

Facts, figures, oddities – a panorama of the focus topic of this issue of "tomorrow."

by Carsten Paulun



2 % OF THE EARTH'S SURFACE IS COVERED WITH TOWNS AND CITIES

50 % OF ALL PEOPLE LIVE THERE, A PERCENTAGE EXPECTED TO INCREASE TO 70 BY 2050

190,000 PEOPLE PER DAY ARE CURRENTLY MOVING TO A CITY

ONE IN TWO URBANITES LIVES IN CITIES WITH LESS THAN 500,000 PEOPLE. A STATISTIC EXPECTED TO REMAIN THE SAME

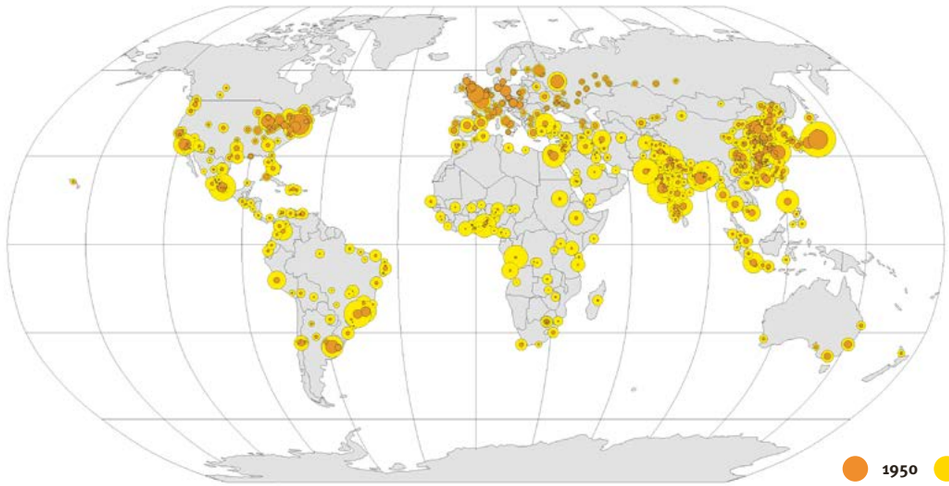
75 % OF THE ENERGY IS USED THERE

80 % OF GLOBAL CO_2 EMISSIONS EMANATE FROM CITIES

85 % OF THE GROSS NATIONAL PRODUCT IN RICH INDUSTRIAL NATIONS IS EARNED IN CITIES. IN POORER COUNTRIES, THE RATE IS 55 %

Source: United Nations

WORLD MAP OF URBANIZATION



Sources: United Nations, Wikipedia, Nordpil.com

ANIMAL LIFE IN THE CITY

A deer in the heart of Paris on the Place de la Concorde – maybe it fled from the wolves occasionally sighted on the outskirts. In cooler regions, polar bears are increasingly appearing in cities. Berlin is not only the capital of Germany but also of wild boars – with 5,000 of them romping in the city. Watching them are up two 240 pairs of kestrels said to be at home in the once divided metropolis … more and more wild animals are attracted to the city, a global phenomenon. One reason for it is climate change. Milder winters boost populations while original habitats shrink due to human influences like construction projects and conversion of forests into farmland that's often used to grow nothing but monocultures. That's why wild animals are migrating to the cities where they find enough food all year round, for instance in gardens, parks, compost heaps and garbage cans.

14 LANES THE AVENIDA 9 DE JULIO IN BUENOS AIRES HAS THIS MANY. THE BOULEVARD IS ALSO FLANKED BY TWO THREE-LANE ONE-WAY STREETS. IT TAKES A PEDESTRIAN ABOUT 2 MINUTES TO CROSS THE 140-METER (459 FT) WIDE TRAFFIC AXIS. THE ONLY STREET THAT'S EVEN WIDER – 250 METERS (820 FT) – IS EIXO MONUMENTAL IN BRASÍLIA, ALBEIT "ONLY" WITH 12 LANES DIVIDED BY A PLANTED MEDIAN STRIP.

» Architecture is not life. Architecture is its background

Hermann Czech (*1936), Austrian architect

SKYSCRAPERS

828 METERS (2,717 FT)

tall is the Burj Khalifa in Dubai – a world record since 2010. In 2021, it might be broken when the 1,002-meter (3,287-ft) tall Jeddah Tower in Saudi Arabia is completed. Tokyo is contemplating a 1,600-meter (1-mile) giant. Experts think that even taller buildings are feasible. Especially if skyscrapers no longer rise high as standalones but merge into units complementing each other in terms of supply and disposal services as well as transportation and rescue routes.

33,073

high-rise buildings more than 35 meters (115 ft) tall are found in South Korea's capital Seoul – more than in any other metropolis in the world, trailed in second place by Moscow with 12,092.

Source: archdaily.com

144

skyscrapers with a height of over 200 meters (656 ft) were completed in 2017 compared to ten in 1996.

Source: Council of tall buildings

ZERO

high-rises taller than 200 meters (656 ft) have been torn down to date. Previous record: the Singer Building in New York City with 187 meters (614 ft) that was demolished in 1968. Next year – also in NYC – the 200-meter mark is supposed to be surpassed: the 215-meter (705-ft) tall headquarters of the JPMorgan Chase bank will clear the way for a 150 meter (492 ft) taller successor.

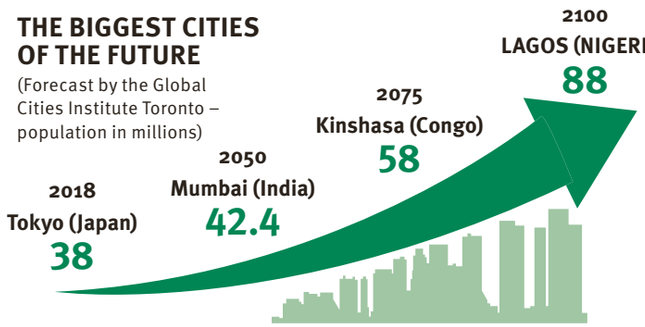
Source: Council of tall buildings

NOMADIC CITIES

On caterpillar tracks and rails, in the sea or in the air – plans for "nomadic cities" emerge from time to time. The "Very Large Structure" by Manuel Dominguez depicted here moves at a pace of 14 km/h (8.7 mph). A utopian vision? Yes, but especially in mining regions (currently, for instance, the town of Kiruna in Sweden with 18,000 inhabitants) or in places where man-made dams are being built nomadic cities are not unusual – except that there moving on always means tearing down and building again from scratch.

THE BIGGEST CITIES OF THE FUTURE

(Forecast by the Global Cities Institute Toronto – population in millions)



16 M² OF LIVING SPACE (172 SQ FT) IN MONACO'S PRIME LOCATION COST 1 MILLION DOLLARS, PUTTING THE PRINCIPALITY IN THE TOP SPOT OF THE GLOBAL RANKING OF TOP-CLASS REAL ESTATE AHEAD OF HONG KONG (22 M²/236 SQ FT), NEW YORK (25 M²/269 SQ FT) AND LONDON (28 M²/301 SQ FT).

Source: Engel & Völkers Real Estate

I'LL PRINT ME A HOUSE

25 % of all buildings are supposed to be produced by 3D printers in Dubai by 2030. The emirate is planning to become the world's capital of 3D printing. As early as in 2016, a ready-to-use office building including interior furnishings was realized using 3D printers (pictures). Printing time: 17 days. But elsewhere in the world buildings are "tumbling" out of printers as well. The Dutch company MX3D, for instance, used the forward-thinking technology to build a pedestrian bridge for Amsterdam, among other things. In Nantes, France, subsidized housing is planned to be printed and the Russian company Apis Cor is promising to produce a printed shell for a detached house in 24 hours. The Italian company WASP is planning to develop a printer that can use straw and soil as materials for low-cost housing in developing countries.

STRONG STATEMENTS

» One should build the cities in the countryside, the air is better there

Henri Bonaventure Monnier (1799–1877), French writer

» One thing is sure. The Earth is now more cultivated and developed than ever before. (...) and cities are springing up on an unprecedented scale. We've become a burden to our planet. Resources are becoming scarce and soon nature will no longer be able to satisfy our needs

Quintus Septimus Florens Tertullianus, Roman theologian, around 200 AD.

» In urban terms, the vision of a civilized city that I propose is not one that has highways but in which a child on a tricycle can move around safely

Enrique Peñalosa (*1954), Columbian economist and politician

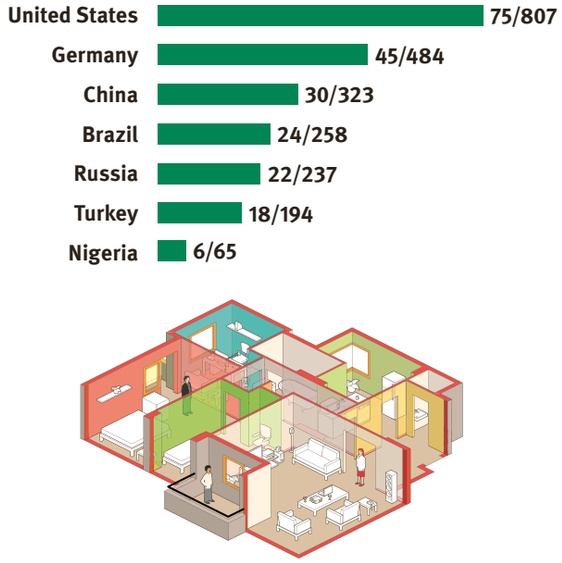
» God made the country, and man made the town

William Cowper (1731–1800), English poet

» If nature had been comfortable, mankind would never have invented architecture

Oscar Wilde (1854–1900), Irish poet and playwright

AVERAGE LIVING SPACE
(PER PERSON IN M²/SQ FT)



HIGH-RISE RETREAT

One thing that's in particularly short supply in many cities is space. Public recreational areas are often the first places to be sacrificed to growing urban densification. The solution to this dilemma: high-rise construction. As part of her graduation project at the Bezalel Academy of Arts and Design in Jerusalem Lilach Borenstein proposed a multi-story "Monument of Void" to which visitors could retreat to take a break in various topographies – be it for skating, climbing, chatting or to just enjoy the view. Similar concepts also exist with green areas growing high into the air.

AWARD-WINNING!
URBAN MARKETING FILMS FROM SCHAEFFLER

For Schaeffller, urbanization is one of the world-changing mega trends and, accordingly, a focus topic of corporate communications as well. Two marketing films with an urban background produced by the Duisburg-based agency Stereoscreen have now won prestigious prizes. The setting for "Why we race" is the first ever auto race held in New York City, the Formula E event that took place there in 2017. In impressive pictures, the short movie tells the story of why Schaeffler is racing in the series and in the hearts of global metropolises. "Why we race" won "Gold" in the "Transport and Eco-mobility" category at the Green Awards film festival in Deauville. The second-award winning Schaeffler marketing film is "Trailblazers" that was the winner of the German Brand Award for outstanding marketing communication. This marks the fourth accolade for the film that shows how the Schaeffler Bio-Hybrid conquers urban traffic areas. "Trailblazers" had previously won a silver medal in the 2017 Corporate Media Award competition in Cannes and other recognition. "tomorrow" was recognized again as well: The online version of Schaeffler's technology magazine was honored as the "Gold Winner" in the 2018 Astrid Award.

Jörg Walz, Vice President Sponsoring & Head of Corporate Communications Future Trends at Schaeffler (r.), and film maker Tim Hahne at the German Brand Award ceremony

500,000 CCTV SURVEILLANCE CAMERAS ARE PLANNED TO CURB CRIME IN THE CHINESE CITY CHONGQING IN THE NEAR FUTURE. LONDON, WITH 51,000 DEVICES, IS CURRENTLY THE FRONT RUNNER IN TERMS OF SURVEILLANCE CAMERAS. ACCORDING TO ASSESSMENTS MADE BY HUMAN RIGHTS GROUPS, EVERY LONDONER IS FILMED BY THE LITTLE SPIES 300 TIMES ON AVERAGE PER DAY.

500 million
pigeons are living in cities worldwide.
Source: NABU Germany

A **LIVING LAB** FOR URBAN MOBILITY

Smart City, City 4.0, Seamless Transportation Systems – urban planners and traffic experts are not short of visions and approaches to getting a handle on the problems of the growing megacities. Singapore is perhaps the most promising showcase: The densely populated island state has also been regarded as a living lab for urban mobility. And Schaeffler is actively involved.

by Oliver Jesgulke

The megacities of today, tomorrow and day after tomorrow are growing rapidly. This trend is a global phenomenon. At the same time, infrastructure and public transportation systems are hardly keeping pace with the development whereas personal automotive mobility continues to increase. In Asia, the dilemma is most obvious: While the elevator in the 632 meter (2,074 foot) tall Shanghai Tower whisks you down at a speed of about 70 km/h (44 mph), the solid lines of cars at the exit only pass you by at walking speed. In the cauldron of Jakarta on the other hand, the agile motorcycle taxi is more expensive today than a normal taxi because in the daily chaos it takes cars twice a long to reach their destination. And in emerging centers like Manila, Karachi or Dhaka, intersections during rush hour appear more like parking lots.

Large-scale test field

By comparison, Singapore has a clear advantage. Asia's paragon of economic development not only has the requisite resources but also secured the services of experts and leading companies specializing in predictive transportation planning early on, as 5.6 million inhabitants in a densely populated area would like to be mobile around the clock. The aim, however, is not to achieve a car-friendly city, but local transportation concepts that meet the city's needs. The authorities are looking for solutions to deconstruct and renature streets over the long haul to create more space for recreational areas. The South-East Asian metropolis therefore regards itself as a pioneer and has initiated various city-wide pilot projects: multimodal mobility apps, self-driving buses providing mobility-on-demand service, autonomous taxis and mini bus shuttles for industrial parks and tourist attractions.

"The whole city is a large living lab," enthuses Schaeffler employee Dr. Marcel Ph. Mayer who lives there. "And the overall political conditions here are ideal for testing our technologies in real-world traffic situations. There are few bureaucratic hurdles and approval processes are usually completed quickly. In addition, the government makes funding available for domestic and foreign companies," says Mayer. Furthermore, the government works closely with businesses and scientific institutions. Decision makers in the respective ministries and authorities are receptive to innovations and new ideas. Since the beginning of 2017, the 39-year-old engineer has been developing the Schaeffler Hub for Advanced Research (SHARE) at Nanyang Technological University (NTU) and the Research Centre for Micro Mobility with a current team of 15 scientists and engineers.

Hand in hand with science

"SHARE at NTU" is part of Schaeffler's global innovation network within the scope of Schaeffler's "Mobility for Tomorrow" strategy. The approach pursues the "Company on Campus" concept that already proved its viability in the collaboration with Karlsruhe Institute for Technology, Friedrich Alexander University Erlangen-Nürnberg and, most recently, with Southwest Jiaotong University in Chengdu, China: Schaeffler employees in the region are working hand in hand with scientists and students. A multinational team from Indonesia, Malaysia, China, India and Germany overseen by Mayer investigates questions relating to urban mobility intended to result in new services and products.

Singapore is intended to become a bicycle-friendly city. By 2030, the network of bike paths is supposed to grow to 700 km (435 mi)

Where driving a car is a luxury

Dr. Marcel Ph. Mayer has been living in Singapore since the beginning of 2017. He doesn't drive an automobile – for good reason, as this is a luxury in the city state that only has a size of 719 square kilometers (278 square miles). High toll and parking fees plus an officially limited purchasing permit have made cars increasingly expensive in recent years. Currently, some 575,000 privately owned vehicles are traveling the street network of some 3,300 kilometers (2.050 miles) that accounts for twelve percent of the land area. Most recently, the number of cars has increased by merely 0.25 to 0.5 percent. Since February 2018, Singapore has no longer been registering any new cars. In the future, registrations will only be possible if another vehicle was previously deregistered and the certificate with a validity of ten years is available on the market again. The price is determined by an auction, most recently it was the equivalent of about 33,000 euros – as much as the price for a new mid-size car.

Priority for buses and trains

Singapore's citizens, however, are well-practiced in temperance. They've learned to forego a few personal freedoms for the sake of the common good. Reason of state is of paramount importance in this context – one of the unwritten laws of the social contract in the island state and, at the same time, the basis for the country's rapid economic development since its independence

120,000

Singapore dollars (about 76,000 euros) is the price of a **Toyota Corolla** including registration, **four times as much as in the United States.**

Source: sgcarmart.com

90 Min

This is the time it will take the new **high-speed train to travel the 350-km (217.5-mi) distance to Kuala Lumpur.** Service is planned to begin in 2026. Alan Chan Heng Loon, CEO of the Singapore Land Transport Authority, regards the train as the most important interurban means of transportation of the 21st century.

1,000

additional buses were purchased between 2012 and 2017. In total, **1 billion Singapore dollars have been invested in the Bus Service Enhancement Programme** (BSEP).

Source: Land Transport Authority Singapur

By 2030, Singapore's metro network is planned to be expanded from today's 200 (124) to 360 km (223.7 mi). 80 % of all households are supposed to be able to reach a station on a ten-minute walking distance

from Malaysia in 1965. In return, Singapore's citizens expect progress and efficiency in their everyday lives. The city's public transportation system stands for this. For years, the bus and train network has been consistently expanded for billions of euros and is one of the most reliable public transit systems in the world. Mayer, like a major part of the population, rides the metro. He commutes between his home, his office and the NTU. "A train stops every three to four minutes and route planning is convenient via an app and in real time. Plus, it's extremely inexpensive." An on-demand bus service and automated people movers for the distance from the doorstep to the train station are intended to further enhance the attractiveness of public transportation," says Ngien Hoon Ping, CEO of Singapore's Land Transport Authority.

A mecca for the mobility avant-garde

The local conditions have long brought OEMs like Peugeot, BMW and Daimler into the arena. Google's parent Alphabet is represented as well. And actively involved right in the middle is the local mobility service Grab that acquired the South-East Asian business of competitor Uber at the beginning of the year. In addition, there are numerous startups such as nuTonomy that develops software for robotic taxis. Scania from Volkswagen Truck & Bus is developing and testing platooning solutions for the harbors under an agreement with the Singapore Ministry of Transport. An autonomous truck convoy is planned to transport containers between two terminals in the future. Floatility, a startup from Hamburg, is present as well. Because the domestic market has largely been closed to the company's founders so far the manufacturer of electric mini scooters went to Singapore where it's now offering its scooters in a sharing service.

LOCAL PARTNERS

Andreas Schick (left), then Regional CEO Asia/Pacific and today Chief Operating Officer with responsibility for Production, Logistics and Purchasing, initiated the collaboration with Nanyang Technological University (NTU) in Singapore together with Chief Technology Officer Prof. Peter Gutzmer, Prof. Lam Khin Yong, NTU Director of Research and Prof. Yoon Soon Fatt, Chair, School of Electrical & Electronic Engineering at NTU. The research budget (about 3.2 million euros for the next three years) is intended to accelerate the development of vehicles and systems for urban transportation.

Light electric vehicles are booming

Such Personal Mobility Devices (PMD) can be seen everywhere in the streets. They also include micro electric vehicles such as electric longboards or drivable transportation platforms. The "last mile," in other words distances that people would normally have to walk, can be covered much faster and more comfortably with them. PMDs are also used to deliver food and meals directly to people's homes by delivery services such as Uber Eats, Foodpanda or McDelivery. In Germany, however, these light electric vehicles, with a few exceptions, are prohibited. Schaeffler itself is testing a development from this segment in Singapore: the E-Board unveiled at CES 2017 in Las Vegas. The device has four wheels and resembles a skateboard. It has a rechargeable battery that supplies the rear axle with energy. The E-Board is steered by means of a flexible steering stick. Now, the drive train and brakes are being optimized further under everyday conditions.

3.1

million passengers per day are served by the metro network.

Source: Land Transport Authority Singapur

» *Singapore's overall conditions are ideal for testing our technologies for urban mobility in real-world traffic situations*

Schaeffler employee Dr. Marcel Ph. Mayer, pictured here with the Schaeffler E-Board

Making traffic safer

In addition, research into the interaction between the light electric vehicles and other road users is conducted at the NTU's two-hectare (5-acre) test facility for connected vehicles. "Electric scooters are fast and have a high hazard potential," Mayer explains. Collisions and serious accidents with cars happen in Singapore again and again. Although the authorities respond to violations of the Road Traffic Act with severe penalties, this does not resolve the root cause. Therefore, the Ministry of Transport supports Schaeffler's research in order to make road traffic safer.

Via V(ehicle)2X-communication the agile vehicles are planned to communicate directly with their surroundings and appear on the navigation displays of automobiles in the future. In automated systems, for example, an emergency braking event could be triggered without the driver's intervention when a light electric vehicle that is invisible to the driver and the car's radar comes dashing out from behind a building. "Managing all contingencies of traffic situations requires well-trained systems. With our research work we aim to make it possible to look around the corner," says Marcel Mayer who will continue to do pioneering work for Schaeffler in Singapore until at least 2020. There's one thing he's sure about: "The automobile is not a problem of the city of tomorrow but will be part of the solution."

THE AUTHOR

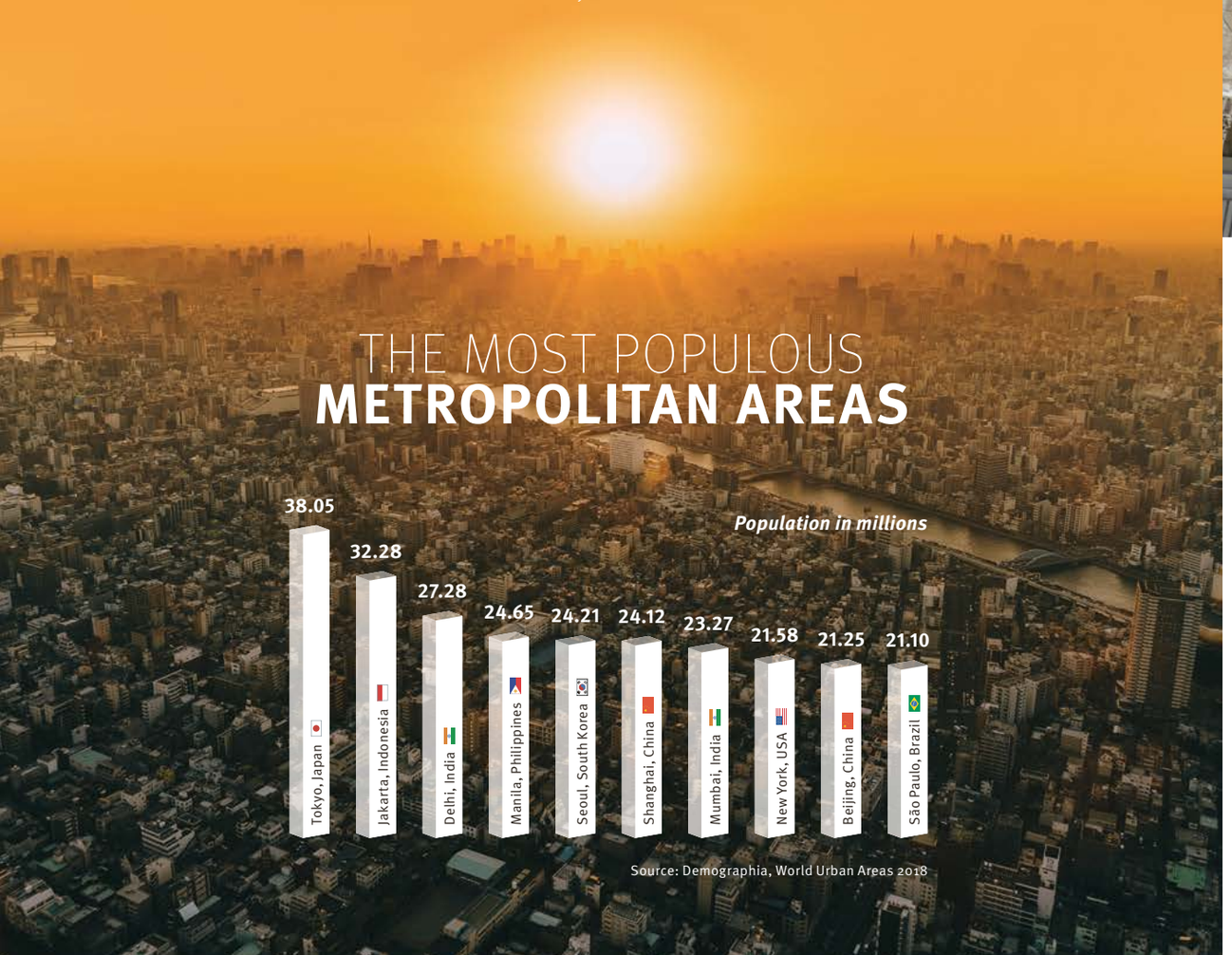
Local public transportation, pedestrians, cyclists, car drivers and delivery traffic – author ***Oliver Jesgulke*** *is intimately familiar with Berlin's daily traffic madness. That's why he was excited to look at Singapore and seeing how the small island state is in the process of making sustainable mobility reality in a densely populated area and how transportation using privately owned vehicles is increasingly subordinating itself to this cause.*

CITY RECORDS

Our cities keep growing. And whenever they can no longer expand they'll grow together with their surroundings to form huge metropolitan areas. Here are ten top-ten lists of our cities for a perusal that provides amazing insights.

by Carsten Paulun

THE MOST POPULOUS METROPOLITAN AREAS



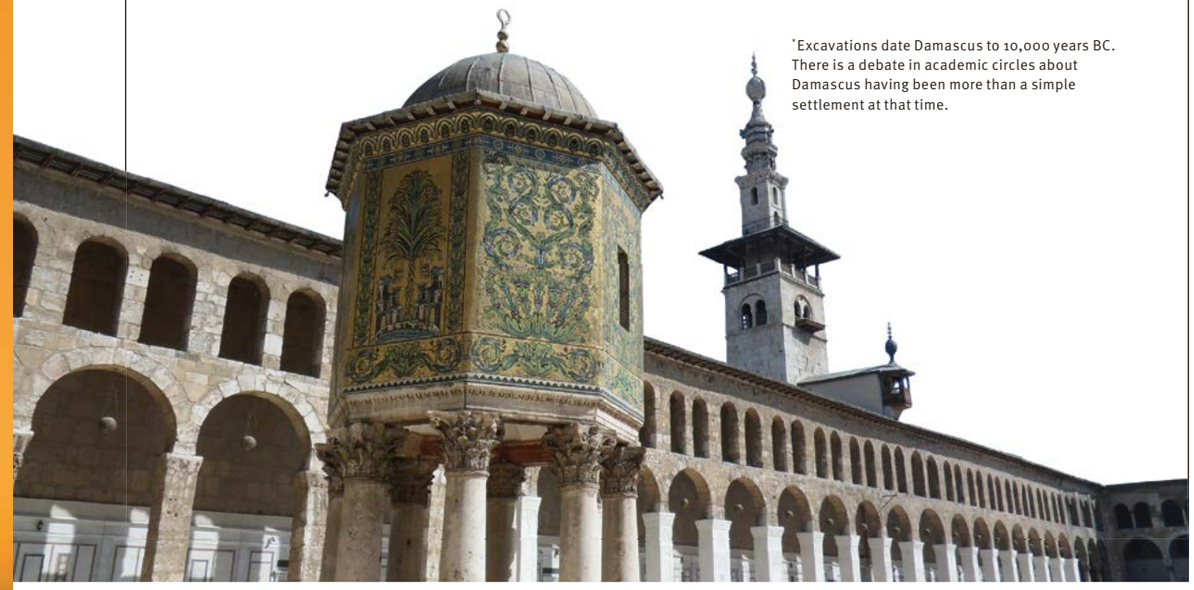
Source: Demographia, World Urban Areas 2018

THE **OLDEST** INHABITED CITIES

Damascus, Syria	***12,000 years****
Jericho, Palestine	***11,000 years***
Byblos, Lebanon	***7,000 years***
Aleppo, Syria	***6,300 years***
Susa, Iran	***6,200 years***
Faiyum, Egypt	***6,000 years***
Plovdiv, Bulgaria	***6,000 years***
Sidon, Lebanon	***6,000 years***
Gaziantep, Turkey	***5,650 years***
Beirut, Lebanon	***5,000 years***

Source: UNESCO, "The Telegraph", 2017

*Excavations date Damascus to 10,000 years BC. There is a debate in academic circles about Damascus having been more than a simple settlement at that time.



THE **MOST EXPENSIVE** CITIES

1. *Singapore*
2. *Paris, France*
3. *Zurich, Switzerland*
4. *Hong Kong, China*
5. *Oslo, Norway*
6. *Geneva, Switzerland*
7. *Seoul, South Korea*
8. *Copenhagen, Denmark*
9. *Tel Aviv, Israel*
10. *Sydney, Australia*

Source: Economist Intelligence Unit's Worldwide Cost of Living Survey, 2018

THE CITIES WITH THE **HIGHEST QUALITY OF LIFE**

People expect greater prosperity and a better life in cities. But which city actually offers the highest quality of life? The consultancy firm Mercer conducts an annual survey that considers political, social, economic and environmental aspects.

1. *Vienna, Austria*
2. *Zurich, Switzerland*
3. *Auckland, New Zealand*
   Munich, Germany
5. *Vancouver, Canada*
6. *Düsseldorf, Germany*
7. *Frankfurt, Germany*
8. *Geneva, Switzerland*
9. *Copenhagen, Denmark*
10. *Basel, Switzerland*
    Sydney, Australia

Source: Mercer, 2018

THE **SAFEST** CITIES

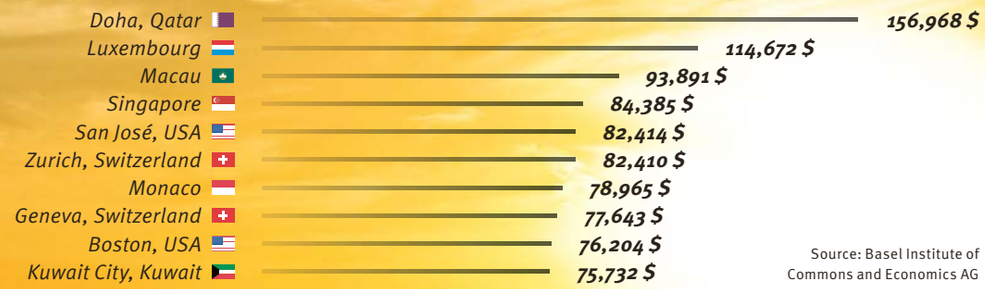
Good healthcare and infrastructure, protection against natural disasters or hackers – safety and security is more than just protection against crimes of violence. Here's a look at the world's ten safest cities.

1. *Tokyo, Japan*
2. *Singapore*
3. *Osaka, Japan*
4. *Toronto, Canada*
5. *Melbourne, Australia*
6. *Amsterdam, Netherlands*
7. *Sydney, Australia*
8. *Stockholm, Sweden*
9. *Hong Kong, China*
10. *Zurich, Switzerland*

Source: Safe Cities Index, 2017

THE **RICHEST** CITIES

The economic strength of a city is measured by the Gross Domestic Product (GDP). It is the total of all the value generated within a city, adjusted by the inflation rate. A per capita GDP calculation makes cities of diverse sizes, geographic locations and political conditions comparable.



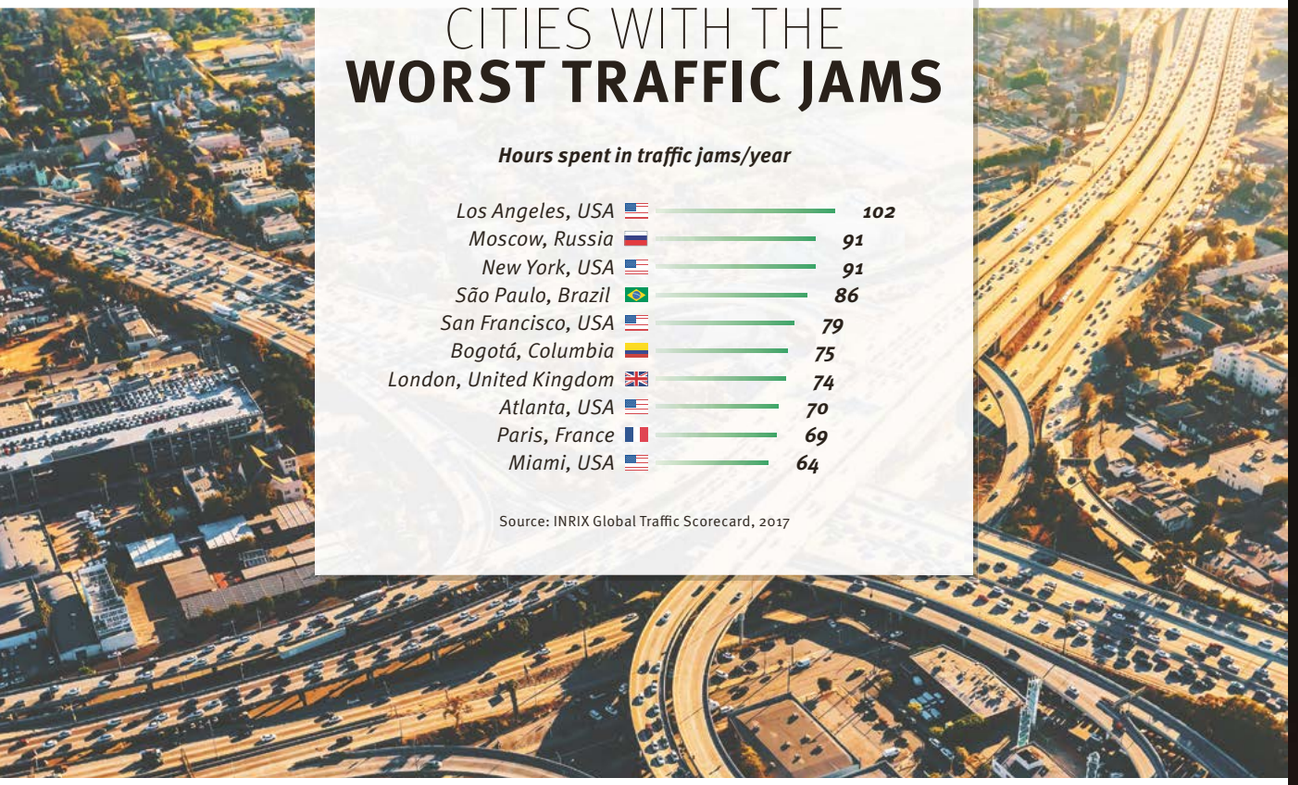
Source: Basel Institute of Commons and Economics AG

THE **MOST INNOVATIVE** CITIES

High-speed internet, smart streets, innovative sewer systems, clever high-rises – the big city of the future will have to completely change compared to today. These cities are already perfectly prepared, according to "Tech Insider":

1. *San Francisco, USA*
2. *London, United Kingdom*
3. *New York, USA*
4. *Seoul, South Korea*
5. *Los Angeles, USA*
6. *Boston, USA*
7. *Taipei, Taiwan*
8. *Toronto, Canada*
9. *Singapore*
10. *Amsterdam, Netherlands*

Source: Tech Insider, 2016



CITIES WITH THE WORST TRAFFIC JAMS

Hours spent in traffic jams/year

Los Angeles, USA	***102***
Moscow, Russia	***91***
New York, USA	***91***
São Paulo, Brazil	***86***
San Francisco, USA	***79***
Bogotá, Columbia	***75***
London, United Kingdom	***74***
Atlanta, USA	***70***
Paris, France	***69***
Miami, USA	***64***

Source: INRIX Global Traffic Scorecard, 2017

CITIES WITH THE WORST AIR POLLUTION

Particulate matter (smaller than 2.5 micrometers/98 microinches) per cubic meter (35 cubic feet) on average for the year

1. Zabol, Iran	***217***
2. Gwalior, India	***176***
3. Allahabad, India	***170***
4. Riyadh, Saudi Arabia	***156***
5. Jubail, Saudi Arabia	***152***
6. Patna, India	***149***
7. Raipur, India	***144***
8. Bamenda, Cameroon	***132***
9. Xingtai, China	***128***
10. Baoding, China	***126***
For comparison:	
56. Beijing, China	***85***
1.340. Stuttgart, Germany	***15***
1.534. Hamburg, Germany	***14***
2.010. Los Angeles, USA	***11****

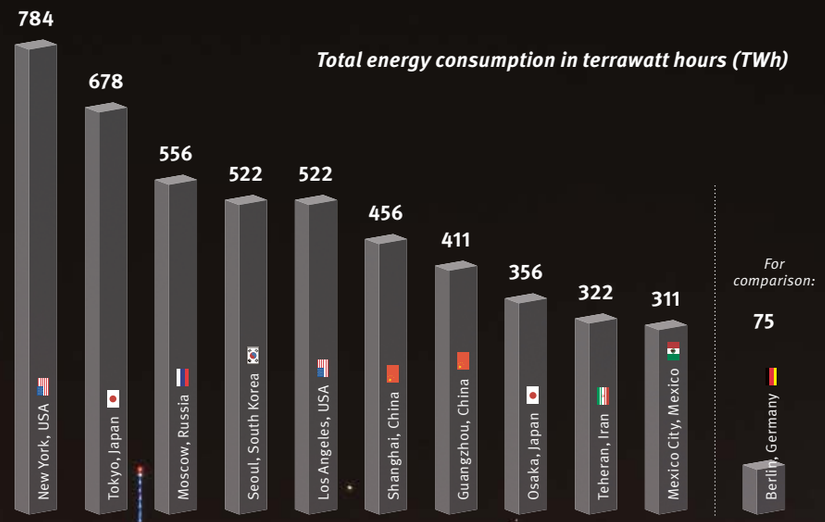
Source: World Health Organization, 2016

*Metropolitan area incl. Long Beach, Santa Ana.

THE CITIES WITH THE HIGHEST ENERGY CONSUMPTION

Hunger for energy is huge particularly in our cities. In 2015, University of Toronto analyzed the annual per capita energy consumption (electricity, oil, gas, coal) in 27 megacities with more than 10 million inhabitants.

Total energy consumption in terrawatt hours (TWh)



Sources: University of Toronto, 2015; Federal Ministry for Economic Affairs

OTHER **POSSIBLY RECORD-BREAKING** CITIES *

THE NORTHERNMOST CITY IN THE WORLD ...

... is **Longyearbyen.** The "capital" of the Svalbard archipelago (Norway) has a population of more than 2,000 and is inhabited all year round. The town is located 1,300 kilometers (807.8 miles) from the North Pole at 78 degrees North latitude.

THE MOST DANGEROUS CITY IN THE WORLD ...

... is **Ciudad Juárez.** In the Mexican-American border town someone is murdered about every three hours. Responsible for the bloody violence is a war between the Juárez and Sinaloa drug gangs that has been raging since 2008.

A SUCCESSFUL CITY ...

... is **Herzogenaurach.** Three global corporations – Adidas, Puma and Schaeffler – are headquartered in the small town, resulting in 22,500 jobs for 23,500 inhabitants. For comparison: neighboring Nuremberg (511,000 inhabitants) not even offers one in two of its inhabitants a job (totaling 207.000).

THE HIGHEST CITY IN THE WORLD ...

... is in Peru at an elevation of 5,100 meters (16,700 feet). The 40,000 inhabitants of **La Rinconada** make a living by working in a gold mine, albeit in poor circumstances. There is neither running water nor a sewer system.

THE SOUTHERNMOST CITY IN THE WORLD ...

... more than likely is **Puerto Williams** on the Chilean Navarino Island. It is located at 54 degrees South latitude and has a population of 2,700. Clearly smaller settlements and research stations inhabited all year round are located in the Antarctic region. The Amundsen-Scott Station is even directly on the South Pole.

THE LOWEST CITY IN THE WORLD ...

... is located about 250 meters (850 feet) below sea level: **Jericho** in the autonomous Palestinian territories has some 22,000 inhabitants.

THE SMALLEST CITY IN THE WORLD ...

... according to "Guinness World Records," is **Hum,** a village in Western Croatia with less than 30 inhabitants. However, the title "Smallest city in the world" is used by other places such as Durbuy in Belgium as well for promotional purposes. Germany's smallest town is Arnis in Schleswig-Holstein with a population of 274.

THE COLDEST CITY IN THE WORLD ...

... has an average temperature of minus 50 degrees centigrade (minus 58 degrees Fahrenheit) in the winter months. Even so, some 460 people feel at home in **Oymyakon,** Russia. In 2013, the record temperature to date was measured: minus 71.2 degrees centigrade (–96.2 degrees Fahrenheit).

THE MOST DENSELY POPULATED CITY IN THE WORLD ...

... with a population density of some 47,400 inhabitants per square kilometer (0.38 square miles) is Bangladesh's capital **Dhaka.** For comparison: the population density of Berlin is about 4,000 inhabitants per square kilometer.

THR NOISIEST CITY IN THE WORLD ...

... according to India's Ministry of Environment, is **Mumbai.** Especially the deafening noise of traffic in the streets and the countless large construction sites make for an enormously high sound level.

THE WARMEST CITY IN THE WORLD ...

... with an average temperature of 46.8 degrees centigrade (116.24 degrees Fahrenheit) is the Iranian desert city **Ahvaz.** Top temperatures of 55 degrees centigrade (131 degrees Fahrenheit) (in the shade) are not uncommon for its 1.3 million inhabitants.

*When does a town qualify as a city? There is no internationally valid definition.

TOKYO 24H

What's it like to live in the world's biggest city as a foreigner? Andreas Neuenkirchen, an author of numerous non-fiction books and novels relating to Japan, has been living in Tokyo with his wife and their child since early 2016. For "tomorrow" he captured a typical day in the metropolis with a population of 38 million.

by Andreas Neuenkirchen

The stereotype is correct: In the morning rush hour, the trains in, under and above Tokyo are jam-packed so that additional passengers have to be pushed through the doors by the combined efforts of platform assistants – until you think this is as full as the train can get. And then it does get even a littler fuller. And after that a little fuller yet. And maybe, at some point, it's really full enough and the train will depart. You get the feeling that all of Japan has just been crammed into a single cabin.

All of Japan? No, because I'm not on board. As a freelance writer I can personally choose when and where I'd like to work and decide whether I even have to take a train to get there. In any case, I first have to drop off my child at the daycare center, which happens around 9 AM. After that, I go to work. By that time, the really big rush on the trains is over, but they're still packed enough. So, I'd rather go to the coffee shop around the corner.

Laptops left unattended

First, I look for a place on the second floor that I reserve by depositing my laptop before returning to the first floor to place my order. The first time I watched how trustingly the Japanese mark their territory with unattended items of value I was impressed by their obviously justified trust in their fellow human beings but thought that, owing to my cultural background, I'd never be able to overcome my inclination to distrust humanity. But, surprisingly, I ultimately did.

Although the people that have made themselves comfortable on the top floor aren't likely to go anywhere anytime soon my seat neighbors are by no means idlers. Practically everyone – like me – is working. The availability of power outlets can be taken for granted in this coffee shop just like a free supply of water. There's a number of companies in this neighborhood that belong to the entertainment industry in some way, so while sneaking a peek at someone else's screen you may catch a glimpse of new Manga figures or video animations in their state of creation. There's nothing to listen in on at the coffee shop, though. People in Japan tend to use other locales for social exchange.

Cashless access to trains

At times you have a need for something to read or would like to write something. My favorite place to hunt for new material is the bookstore of the Kinokuniya chain in the Takashimaya Times Square shopping mall in Shinjuku. The Yamanote railroad line untiringly circles the downtown area. A full circle takes 90 minutes, and from my station to Shinjuku just twelve.

Shinjuku is probably the busiest station in the world, serving more than 3.5 million passengers per day. There are no ticket inspectors or checks in urban transportation systems and on most long-distance trains as

» This, too, is Tokyo: ATMs with operating hours

OVER 5 MILLION

vending machines exist in Japan – for beverages, umbrellas, fish soup or even face masks for protection against the flue. The products – if at all – are only slightly more expensive than those bought at a store. The machines generate annual sales of over 50 billion euros. Since the nineties, customers wishing to buy drinks like beer or sake, or cigarettes, will have to identify themselves to the machines.

you can't access the tracks without having paid in the first place. Today, though, you can hardly see anyone inserting a paper ticket from a vending machine into the slots of the access gates anymore. Even most tourists are sold on the rechargeable cash cards you just hold in front of a sensor at the beginning and end of your trip and that automatically debit the correct amount of the fare. If you don't have enough money on your card you can locally recharge it. Now it's even possible to have the credit on your cash card automatically replenished from your own bank or credit card account as soon as the balance drops below a specified amount.

The Kinokuniya bookstore in Shinjuku used to offer books on several large floors of the building. Now the offering has been reduced to international books and the remainder of the space converted into a furniture store. Life is no longer easy for bookstores in Japan either. For my book search, I was able to use the on-site search computer that issues a small slip of paper with a map and number of the shelf for each title searched. I don't need that, though. Although I may get lost in the streets of the city from time to time I do know my way around in its bookstores.

Noodles between tracks

I probably spent more time at Kinokuniya than planned, so for lunch there'll just be tachigui soba, literally meaning stand-up soba noodles. Today, though, the expression no longer needs to be taken quite so literally. There are soba fast food restaurants that offer other types of noodles as well and in some cases even seating. Common to all of them is that they're located on the platforms of train stations, surrounded by the noise of trains entering and leaving on either side of the track. This way, business travelers in a hurry don't have far to go when plagued by hunger pains. You order and pay for your meal at a vending machine before entering the small booth and giving the ticket to the waiter or waitress inside. The vending machine in front of the shop at my home station has a touchscreen and can be switched to several languages. I normally like trying my skills with the Japanese original but this time consideration for the other hungry people in the line behind me demands that I get moving. So, I give up and switch to English which prompts the machine to incessantly yell at me in a penetrating voice: "PLEASE INSERT YOUR MONEY NOW"! "PLEASE WAIT"! "PLEASE TAKE YOUR RECEIPT"!

A cup of coffee after the meal, but not at the coffee shop again? No problem. There's a vending machine around every corner with a selection of canned coffee so extensive that it's not conducive to making quick choices. Paying attention to the small labels posted in front of the cans is advisable to prevent nasty surprises: Red means scalding hot and blue ice cold. Both harmoniously reside in the same machine. Not surprisingly, following the natural and energy disasters in March 2011, shutting off the beverage vending machines was one of the first energy conservation actions taken.

My afternoon belongs to working in my office at home and more than likely is pretty similar to home office afternoons in other parts of the world. A commonly known home office rule is to never work in your pajamas because wearing PJs will make you think: sleep. I'd add the rule to never work in your living room because when sitting in your living room you'll think: done for the day. However, before my work day actually ends I mustn't forget to pick up my child from the daycare center. Once everyone's at home, well-fed and the youngest family member exhausted and gone to sleep on the family's futon, the relaxing part of the evening could begin. If you feel like chilling out over a drink and some nibble snacks you can stop by the next convenience store, colloquially called a konbini. There are some 55,000 of them in Japan, one per about 23,000 people. A konbini is a supermarket,

WHY WE LOVE TOKYO

Tokyo is huge. And full of variety. Above all, Tokyo is livable and lovable – a sentiment that these five Schaeffler employees living there as expats share as well.

We're *Natalia Pryakhina and Laura Studer*

We've been living in Tokyo since *April 1, 2018*

At Schaeffler, we're ... *doing an internship abroad for several months. Natalia is involved in working on innovative industrial products and Laura optimizes interface processes in the HR department.*

Tokyo is special ... *because it's a city of contrasts. Directly next to the world-famous and very traditional Meiji Shrine you can find the craziest things on Takeshita Street in Harajuku. Subsequently, you'll cross the world's largest crosswalk in Shibuja. If our feet still support us after that, we'll spend the night dancing in one of the countless small clubs in Roppongi. The city simply never sleeps.*

I'm *Christoph Klaar*

I've been living in Tokyo since *December 1, 2016*

At Schaeffler, I work ... *in project management for transmission applications. In addition, I view my role as that of a bridge between the German and the Japanese side of our company.*

Tokyo is special ... *because you can be very relaxed about living in the city due to its good organization and the Japanese mentality. Where else can you wake up in the morning on the 41st floor on a man-made island with a view of the city all the way to Mount Fuji? Together with my wife I enjoy taking a boat to Odaiba, one of the neighboring islands. There we enjoy sitting in a café, shopping or just taking a walk on the beach.*

I'm *Pierre Lamothe*

I've been living in Tokyo since *March 1, 2017*

At Schaeffler, I work ... *in key account management for our customer Renault-Nissan-Mitsubishi.*

Tokyo is special ... *because it has numerous excellent restaurants with Japanese as well as international cuisine. None of the izakayas has ever disappointed me – on the contrary, I keep experiencing extremely positive surprises.*

I'm *Christiane Tietz*

I've been living in Tokyo since *August 1, 2017*

At Schaeffler, I work ... *as a team coordinator in the communications department. At the moment, I'm on parental leave in Japan.*

Tokyo is special ... *because of its cleanliness and safety – like all of Japan. In what other international big city can you use the public restrooms without any concerns or briefly leave your cell phone or wallet unattended? Of course, at the moment, I'm delighted about the wealth of things available to mothers and babies. Hassle-free shopping? No problem. You can rent strollers at the malls and afterwards make your child's heart beat faster at one of the numerous indoor playgrounds.*

TOKYO IN NUMBERS

1446

is the year in which the city's history begins when Edo Castle is built. Not until 1886 Edo is renamed Tokyo which translates into **"eastern capital."**

8.7 million

people per day use the Tokyo subway. During rush hour the trains are sometimes jam-packed so that **oshiyas** ("pushers") push the passengers into the cabins from the outside.

Position 1

is Tokyo's spot in a comparison of cities by the travel portal "TripAdvisor" in terms of **public transportation, taxi, cleanliness and safety.**

2020

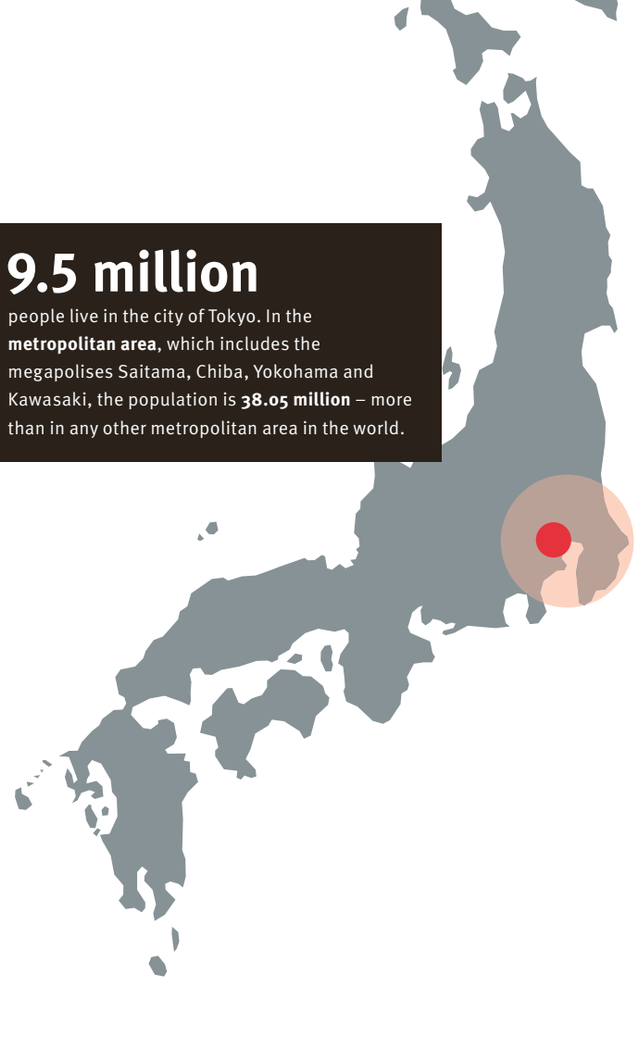
Tokyo will host the **Summer Olympics.** All the sports venues are supposed to be accessible on public transit systems within 30 minutes.

9.5 million

people live in the city of Tokyo. In the **metropolitan area**, which includes the megapolises Saitama, Chiba, Yokohama and Kawasaki, the population is **38.05 million** – more than in any other metropolitan area in the world.

100 yen shops

– besides the konbinis – are truly a shopping institution in Japan used by people from all walks of life. Any everyday item costs 100 yen (105 incl. taxes), in other words less than one Euro. **The merchandise ranges from useful to quirky, from household to joke items.** Japan expert Neuenkirchen recommends: "A visit will be most gratifying when you go into a 100 yen shop without any preconceived notions and allow it to dictate your wishes to you."



stationery and consumer electronics store, a liquor store and coffee shop, a drugstore, ice cream parlor, pharmacy, post office, a bank and social hub all rolled into one. This is where I scan, copy and fax documents as well. Why should I own a multifunctional device when there are at least six konbinis close by? So I'd rather use the space on my desk for one or two extra stacks of books. At a konbini, I can also pay for our orders from various online shops or pick up the merchandise, and at the automatic teller machines of the 7-Eleven chain I can even draw money around the clock using my German card. Neither of these conveniences can be taken for granted as most ATMs are not very accommodating of foreign banks. When using my Japanese card, though, I'm often faced with the problem that local banks have operating hours for their ATMs as well. Even when the night is still pretty young you frequently get the message: Please come back tomorrow.

Colorful and fancy

Once finances have been taken care of, snacks and drinks secured, it's time to watch TV. Japanese television sometimes strikes me as if its makers had just invented color, still fascinated by the gamut of its possibilities. Yet as colorful and fancy as the sets and costumes may be, we tend to find content to pale by comparison with presentation. So, we prefer streaming our TV shows from less colorful countries. After all, we get to enjoy our fair share of Japan during the day – and tomorrow's another day.

THE AUTHOR

"Monocle" magazine has ranked Tokyo as the most livable city for three years running. Yet nearly every travel guide includes this warning: "Tokyo is not a beautiful city." Even so, ***Andreas Neuenkirchen*** *chose to stay with his wife and child and in a delightfully entertaining way reveals the secret of why the city he now calls home is one that makes people happy in its own unique ways. That's also why his latest book is titled "Happy Tokyo."*

in motion

Innovations in the course of time

MARKET HALL **4.0**

Commerce and markets have been driving the prosperity of our cities for centuries. Markets would supply the population of a city with food, clothing and news. The end of the 19th century rang in a Europe-wide trend of covering marketplaces – primarily for reasons of hygiene. As department stores and supermarkets emerged, both open-air and covered markets suffered a massive loss in importance. Many market halls began to deteriorate. Some of them, however, were saved and converted for other uses like museums, concert halls or food courts. Even some new halls were built. Such a modern-day market hall has existed in the Dutch city of Rotterdam since 2014. Actually, the horseshoe-shaped eleven-story building is a small city itself. It has shops, restaurants, bars, 1,200 parking spaces and even 228 apartments – and, of course, a marketplace. Remarkably, architect Winy Maas completed the "Rotterdam Markthal" project within the scheduled construction period of five years and also adhered to the budgeted construction costs of 175 million euros.

THE LARGEST MARKETS IN THE WORLD

North America: *Central de Abasto in Mexico City (Mexico), dozens of halls spread over an area of 304 hectares (751 acres).*

South America: *Feria 16 Julio in El Alto (Bolivia), 240 hectares (593 acres), open air.*

Europe: *Rungis near Paris (France), 232 hectares (573 acres), 23 halls, regarded as the world's largest central market.*

Africa: *Merkato in Addis Abeba (Ethiopia), 120 hectares (297 acres), open air.*

Central Asia: *Dordoy Bazaar in Bishkek (Kyrgyzstan), 55 hectares (136 acres), mostly double-deck container rows with covered aisles.*

Far East: *Divisoria Market in Manila (Philippines), 40 hectares (99 acres), open-air market stalls and an old shopping center merge into each other.*

CITIES OUT OF NOWHERE

The term planned city describes the phenomenon of building a city from scratch: initially celebrated and subsequently criticized. Eight examples illustrate why planned cities entail risks and why we need them anyway.

by Rosa Grewe

WASHINGTON D.C.

Washington's splendid National Mall photographed from the roof of the Capitol

MOSQUITOS YESTERDAY, WORLD POLITICS TODAY

The place where world politics are conducted today was merely a swampy delta of two rivers more than two hundred years ago. *Here, in the mosquito-infested middle of nowhere, far away from New York's and Philadelphia's lobbyists, the new capital of the United States, planned by Pierre Charles L'Enfant in 1791, was built from scratch.*

Unlike a city that has gradually grown, a planned city has a designed layout and often a uniform appearance and specific purpose. Ancient Cologne, for instance, was built on the basis of a standard layout that applied to all new Roman settlements. Another example is Neuf-Brisach commissioned as a new fortress-city by Louis XIV to secure the French border on the Rhine. In most cases, planned cities are an expression of an ideology – such as Karlsruhe that was built with a ruler's claim to absolute power or Halle-Neustadt, a city planned much later according to socialist ideals. The planned city represents the desire to create a perfect setting for a perfect society.

L'Enfant, as well, planned Washington D.C. with plenty of prestige and impressive effects in mind: a grid street plan with splendid squares and parks, and traversed by long boulevards starting from the center of power, the Capitol. 800,000 people were planned to live here. When Congress moved into the United States Capitol in 1800 the city only had a population of 8,000 whose homes appeared lost in the fields below the Capitol Building. Those setting foot outside the Capitol Building better wore boots as protection against the mud. The National Mall with numerous museums as a defining element of the cityscape was only added to Washington D.C. in the 20th century. In 1950, the city finally achieved the number of inhabitants it was planned for. In the core city, below Capitol Hill, the originally planned city has been preserved and, thanks to the wide streets, remained functional as well. However, the days of peace and quiet for government are over: Washington, today, not only has many lobbyists, but also major social issues, poverty and violence.

WHY CITIES **ARE WHERE THEY ARE**

Cities have always had their own momentum and their hearts are beating faster and faster. They grow, stagnate and shrink. But where and how do cities actually emerge and what keeps them alive?

The hope for profit is the engine that drives any city. Wherever people exchange goods, information and services they'll be joined by others seeking to profit from these activities as well. This is how even as far back as in antiquity settlements and the first towns were established along trading routes. Because ships were the most effective means of transportation in those days, cities primarily grew on waterfronts. The first advanced civilizations in antiquity were primarily formed around the Mediterranean Sea and along the big rivers of Persia and China. The first metropolis with a population of more than a million was Rome around 300 AD. Only after the Romans had established trade and military routes northward along the Danube and the Rhine did bigger cities emerge in Central Europe as well. They remained lively trading places even when the Romans withdrew. In the early Medieval Period, numerous principalities and bishoprics emerged. Their fortresses and abbeys offered work and protection for the local population and for merchants – perfect for settlements to grow into small towns.

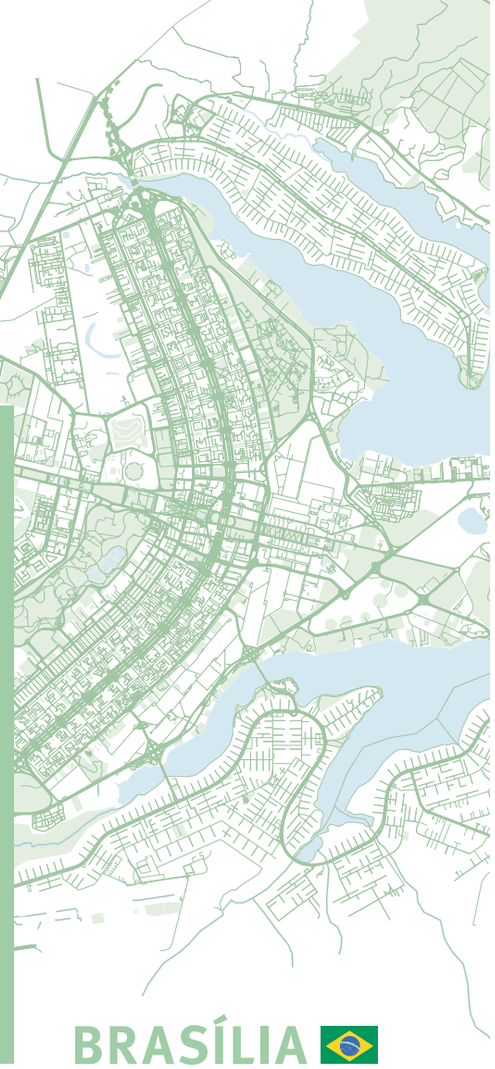
Cities actually began to burgeon in England and North America. Around 1800, inventions like the steam engine and the mechanical loom accelerated the production of goods. The railroad that had just been developed offered a fast means of transportation. Billowing smoke stacks above the city silhouettes promised work and attracted millions of impoverished farmhands.

London, the mother of all industrial towns, was the fastest-growing city in the world at that time. Progress arrived in heavily fragmented Central Europe a few decades later, following a new geopolitical order and establishment of a free-trade zone. As a result, industrial cities and regions began to flourish there as well. The Ruhr region and the Saarland supplied coal, ore and steel for railroad construction. Berlin and Chemnitz benefited from mechanical engineering, the textile industry and later from the electrical and chemical industry. In the 19th century, the population of Berlin increased ten-fold to nearly two million. At the beginning of the 21st century, most people are still living in cities, particularly on the coasts of South-East Asia, Africa and Latin America. They're still hoping for work, safety, shelter, education and prosperity. The greater their hope the faster the city will grow. The smaller the hope the faster it will shrink such as in the case of the ailing industrial metropolises of Detroit, Manchester or Chemnitz: an urban inhaling and exhaling with an increasingly fast rhythm. London, for instance, as the world's biggest city 100 years ago had a population of some seven million, which does not compare with the roughly 36 megacities today that each have over ten million inhabitants. The world is turning into a city.

View of Brasília's government district

THE BRAZILIAN DREAM

Another planned city is Brasília, built in a tropical wasteland in the geographic center of Brazil according to the plans of Lúcio Costas and Oscar Niemeyer. *The new capital, the construction of which began in 1951, stood for a different type of life, far away from the corruption, inequality, poverty and crime of the coastal cities. In Brasília, half a million people were planned to live together in conditions of fairness, dignity and peace. The project was mind-boggling: The construction area was an undeveloped piece of land. Thousands of workers cut passages over a hundred kilometers (62 miles) long through the overgrown wilderness for streets and roads. Truck convoys transported tons of sand and gravel to the site. Within a short period of time, workers built a fascinating concrete city of elegant arches, boldly curved roofs and discs rising high into the sky with large main streets and vast green spaces in between. Brasília is an architectural manifestation of a social utopia. Today, it's on the world cultural heritage list, but socially it failed: The core city is too costly for the working class and too bleak for the affluent. While the workers live in the growing slums of the suburbs the wealthy fly to Rio or São Paolo on the weekend. As industry has not been showing any interest in Brasília either unemployment and crimes rates are among the highest in the country.*



BRASÍLIA

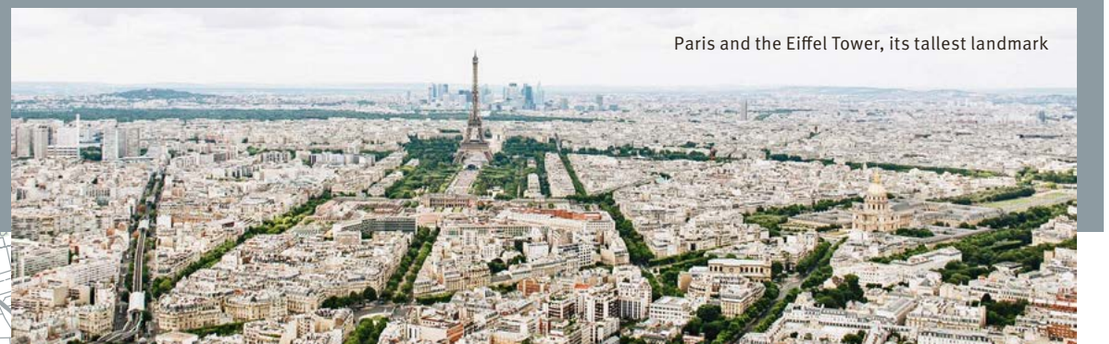
PARIS

3 MILLION INHABITANTS

were to be accommodated by ***"Voisin,"*** *the car-friendly city designed by the architect Le Corbusier in 1925. Eighteen cross-shaped, sixty-story high-rise buildings towering above large roadways were to replace the old downtown area of Paris. It remained a utopian vision.*

BEAUTIFIED LIVING

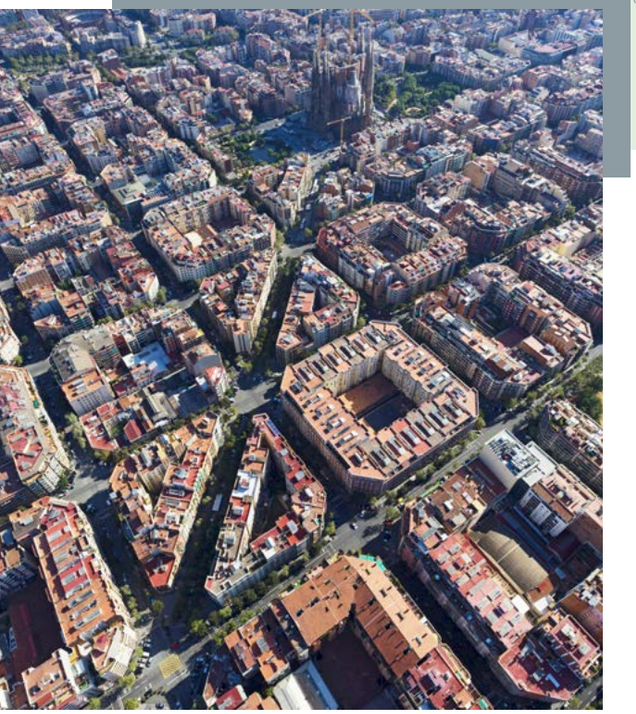
In most cases, a planned city is simply necessary, for instance when the old one has become dysfunctional – as in the case of Paris, which had densified to nearly a million inhabitants by the middle of the 19th century. *The city was cramped, dark and smelly. It had no drinking water supply, no sewer system, but a high infant mortality rate and was repeatedly struck by epidemics. In 1853, Georges-Eugène Baron Haussmann, the prefect of Paris, ordered some 19,000 buildings to be torn down as a last resort. In their stead wide tree-lined boulevards, squares, tall residential buildings and numerous monuments were built, resulting in the classicistic Paris. The construction sites produced noise and dust for more than twenty years. Haussmann's plan was regarded as a success and benchmark for all subsequent urban planning. But the conversion revealed the downside of any clean-sweep project: As neighbors and familiar streets disappear so does the identity of the old city and the feeling of being at home. And when rents increase, as they did in Haussmann's Paris, long-established and poor residents are displaced to the outskirts.*



Paris and the Eiffel Tower, its tallest landmark

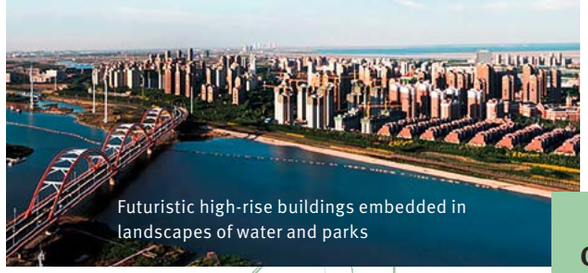
CATALAN GRID PLAN

Same problem, different city: Like Paris, Medieval Barcelona became too cramped, but instead of tearing it down urban planner Ildefons Cerdà enlarged the metropolis by about eight times its previous size. *For the "Eixample," he planned five-story residential buildings on a grid system, with green patios and small parks. Tree-lined boulevards crisscross the grid in the form of rays toward the splendid Plaza de las Glòries. However, real estate speculation drove up the price of the properties. Instead of light, air, green and patios a kilometer-long mass of houses grew. The prestigious Plaza de las Glòries became a two-level street circle. Today, the Eixample is one of the most densely populated residential districts in Europe. Even so, it's very popular. The city government is planning to triple the number of trees, rid the Plaza de las Glòries of cars and to transform it into an urban park by 2020. Thus, Barcelona is following the new vision of our times: the green planned city.*

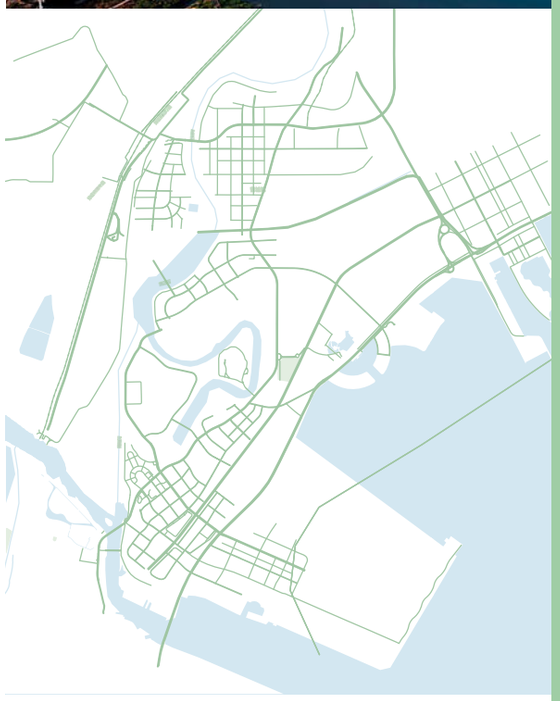


Attractive grid pattern: Barcelona's hip Eixample district with the famous La Sagrada Familia cathedral

BARCELONA



Futuristic high-rise buildings embedded in landscapes of water and parks



TIANJIN ECO CITY

CHINA'S GREEN WAVE

The world is in a state of rapid urbanization. In China alone, one billion people are planned to be living in cities by 2030, so new solutions for environmentally compatible urban mobility, energy and industry are needed. *Tianjin Eco City, a 30-square kilometer (11.6-square mile) green utopia, 150 kilometers (93 miles) from Beijing, is supposed to set standards. Started in 2007, the city is being built on a section of the coast that used to be contaminated by gray water. The environmental aims of the project planners are ambitious: With futuristic high-rise residential buildings and green belts the size of 588 football pitches the city is intended to enable a sustainable lifestyle. Electricity is planned to be supplied from renewable sources, the buildings are supposed to be energy-saving and planted with greenery across the surfaces. People are intended to live in socially mixed neighborhoods and able to go to work and do their shopping in close proximity to their homes on foot, by bicycle or by bus and train. By 2020, 350,000 people are planned to be living here. At the moment, the population figures are still below expectations and the houses built so far do not present a really eco-futuristic appearance. But the spaces for the parks are available and anything is still possible because the Chinese construction industry is changing its visions, standards and regulations at an amazing pace. It launches construction projects with a euphoria about the future that would be rather unusual among Europeans, abandoning without hesitation the past, obsolete project ideas, historic city districts or old buildings. In China's cities there's nothing that lasts for a long time.*

FOSTER'S FATA MORGANA

The inhabitants of Masdar City are still in a state of hope as well. *The project was launched in 2008 as the world's first planned eco city, in the desert near Abu Dhabi. The British architect Sir Norman Foster planned Masdar in a compartmentalized form based on the example of old Arab cities, with shaded alleys and small squares. Both traditional and new forms of construction serve to shade and cool the buildings in the desert heat. In fact, the architecture built so far is as exciting as it was in the initial plans. In Masdar, outstanding technologies can be found such as self-driving electric taxis to replace privately owned cars, modern wind towers for cooling buildings and a 22-hectare (54.3-acre) photovoltaics system. Only the construction progress decelerated enormously: The city was planned to be finished by 2016, have 47,000 residents and be totally self-sufficient in terms of energy and sustainably functional. By 2017, only 13 buildings, five percent of the city, had been completed. The small number of residents are now hoping that their city will finally be finished by 2030.*

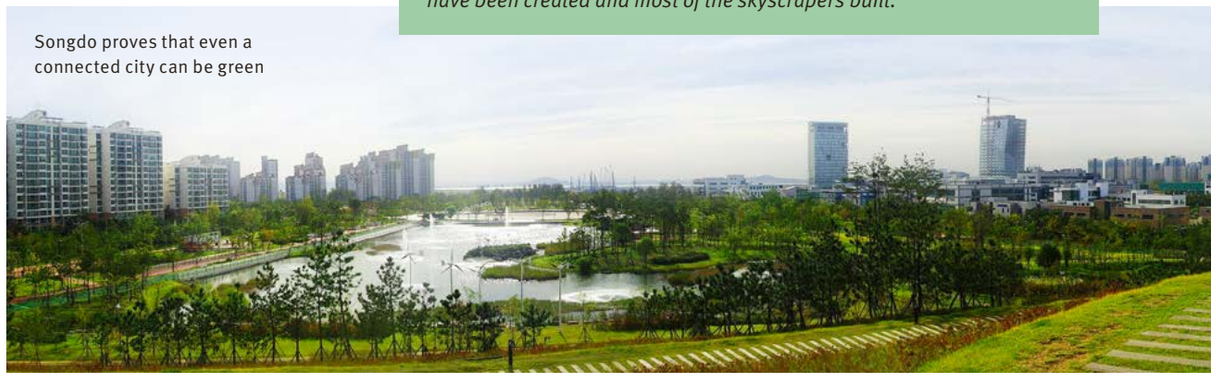
Instead of by 2016 Masdar will only be completed by 2030 at the earliest

MASDAR

SONGDO

DATAFLOW IN SONGDO

There's another current vision for planned cities: the digital, the smart city. *For a city of this type, construction of the South Korean coastal city of Songdo IBD, a six-square kilometer (2.3-square mile) planned city for some 70,000 people, 40 kilometers (25 miles) from Seoul, was started in 2005. Here, as well, everything that a functional city requires has been planned: mixed-use areas for living, working, education and the arts, large bodies of water and parks that occupy about a third of the total area, plus traffic connections via electric water taxis, a subway and buses. The connection of all user data – of residents, visitors and service providers – via the internet, facility engineering, a city-wide camera system and multifunctional chip cards is what makes Songdo IBD a smart city. Residents use the chip cards as transportation tickets, keys to their homes and as cards for health insurance and banking purposes – one card for all needs. An IT system collects all the data and controls the infrastructure, such as facility engineering and local transit systems, as needed. The objective is to optimally control resources like electricity and water and to achieve savings of up to 30 %. Many Koreans view what sounds like an Orwellian nightmare as something that makes everyday life easier and protects the climate. After all, about half of Songdo IBD is already inhabited. Many companies have already moved there, the parks have been created and most of the skyscrapers built.*



Songdo proves that even a connected city can be green

PLANNED CITIES
UNDER CONSTRUCTION

The planned city offers the only opportunity to design livable spaces on a large scale for many people within a short period of time. Every planned city begins with a great vision. But very often, planned cities suffer from the megalomania of those who build them or from the lack of their ability to change in an increasingly fast-paced world.

HafenCity Hamburg, Germany
for 14,000 inhabitants on 240 ha (593 acres), planned completion 2030

Seestadt Aspern near Vienna, Austria
for 20,000 inhabitants on 240 ha (593 acres), planned completion 2028

Ørestad near Copenhagen, Denmark
for 20,000 inhabitants on 310 ha (766 acres)

EuropaCity near Paris, France
Entertainment district on 80 ha (198 acres) with hotels, shopping malls and attractions for 31 million visitors/year, no inhabitants, planned completion 2024

Rawabi, West Bank
for 90,000 inhabitants on 630 ha (1,550 acres)

Lingang City, China
for 800.000 inhabitants on 45,326 ha (112,000 acres), planned completion 2020

Sejong, South Korea
Administrative capital for 500,000 inhabitants on 46,523 ha (114,961 acres), planned completion 2030

Ciudad Caribia, Venezuela
for 100,000 inhabitants, planned completion 2018

Naypyidaw, Myanmar
planned as the capital for nearly 1 million inhabitants on 705,440 ha (1,743,180 acres)

3000

... planned cities planned as capitals
Canberra, New Delhi, Valletta

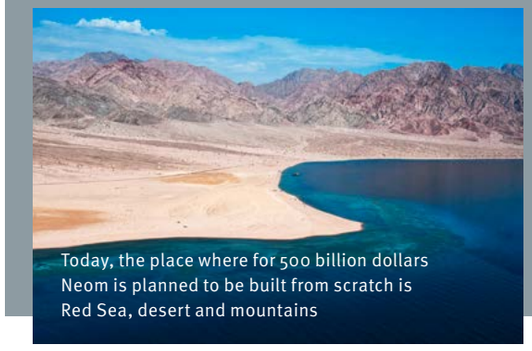
... ancient planned cities
Augsburg, York, Jerusalem

... planned cities built as fortresses
Neuf-Brisach, Bourtange, Saarlouis

NEOM

"NEVER-SEEN-BEFORE"

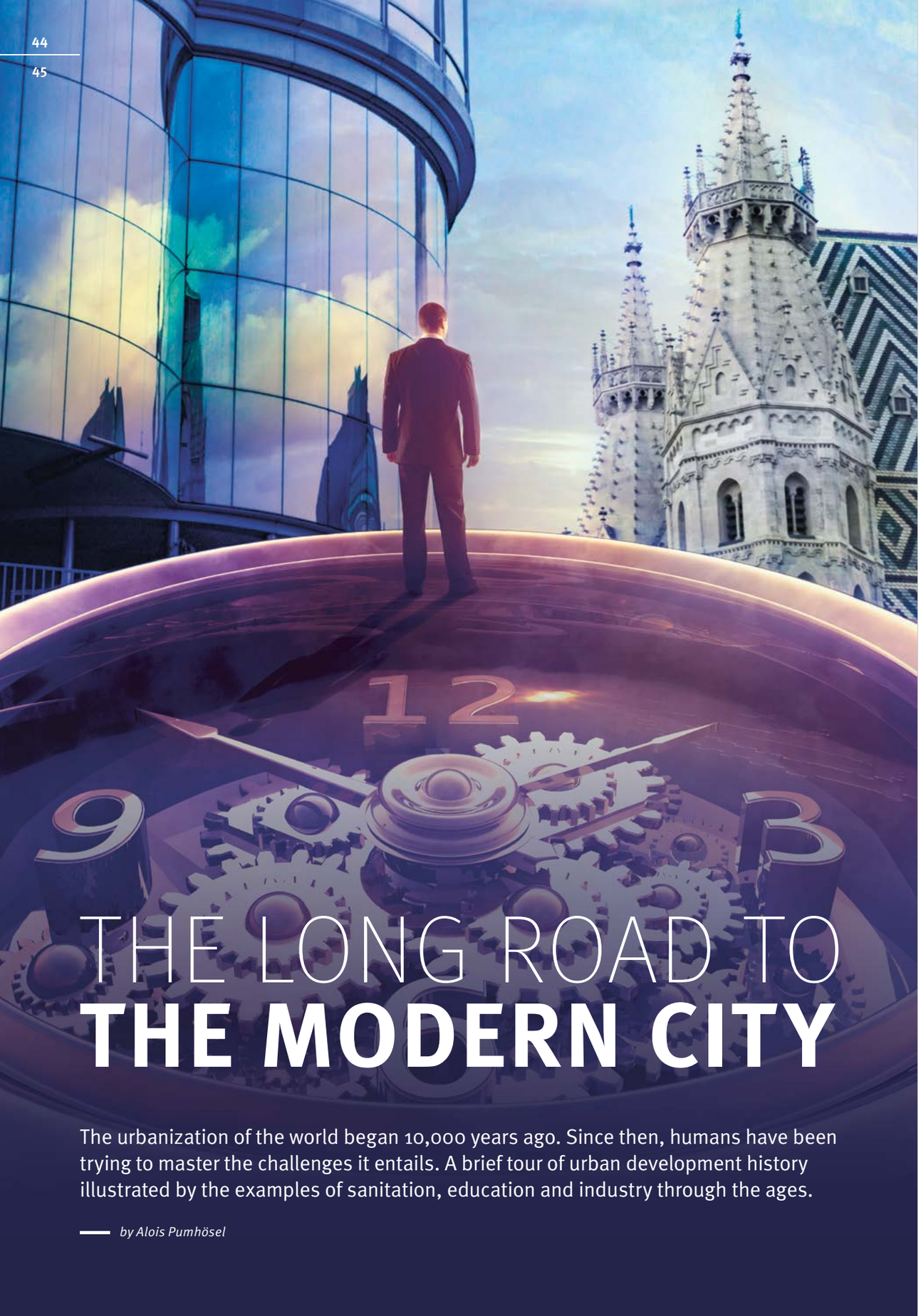
While Songdo has already become reality, the House of Saud is planning to top all previous planned cities. *On the Red Sea in the Saudi Arabian middle of nowhere, in an area larger than the Paris metropolitan area, the city of Neom is planned to be built. While the city at the moment is still desert rock it's also more than that: Neom is a utopia of superlatives with a 500-billion dollar budget. Here people are supposed to live together in more relaxed, varied, modern, smarter and happier ways. They're supposed to explore new technologies and establish new business sectors, and to advance culture, the arts and education, an automated infrastructure as well as climate and environmental protection. In the words of the investors: a place of "an extent never seen before for a new, inspiring era of human civilization."*



Today, the place where for 500 billion dollars Neom is planned to be built from scratch is Red Sea, desert and mountains

THE AUTHOR

Rosa Grewe *is a freelance journalist specializing in architecture, structural engineering and urban planning. The rhythm of the city entered her bloodstream during a year spent in Mexico. That's why she studied architecture majoring in urban planning. That's why she subsequently went to Barcelona. That's why she moved to Rhine-Main after that. That's why today she lives in the heart of the city and writes about the city – and about the people that bring it to life.*



THE LONG ROAD TO THE MODERN CITY

The urbanization of the world began 10,000 years ago. Since then, humans have been trying to master the challenges it entails. A brief tour of urban development history illustrated by the examples of sanitation, education and industry through the ages.

by Alois Pumhösel

The original reason why humans permanently settled down and cities evolved can be found – in the country. The ability to grow crops and raise livestock made it possible to feed many people in one place. Humans became sedentary. Settlements were established, expanded and turned into towns. But as populations grew, so did problems. Johann Peter Frank, a physician in the Franco-German border region, in 1790 made the famous statement: "Most of the ills that plague us stem from humans themselves." They include garbage, dirt and diseases.

Some of the early advanced civilizations already had water supply and sewage systems – achievements that would subsequently characterize many cities in Greek and Roman antiquity as well. The ancient Sumerians in today's Iraq are said to have even had toilet rooms with flushing systems. However, in the Medieval Period, much of the knowledge from antiquity was lost again. In his article "Hygiene und Öffentliche Gesundheit" ("Hygiene and Public Health") Martin Exner explains that the average life expectancy at the beginning of the 20th century was about 45 years – equating roughly to that of a Roman 2,000 years ago. This shows how advanced people in antiquity were in terms of sanitation.

City life and sanitation – a dichotomy with a long history

When looking at the conditions in medieval cities low life expectancy comes as no surprise. Nobles and servants alike grossly neglect sanitation and personal hygiene. Livestock typically dwell in the same four walls as humans. Clean water is in scarce supply and, due to the misbelief that water might penetrate the skin through the pores and thus cause serious diseases, washing is reduced to a minimum. The consequences of this lack of hygiene are epidemic diseases such as the plague, smallpox or cholera.

Only in the High Middle Ages do water supply and sewage systems gradually return to the cities. In 1596, the Englishman Sir John Harington comes up with the revolutionary design of a flushing toilet with a tank and flush valve – the first example of modern sanitary engineering, albeit one that won't be followed by others for a long time. The common people continue to live in deplorable conditions much longer. In the 18th century, Johann Peter Frank writes: "In a very large number of houses, there are no privies at all and certain containers are used for each family so long as this is possible. The place where all excretions are collected is either a dung heap enclosed in the narrow yard or perhaps even the public street."

Only in the 19th century, many big cities issue stricter regulations. Yet 2.3 billion people are still living without basic sanitary systems today, according to the World Health Organization (WHO). Plastic bags are a popular, albeit poor substitute for toilets in the world's slums. The bags either end up on the side of the street or on the roofs of houses which, ultimately, endangers human lives: 3.5 million people per year die from diarrheal diseases. Creating basic sanitary systems is one of the most urgent challenges faced by growing metropolises in poorer regions.

In 1596

John Harington, commissioned by Queen Elizabeth I, invented the **first flushing toilet.** His contemporaries, however, thought the unusual contraption was a joke, so his invention sank into oblivion for nearly 200 years.

3 cents

is the cost of "Peepoo," a toilet bag invented in Sweden, which makes the **waterless disposable toilet** affordable even for people who live in slums. A mixture of chemicals in the bag kills all germs and transforms human excretions into fertilizer within a few weeks. Thanks to its usefulness for farming the fertilizer can even be sold. The bag itself is biodegradable and dissolves within a year without leaving any residues.

Education is a child of the city

Let's turn to another aspect of urban life: education. The idea of schools is older than one might think. The first known record of a school is found on an Egyptian epitaph written some 4,000 years ago. In ancient cities, entire educational systems emerge: Teachers provide lessons against remuneration on market squares, in backyards or in the private mansions of rich citizens and they usually don't treat their pupils with kid gloves. In

recorded memories of school, the poet Horace describes his teacher, Orbilius Pupillus, as “fond of flogging.”

This early educational system, however, is a far cry from education for the masses. Estimates assume that a tenth of the population gets to enjoy it. And the number of those who do dramatically drops with the collapse of the Roman Empire. In the Medieval Period, cities are no longer the main places of learning. They’re now primarily found in abbeys where the libraries from antiquity are hoarded. The more than 2,000 scripts that have been preserved in the Abbey library of Saint Gall in Switzerland founded in the 8th century bear witness to this. The importance of education only changes again when at the end of the Middle Ages new cities are founded and the ideas of antiquity are rediscovered. In many cities, grammar schools and universities are established.

11 aqueducts

supplied Rome with fresh water in the 2nd century AD. The main sewage system, the Cloaca Maxima, was a 3 meter (9.8 feet) wide, 4 meter (13.1 feet) high canal that has been preserved to this day with its outfall into the River Tiber – as shown in this drawing. Other Roman settlements such as Cologne, Trier and Xanten had similar water supply and sewer systems.

The art of printing buds in the city

The most important pioneer of printing is the son of a merchant in Mainz, Germany. In the middle of the 15th century, Johannes Gutenberg develops a technique for making type pieces that can be individually cast and arranged quickly. Movable type is an invention that propels humanity into a new era and restores the former role of cities as centers of learning. By 1500, as many as 252 cities have printing shops. This is where books, and subsequently newspapers, are produced and the majority of their readers are found. American media theorist Neil Postman fittingly put this development in a nutshell: “If the telescope was the eye that gave access to a new world of facts and new methods of obtaining them, then the printing press was the larynx.”

Subsequently, education becomes systematized, frequently starting at urban universities. In the 17th century, Johann Amos Comenius, a Czech pedagogue who also studied in Heidelberg, Germany, advocates mandatory schooling for everyone, irrespective of social origin and gender. His idea catches on. Austria’s empress, Maria Theresia, introduces mandatory schooling as early as in 1774. However, in spite of all the decrees issued by local rulers, school only begins to reach all children in the course of the 19th century – and clearly more effectively in the city than in rural regions where in village schools for all grades a single teacher may teach as many as 100 pupils of various ages. The curriculum is more varied in the city as well. In almost all countries of the world there’s still an achievement gap between students in urban and rural areas, according to the Programme for International Student Assessment (PISA). A larger and more reliable educational offering and a more varied cultural and social environment speak for the city, according to PISA.

1,421 years

old is the **oldest school in the world** that has continuously been providing education until today. It is the King’s School in the English city of Canterbury.

The education offensive driven in the 18th and 19th centuries primarily in the cities ultimately, if not earlier, pays off when factories emerging in the course of industrialization create a high demand for skilled workers. Educational institutions have evolved over centuries into an important element of urban identities: The high-tech location of Silicon Valley for instance originated as Stanford Industrial Park right next to the famous university in California. Many of its graduates started their own businesses there.

Smog as a next-door neighbor

A third aspect without which modern cities are inconceivable is the way in which the previously mentioned industrial revolution has influenced them. The invention of the steam engine in the 18th century makes manufacturing independent of the locations of raw material supply and moves it into the cities – followed by millions of rural residents looking for work. In the 19th century, the population of London skyrockets to seven times its previous number. Slums emerge. The city becomes dirty and loud. “A sort of black smoke covers the city. The sun seen through it is a disc without rays … A thousand noises disturb this damp, dark labyrinth …” This is how the Frenchman Alexis de Tocqueville describes the industrial city of Manchester in the 1830s. Billowing smokestacks, freight trains thumping through residential areas, the factory turns into a next-door neighbor. Due to industrialization, the city also develops a different sense of time than people are accustomed to in rural regions. The rhythm is no longer driven by sunrise and sunset. Factory owners enforce their ideas of punctuality by means of minutely detailed schedules and supervisors. And even today, the old wisdom that the clock ticks differently in the country is still true.

The English industrial city of Stoke-on-Trent in 1946: Factory smokestacks shroud the neighboring residential districts in smog – a typical sight of a city since the beginnings of industrialization. Manufacturing starts to move to dedicated areas on the outskirts only in the 1960s

One after the other, smokestacks grow into the sky in the heyday of industrialization – and social divides widen: “While more and more people flocked to the city, the rich bourgeoisie moved to the outskirts,” explains Bernd Kreuzer, who conducts research into the history of technology at RWTH Aachen. “Good” and “bad” neighborhoods emerge. “Today, you can see in many European cities that the better residential areas are located in the western part of town. The reason is that the predominant weather conditions would blow emissions toward the eastern part.”

What was separated is growing together again

In the 20th century, cities become even more radically structured. “In contrast to the previous mix of commerce, manufacturing and housing, the central modern-day idea of urban planning featured a strict separation of urban districts according to function,” Kreuzer explains. The distances between residential neighborhoods, industrial areas and office districts are overcome by an invention that literally marks a breakthrough – the automobile.

The evolution of technology makes city air cleaner again. Environmental legislation emerges in the 1960s. In the United States alone, in addition to 27 laws, hundreds of environmental regulations are passed between 1969 and 1979. Many industrial nations are reducing sulfur-dioxide emissions to curb acid rain and tree decline. CFCs are identified as the gases that cause the ozone hole and subsequently banned. However, many “reported successes” only show how bad the situation still is: at the beginning of 2018, Beijing was without smog for five weeks – a sensation!

The greatest challenge that has come in the wake of industrialization is the current battle against climate change. The use of fossil energy carriers is reduced and its efficiency enhanced. Digital transformation and artificial intelligence are shaping the new, connected metropolises. Old concepts of urban life are abandoned. “The compact city” in which the places for living, working and shopping are close together is now in vogue again. The city – any city – was, is and will remain an incomplete project.

THE AUTHOR

Alois Pumhösel *commutes between city life in Vienna and country life in Tyrol. As a journalist for the Austrian daily paper “Der Standard” and other publications he writes about science, environment and technology. Whenever he’s had his fill of the hustle and bustle in the city, he retreats into the mountains on foot, a bicycle or skies.*

NO BRAVE NEW WORLDS

The city in science fiction stories rarely lifts the reader's spirits. In most sci-fi novels, people are living in cramped conditions of dirty megacities instead of picking flowers on Mars. But why?

by Wiebke Brauer

"Here begins a happy day in 2381. The morning sun is high enough to touch the uppermost fifty stories of Urban Monad 116." This is how "The World Inside" written by Robert Silverberg in 1971 begins – and even if you haven't read the book you suspect that this is a world of make-believe. "Urban Monad 116" is a three kilometer (1.9 mile) high building inhabited by hundreds of thousands of people who won't leave it until they die. Should any of them come up with the idea that it might be great to see the ocean for a change, they'll be condemned for "anti-social behavior." You can imagine the rest.

Post-apocalyptic worlds

It's hardly an uplifting vision of the way people will be living together in urban areas of the future, but one that's pretty typical of how science fiction writers have been describing plans for city life ever since the beginnings of this genre. If you follow their ideas, future generations will mostly be living in a post-apocalyptic world ruled by totalitarian regimes, in claustrophobic megacities, in subterranean cities like in Hugh Howeys "Silo" or underneath domes described by Isaac Asimov, in tiny "Conaps" described by Philip K. Dick or in tent-like "hotellos" described by Kim Stanley Robinson. Not an appealing thought, not a brave new world, and it does make you wonder why the majority of sci-fi novelists paint such a grim picture of the world's future metropolises.

A likely assumption is that stories about the future reflect present-day fears. The seventies produced a growing awareness of demographic trends, industrialization, environmental pollution and the destruction of resources. In 1972, the Club of Rome published its report titled the "Limits to Growth" and it was also the year in which the World Environment Conference of the United Nations was held that's deemed to have marked the beginning of international environmental policy. This was followed by civic initiatives, changes in legislation, a direct effect on urban planning – and on the imagination of writers who in the seventies virtually wallowed in visions of dystopia. Which, of course, would not explain why H.G. Wells and Jules Verne described air pollution, commercialization and housing shortage even as far back as in their day.

The city as the perfect setting for the future

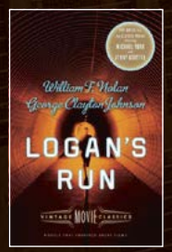
The truth is that ever since the early days of industrialization, the city has provided a perfect setting to portray the consequences of automation – as well as technological progress! Jules Verne in 1863 fantasized about "gas-cabs." Four years earlier, Étienne Lenoir had filed a patent for a gas engine. Looking at it this way, science fiction writers use the metropolis as a platform to express criticism of the present, to craft a plot – and as a possibility to think inventions and developments through to the end. Unfortunately, it's usually not a happy ending.

Naturally, we shouldn't forget that exaggeration is part of the sci-fi genre just like abomination is of horror fiction. "Creation of drama, conflict and suspense" is what academics call this, but it could also be put in much simpler terms: catastrophes are just more fun – especially in cities. A few examples on the following pages illustrate the point …

SCIENCE FICTION CITIES

LOS ANGELES
“LOGAN’S RUN” (1967)

Authors William F. Nolan and George Clayton Johnson



This is what it’s like there *It is the year 2116 – and no, the city is not covered by domes like in the movie from 1976. What it does have is residential complexes and fun parks, plus the neighborhoods are connected by “express belts.” The inhabitants usually get around on foot but are also able to travel around the world underground at “fantastic speeds.” Nature exists to the extent that the extra-urban space is portrayed as a refuge from totalitarian rule.*

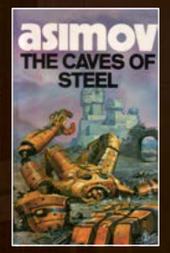
Would we like to live there? *Principally yes, especially since people are living in an affluent society. However, at age 21, they’re eliminated to prevent overpopulation. At least, in the movie, their life span has been extended to 30 years – at which time they’re evaporated in a ritual called “carrousel.”*

OKLAHOMA CITY
“READY PLAYER ONE” (2011)

Author Earnest Cline

This is what it’s like there *In a nutshell: dismal. In 2044, the majority of the population is poverty-stricken following an energy and economic crisis. In Oklahoma City, people live in trailer homes piled on top of each other called “stacks” – and are spending their time near-exclusively in virtual reality, a digital miracle world in which you can play, work – and learn: OASIS (Ontologically Anthropocentric Sensory Immersive Simulation) serves as a free educational system because the official institutions have become dysfunctional.*

Would we like to live there? *No.*



NEW YORK
“THE CAVES OF STEEL” (1953)

Author Isaac Asimov

This is what it’s like there *At the beginning of the 30th century, most of the eight billion people on Earth live in crowded semi-self-supporting domed cities (“caves of steel”). In New York, where the population is over 20 million, the staple food is yeast which also serves as a source of energy. Automobiles do not exist, but expressways and localways – belts moving at various speeds – traverse the city. A popular and dangerous game played by teenagers is “strip running,” a type of race on the belts. By contrast, the so-called “spacers” live in a high-tech parallel society in outer space.*

Would we like to live there? *If so, then in outer space because on the inhabited planets every family lives in its own dome, plus people there can expect to live for as many as 350 years.*

ELEKTROPOLIS
“THE 35TH OF MAY” (1931)

Author Erich Kästner

This is what it’s like there *In his children’s book Erich Kästner describes the city Electropolis with awesome prescience: There are cell phones (“pocket phones”), self-driving cars – steered by a sensible connection of an electromagnetic field with a radio center – and autonomous trains. News are projected against the sky and sidewalks are moving belts. Also, there’s a fully automatic cattle conversion line on the outskirts of the city that sucks cows in at the front – and ejects leather goods and milk at the back.*

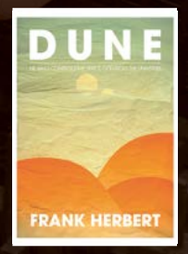
Would we like to live there? *Actually, you’d always like to live in Kästner’s worlds – even in this one. At least, money has been abolished and nobody has to work.*

> ***A gentleman was travelling along the pavement in front of them, when suddenly he (...) took a telephone receiver from his pocket and called a number***
> From “The 35th of May”

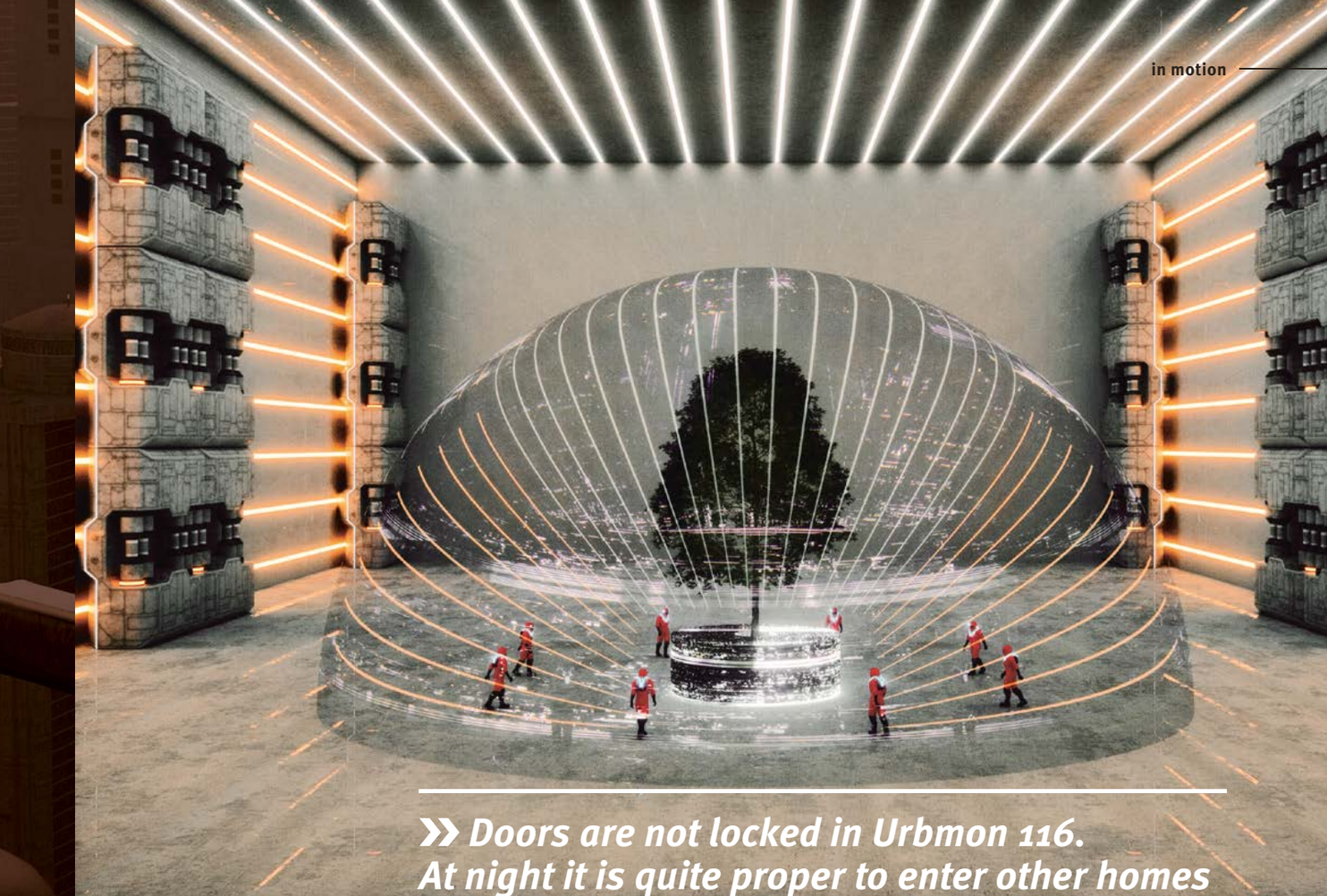
ARRAKEEN
“DUNE” (1965)

Author Frank Herbert

This is what it’s like there *The city of Arrakeen is built on rock on the rather inhospitable planet Arrakis, protected by a mountain range to prevent an invasion of giant worms living there. Human life on the planet is entirely focused on collecting and preserving water. Besides that, “the spice” is collected there, a hallucinogenic drug.*

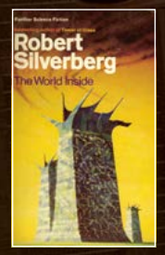


Would we like to live there? *Maybe those of us who really love sand.*



» *Doors are not locked in Urbmon 116. At night it is quite proper to enter other homes*

From “The World Inside”



URBMON
“THE WORLD INSIDE” (1971)

Author Robert Silverberg

This is what it’s like there *The “Urbmons,” short for “Urban Monads,” are cone-shaped skyscrapers inhabited by millions of people who typically won’t leave them during their lifetime – although speedboats commute between the buildings. “Urbmon 116” for example is three kilometers (1.9 miles) high and has 800,000 residents. A computer controls the technical infrastructure, garbage and sewage are recycled. The food for the residents is grown in agricultural communes and delivered to the “Urbmons” by courier capsules. This is another place where the rule applies: the higher you live the higher your social standing.*

Would we like to live there? *Depends on how you look at it. The society is focused on maximum procreation, residents with “anti-social inclinations” (including the wish for fresh air) are thrown down a chute.*

LONDON
“THE SHAPE OF THINGS TO COME” (1933)

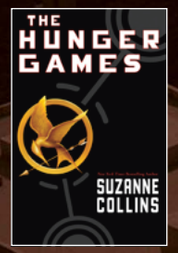
Author H. G. Wells

This is what it’s like there *In the 22nd century, the UK has only four megacities with glass-like climatic enclosures and wind turbines rotating on top of them. London has 33 million inhabitants. Rolling streets take the urbanites from A to B, there’s acoustical advertising in the streets, working class people live in the lower sections of the city and some of them have to produce electricity in the “treadmills.”*

Would we like to live there? *The sentence “The city had swallowed up mankind” doesn’t suggest we would.*

CAPITOL
“THE HUNGER GAMES” (2008–2010)

Author Suzanne Collins



This is what it’s like there *The Capitol is the capital city of Panem and located west of the Rocky Mountains. The rest of the country is divided into 13 districts that supply the Capitol with raw materials. The architecture (and lifestyle of the upper class that exclusively lives in the Capitol) might be interpreted as a modern adaptation of ancient Rome. The 96,463 residents primarily pursue their decadent lifestyle of a high-tech society with genetically modified animals, force fields and high-speed trains.*

Would we like to live there? *If you’re into gluttony and gladiators, why not?*

PARIS
“PARIS IN THE TWENTIETH CENTURY” (1863)

Author Jules Verne

This is what it’s like there *In 1863, Jules Verne writes about the French capital 100 years later: In 1960, people travel on passenger trains propelled by compressed air, there are so-called “gas-cabs” with up to 30 horsepower and the saying goes: “In Paris there are no longer houses, only streets!” In other words, there’s a housing shortage. The prescience with which Jules Verne even back in his day writes about air pollution and as asides mentions a defibrillator, fax machines or huge calculators is amazing.*

Would we like to live there? *Perhaps not, if we felt like Jules Verne who laments women’s liberation that has caused “the Parisiennes to evolve into American women.”*

NEW YORK
“NEW YORK 2140” (2018)

Author Kim Stanley Robinson

This is what it’s like there *In 2140, the sea level – due to climate change – has risen by 15 meters (50 feet). Only the tips of the skyscrapers are above water, linked by sky bridges. There are greenhouses and farming floors in buildings with photovoltaic coatings, cargo airships in the sky, flying communities suspended from balloons and floating cities cruising on the ocean. People move around in New York in “vaporetto” boat taxis or privately owned boats. Here, as well, residential space is scarce and many people live in packable rooms called “hotellos.”*

Would we like to live there? *Honestly speaking, yes, because the description of the “skimmers” is simply enticing: they ride the waves of the flooded streets on their surfboards.*

THE AUTHOR

Wiebke Brauer *from Hamburg is not only a bred-in-the-bone urbanite but also admits to being a sci-fi genre junkie. Even as a child she relished the horrors of movies like “Soilent Green.” While reading the books for this story, she noticed (much to her chagrin) that the frequently described idea of the moving sidewalks has not yet caught on.*

URBAN INTERACTION

The Hanseatic League – a historic confederation of cities as a role model for responsible globalization.

by Jan Oliver Löfken

> ***The things that were important for the Hanseatic League are high on the agenda of globally active companies today as well***
>
> Prof. Tim Hosenfeldt,
> Senior Vice President Technology Strategy & Innovation at Schaeffler

From London to Novgorod, to Visby on the island of Gotland to Cologne: The Düdesche Hanse or Hansa Teutonica dominated trade in Northern Europe for some 500 years. From Central and Western Europe salt, fabrics and metal goods would travel eastward while coveted commodities such as fur or wood were shipped westward on the way back. Hansa trade – a highly profitable business for its merchants – had effects on regions as far as Asia and Africa. Thus, the importance of this initially rather loose alliance kept growing. Its home bases – with Lübeck in Germany serving as the hub – became increasingly rich and powerful in the confederation of cities forming the Hanseatic League of nearly 300 coastal and non-coastal towns. Thanks to Hansa trade merchants as members of the bourgeoisie for the first time found themselves on a par with princes and kings.

The Hanseatic aims resemble those of modern business

Safe trade routes on land, through rivers and channels and, above all, across the Baltic Sea were just one key to Hanseatic success. In the 13th century for instance, the "Hansa cog" evolved into one of the most efficient means of transportation at the time. The importance of these wooden vessels was nearly the same as that of today's container ships. They would carry cargo weighing up to 200 metric tons (220 short tons) and even small crews could safely navigate them in rough seas. Advanced technology and modern logistics in a closely knit network of cities are extremely important. "Shared logistics, end-to-end supply chains, enhanced efficiency at the lowest possible cost and leading-edge technologies: the things that were important for the Hanseatic League are also high on the agenda of globally active companies today," says Professor Tim Hosenfeldt who is responsible for corporate technology, strategy and innovation at Schaeffler. These factors alone, however, cannot explain the success of the Hanseatic League. Equally important are integrity, trust and reliability – Hanseatic virtues put in a nutshell. They were the cornerstones on which the Hanseatic League was able to grow and prosper. Even the term "Honorable Merchant" soon emerged during the Hansa period, a guiding principle that in German-speaking countries today still stands for responsibility, modesty and resulting long-term business success.

After the Hanseatic League's demise in the wake of the Thirty Years' War in the middle of the 17th century, no other confederation of cities ever attained so much influence and power again. Yet fundamental principles, the Hansa ideas, have lived on. "In the Hansa kontors (trading posts) for instance, goods would be carefully inspected and provided with respective seals," says Lübeck historian Rolf Hammel-Kiesow, a Hansa expert and honorary professor at Kiel University. "The Hanseatic League practically introduced quality inspections, standardization and branded goods into business life, which tremendously facilitated international trade." These aspects immediately suggest a comparison with the European Union: a cross-border economic area with standardized rules and a currency of its own (the euro in the EU and the "Lübische mark" in the Hanseatic League). This enormously facilitates and promotes trade within the EU's borders and strengthens the EU in negotiations with other economic powers.

The WTO as a global modern-day Hansa

From a global perspective, today, the World Trade Organization (WTO) by coordinating the economic

Many Hanseatic cities like Gdánsk shown here are still characterized by old kontor buildings

THE HANSA COG FROM S TO XXL

From the 13th century on, the Hansa cog evolved into one of the most efficient means of transportation at the time, comparable with the significance of today's container ships. The ships would carry cargo of up to 200 metric tons (220 short tons) and even small crews were able to safely navigate them in rough seas.

Small cog **Cog with forecastle and aftercastle** **Three-masted caravel-built hulk with weapons**

policies of the member states and mediating disputes among them takes on Hanseatic tasks as well. Cities, however, no longer directly play any part in the two modern alliances of the EU and the WTO. It is the national states that negotiate agreements and pass joint resolutions. By contrast, in the Medieval Age, the Hanseatic League was based on the unanimous consensus of some 70 cities. The decisions were binding upon the merchants from more than 200 cities from the estuary mouth of the Rhine river all the way to Estonia.

A Hanseatic League of science

The idea of a confederation of cities, though, has not completely disappeared. In 1980, the "New Hansa" was formed – a confederation of cities extending from Finland and Belarus via Poland and Germany all the way to France and the United Kingdom – with a total of 190 modern-day Hanseatic cities in 16 countries. This community is focused on exchange emphasizing culture and science. The cities aim to "keep the Hanseatic spirit of the cultural and civic community alive." The self-awareness of the cities and towns within the national states and confederations of states such as the EU is to be strengthened. "An initiative like this should not be underestimated," Hosenfeldt agrees: "Because access to knowledge is a really important commodity for the globalized economy as well." Although such a close alliance of cities does not yet exist at a global level mayors from all over the world exchange their knowledge and experience at Habitat conferences initiated by the United Nations. This is intended to help master many challenges from climate change to growth in megacities such as Lagos in Nigeria, Mexico City and Karachi in Pakistan more effectively.

Specific exchange of knowledge and people between cities and metropolitan areas even takes place within globally active companies. Do Hanseatic virtues secure sustainable success here as well? "This is a very inspiring thought," says Hosenfeldt and easily comes up with examples from his company. To address topics such as climate change and mobility, research and innovation, multilateral exchange on an equal footing is very important – for Schaeffler as well. The company, among other things, maintains a global innovation network called SHARE (Schaeffler Hub for Advanced Research) that closely cooperates with universities, institutes and research facilities in the areas of research and development for urban and interurban mobility. "We connect people, interlink knowledge and thus build local mutual trust," says Hosenfeldt – a basis that goes a long way in assuring the satisfaction of customers and business partners.

Urban cornerstones of democracy

In our times, in which nationalist tendencies are on the rise, threats of protective tariffs loom and the termination of political and economic treaties is becoming reality, does a meaningful niche for confederations of cities even exist at all? Benjamin R. Barber, one of the most influential U.S. political scientists, would have answered this question with a clear "yes." Before his death about a year ago, he emphasized the important role of cities in an essay for "Internationale Politik" (IP), a notable foreign policy magazine. This the hour of the cities, he wrote, which have by now grown into global cities. It is up to them to save democracy once again. While even Barber himself admitted that this challenge might be out of their league he felt that it was more likely for cities to be able to help govern the world democratically from the bottom up and to resolve issues pragmatically instead of ideologically. What opportunities for this exist today is anyone's guess, but the Hansa merchants would have liked the idea.

CONNECTING CONTINENTS

China is planning to invest some 900 billion dollars in the "New Silk Road" infrastructure project *that bears some similarities to the ancient Silk Road and the historic Hanseatic League. Numerous metropolises in about 70 countries are already involved in the project billed, initiated and driven by the Chinese as "One Belt, One Road." New roads, railroad tracks, airports and seaports are planned to be built between China in the east, Europe in the west and Africa in the south. 62 percent of the world population would be affected by this mammoth project.*

The Schaeffler Group actively participates in the "One Belt, One Road" initiative and related projects, coordinated by Professor Rainer Lindner PhD, CEO of the Subregion Central & Eastern Europe/Middle East & Africa:

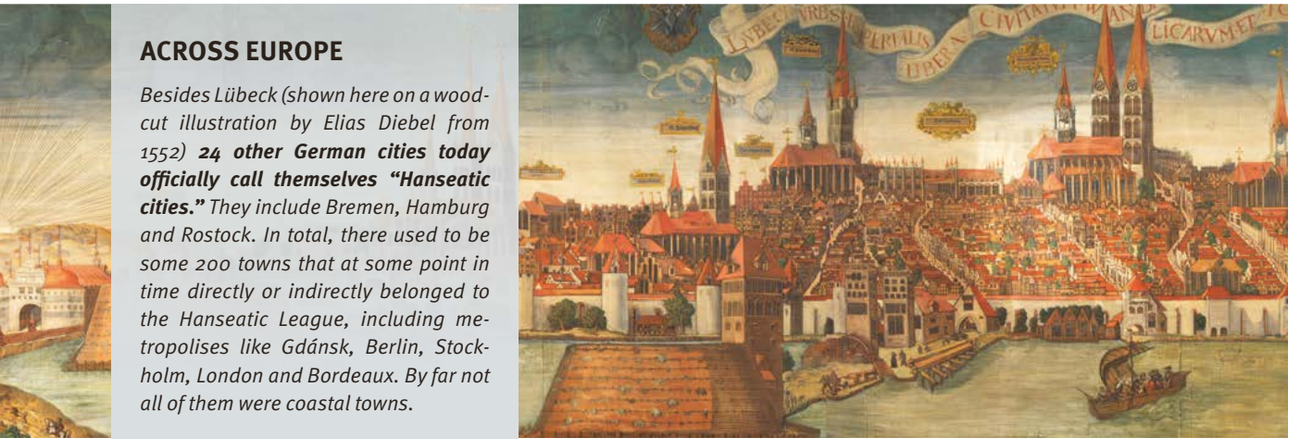
— *In a project launched at Expo 2017 in Astana, Schaeffler supports the modernization of the Kazakhstan railroad. Kazakhstan is an important hub for many routes along the New Silk Road.*

— *Development of other railroad projects in the Asia/Pacific region (including Indonesia, Malaysia and other countries).*

— *Already actively deployed are rail shipments of cargo on the track between the Duisburg Harbor and China.*

— *Schaeffler taps into business potential in the Khalifa Port Abu Dhabi Phase II project.*

— *Schaeffler, together with the Foreign Office, initiated the "Eurasian Connectivity" working group that, in addition to the German federal government, includes companies and business associations. The working group's objective is the timely gathering and evaluation of information about new projects.*



ACROSS EUROPE

Besides Lübeck (shown here on a woodcut illustration by Elias Diebel from 1552) ***24 other German cities today officially call themselves "Hanseatic cities."*** *They include Bremen, Hamburg and Rostock. In total, there used to be some 200 towns that at some point in time directly or indirectly belonged to the Hanseatic League, including metropolises like Gdánsk, Berlin, Stockholm, London and Bordeaux. By far not all of them were coastal towns.*

THE AUTHOR

As a physicist and science journalist for numerous supra-regional media ***Jan Oliver Löfken*** *enjoys writing about new approaches to energy, mobility and urban development. As a native of Hamburg he appreciates the combination of reliability and liberality of the Hanseatic metropolis.*

» Any foolish boy can stamp on a beetle, but all the professors in the world cannot make a beetle
Arthur Schopenhauer

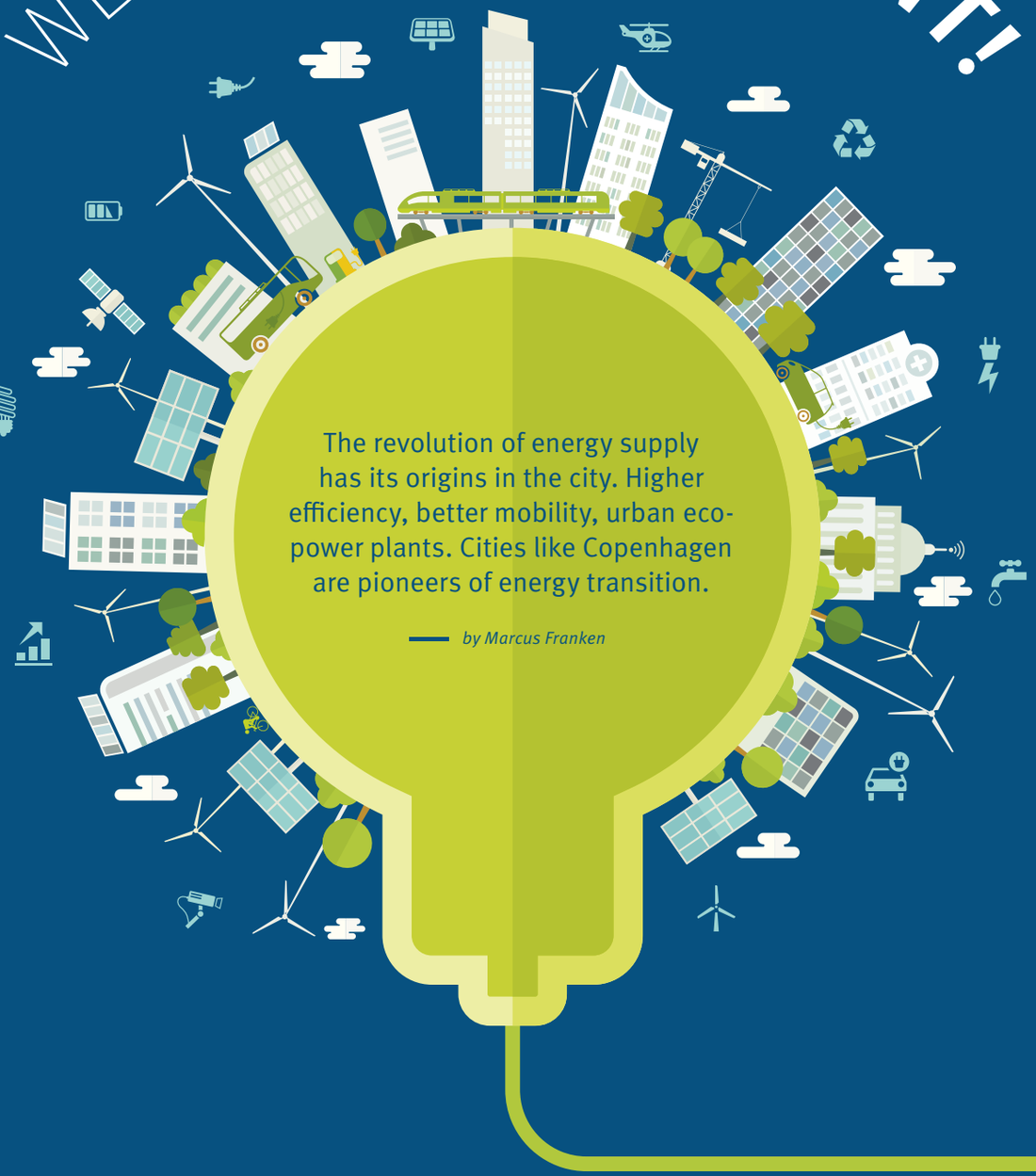
MEGACITIES
"EN MINIATURE"

Ants have been populating our planet for some 150 million years, in other words since the days of the dinosaurs, creating impressive habitats. A colony of ants is ruled by a queen as the only fertile female. The male ants exclusively serve to fertilize her eggs. The sterile females are minor or major workers or soldiers. The workers and soldiers may include "specialists" depending on the subspecies. Some of the workers of the honeypot ants – one of about 13,000 ant species – depicted here serve as living larders for their community, gorged with food up to the point of becoming immobile. An ant colony may be a village with just a few hundred insects or a megacity with a population of 20 million. Such a big city of ants may reach the dimensions of a detached three-level house (see graphic). As "urban planners" the little architects are highly creative, constructing underground nests, hills, nests in trees and plants, as well as hanging ones, and even nests in tidal zones that can be closed watertight when the tide is high. In the case of some species such as the Argentine ant introduced to Europe the typical monogyny with one queen has evolved into polygyny with several queens. By budding, polygynous species form ever new, rather small nests that may turn into super colonies. The largest documented one extends over nearly 6,000 kilometers (3,728 miles) of the coastline from Galicia in Spain to Northern Italy. Billions of ants belong to this huge living structure. It is the largest agglomeration of multicellular organisms in the world.

A DETACHED HOUSE VS. AN ANT HILL

The largest single nest of an ant colony ever measured had a footprint of 50 square meters (538 square feet) and a depth of eight meters (26 feet). An ant colony is able to create 1,900 chambers in six years. To accomplish this feat, the ants have to haul 40 metric tons (44 short tons) of soil out of and six metric tons (6.6 short tons) of cut leaves into the chambers.

WATTS AND VOLTS? WE'RE SELF-SUFFICIENT!



The revolution of energy supply has its origins in the city. Higher efficiency, better mobility, urban eco-power plants. Cities like Copenhagen are pioneers of energy transition.

by Marcus Franken

The future always hits the cities first. And the Little Mermaid in Copenhagen's harbor had already seen a lot: the first airplanes, the first automobiles, the first avant-gardists of the 1960s – who beheaded her. But wind turbines in the water – in 2000, that was a new sight to behold even for the mermaid.

By 2025, Copenhagen will be self-sufficient in terms of carbon-neutral electricity supply, as the first capital city in the world, the city government has promised. The 20 wind turbines which the city built in the Øresund back in 2000 – within sight of the famous mermaid – marked the first step. A small city as a role model for the world?

Clearly, cities are growing at a rapid pace, which makes urban agglomerations hotspots of energy consumption. Especially in countries like India and China, the demand for energy has increased as much as three-fold since 1990. If the current trend continues the worldwide energy requirement will more than double again by 2050.

Today, urban centers already account for two thirds of the energy consumption, according to a Siemens study and, based on the Paris Climate Agreement, the energy demand should be covered by renewables. But whereas sparsely populated rural regions can satisfy their electricity requirements with a few wind turbines and solar systems, the possibilities of the big cities are limited. Even in a city like Berlin with a population of 3.6 million only five large wind turbines exist today – all of them located on the outskirts. In spite of solar systems on many roofs of the city, Germany's capital, by its own account, is not even able to produce four percent of its electricity demand itself. In terms of thermal energy for heating and fuels for automobiles the rate is practically zero. In multi-million urban agglomerations like Tokyo, Delhi, New York or Shanghai, the situation is even worse.

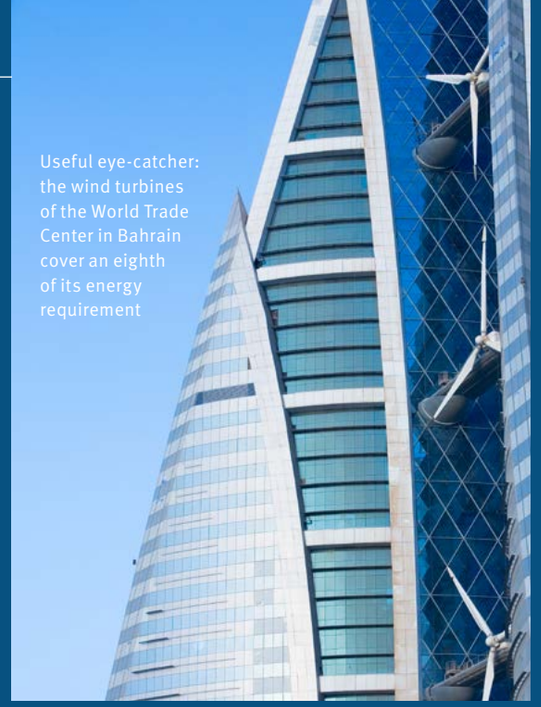
Cities as eco-pioneers

Actually though, the inhabitants of high-density big cities have the opportunity to be the real eco-pioneers because in terms of energy consumption, the individual urbanite regularly does better than people living outside of cities. In Germany, for instance, average CO_2 emissions amount to 11 metric tons (12 short tons) per capita and year. In Hamburg, by contrast, it is six metric tons (6.6 short tons) and in Berlin only about five (5.5) per capita. In Paris, London, Singapore, Moscow and Hong Kong the individual citizen uses comparably little energy as well. The reason is simple: People in the city have relatively

Those who harvest wind produce electric current: Copenhagen's most important energy source is in the ocean

short distances to travel, are less dependent on cars and have better opportunities to switch to bicycles, buses and trains. Apartments in cities are smaller as well. They consume less energy for heating than detached houses in the countryside.

Large, dense and compact – conditions that are not conducive to quality of life present a major opportunity for climate protection and energy supply particularly if in addition to offices and residential areas industrial infrastructures are present as well. Let's take Hamburg for example: There an old copper smelting plant in the Veddel industrial harbor will supply the new HafenCity with heat in the future. The pipes are currently being built. Or take high-rises: The architects of the Bahrain World Trade Center integrated three wind turbines in the 240-meter (787.4-foot) tall twin towers that supply as much as an eighth of the energy required by the building. Mobility is another example: In cities like Berlin only one in two people has a driver's license for automobiles. Instead, rental cars, rental bikes and the public transit system with buses and trains are available throughout the city. "If all of this can be used via a single app like planned in Munich and other places mobility of the future has to some extent already become reality," says Weert Canzler. The mobility expert at the WZB Berlin Social Science Center is convinced that vehicles with efficient electric powertrains are the future. And that this future will begin in the cities.



Useful eye-catcher: the wind turbines of the World Trade Center in Bahrain cover an eighth of its energy requirement

REYKJAVÍK

is regarded as the world's cleanest city, even outstripping Copenhagen and other "green" strongholds such as Vancouver and Oslo – thanks to the forces of nature. Iceland's capital city with its population of 120,000 is supplied with electricity, thermal energy for heating and hot water by hydropower and geothermal energy. By 2050 at the latest, fossil fuel for internal combustion engines is supposed to have become a thing of the past as well.

Plus, one of the oldest vehicles is now experiencing a revival: the bicycle. In Copenhagen, the number of cyclists commuting in and out of the downtown area surpassed those using cars already in 2015. Because the city promotes the use of bicycles by providing better bike paths and more direct connections the number of cyclists has nearly tripled since 1970 whereas the number of car drivers has dropped by more than a third. So does that mean that only environmentalists live in Denmark? Not really. Copenhagen, according to Forbes, is one of the most expensive and desirable places to live in Europe. And only one in a hundred cyclists uses a bike for environmental reasons. A survey has shown that most people choosing to ride bicycles do so because they're cheap, healthy and fast. City governments in Asia that for decades were endeavoring to replace bicycles by automobiles have since discovered the advantages of the pedal-powered two-wheelers as well. Bike rentals are burgeoning there.

Electricity and heat: wood replaces coal

But where will the electricity come from if in the future cars are going to need energy from the grid just like the growing number of buildings being heated with electric heat pumps? Copenhagen is committed to producing its own electric power. The city has not only invested in the 20 wind turbines in Øresund and other offshore wind farms but also operates wind turbines of its own in Jutland and Lolland. Other cities have been following suit. The public utility in Munich for instance has secured wind farms as well, particularly in the distant North Sea, and comments with pride: "By 2025, we intend to produce as much green electricity in our own wind farms as Munich needs." The public utilities of other cities are investing in renewable energies as well and many local politicians are urging the operators of old coal-fired power stations to replace the CO_2-belching plants by climate-friendly ones. Pressured by the city, the Vattenfall power company recently replaced a large brown coal fired power plant by more eco-friendly gas-fired power stations.

But Copenhagen is taking things a step further in this area as well. Also within sight of the Little Mermaid, Denmark's largest utility company, Hofor, is currently building a power station that will exclusively burn wood, starting next year. The carbon dioxide emitted in the combustion process of wood is simultaneously trapped where the wood for the coming years is currently regrown. Even today, the CO_2 emissions of every resident of Copenhagen are only 2.8 metric tons (3 short tons) per year. The new power plant will supply a third of Copenhagen's households with climate-friendly heat. This will bring the city another step closer to reaching its goal of successfully completing its energy and climate project by 2025. Plus, it'll become an even more attractive destination for mayors from all over the world to visit and learn from its example.

2,394

solar modules have been covering the roof – the size of a soccer pitch – of the Paul VI Pontifical Audience Hall for ten years now. The system has a **total capacity of some 220 kilowatts** and supplies about 300 megawatt hours of electricity per year, which equates to roughly the **annual requirement of 100 European four-person households or one fifth of the Vatican's demand.** The German pope, Benedict XVI, also pushed through waste separation in the smallest state of the world at a time when in the surrounding Italy this was still regarded as a hobby of freaks.

THE AUTHOR

Marcus Franken *studied environmental engineering in Berlin, worked as an environmental journalist and is now in charge of Ahnen&Enkel, an agency that provides consulting services to companies regarding environmental topics. In spite of being a staunch urbanite he spends nearly every weekend at the family's "dacha" in the country where the wind turbines in the Uckermark region provide him with a live experience of energy transition right on his doorstep.*

CATHEDRALS OF MOBILITY

New York

Grand Central Terminal (officially opened in 1913, photographed in 1930)

67
tracks in total on two levels: the Grand Central Terminal has more tracks and platforms (44) than any other train station in the world.

750,000
people enter the terminal every day, more than any other building in the United States.

One
minute: The **200 clocks** of New York's Grand Central Terminal are one full minute fast – as a safeguard to prevent passengers from missing their train.

Static structures as symbols of dynamic momentum: Around the world, magnificent train stations are impressive urban islands of permanence in a world of fast-paced mobility.

by Kay Dohnke

67 tracks! 75 meters (246 ft) tall, 180 (591 ft) meters of façade! 2,600 trains and and two million passengers daily! No matter in what era they were built: Train stations are still breaking records today. Their history is inseparably tied to the rapid growth of worldwide rail transportation. As important elements of our cultural heritage, the most beautiful, extravagant stations symbolize the era of a world in motion.

Nobody had any idea of how the summer of 1835 was going to fundamentally change the world. The first railroad established in Continental Europe from Nuremberg to Fürth is deemed to have been one of the central events marking the birth of rail transportation – which goes on to see a truly explosive development. In 1840, only 8,591 kilometers (5,338 mi) of railroad tracks exist in Europe and as early as in 1880, a railroad network of more than 365,000 kilometers (226,000 mi) opens the door to the world. Sheer endless bands of steel make the remotest corners accessible, shortening what used to be week-long journeys to the length of day trips. Faraway cities are now nearby; railroad tracks make people's dreams of distant places and yen for travel reality.

Marble, domes and baroque style

This rapid breakthrough development is synchronously reflected in the station architects' zeal to build. Train stations are the central anchoring points of this novel and interurban mobility. And these anchoring points nurture the evolution of the cities that surround them in ways that only ports did before them. The big wide world is now moving into the space behind the doors and facades of the stations' concourses. They deliver on the railroad's promise of overcoming space and time. Many cities stage their participation in this Europe-wide and global journey into mechanized mobility in stone, marble and glass. Antwerpen-Centraal receives its 75-meter (246-ft) tall domed concourse as early as in 1905 the Gare du Nord in Paris a 180-meter (591-ft) long neo-classicistic façade in 1864 and the western terminal Nyugati Pályaudvar in Budapest begins to boast its neo-baroque glass façade in 1877 by Gutave Eiffel. In 1888, the Victoria Terminus in Bombay manifests the splendid Indo-Saracenic architectural style in which cultures merge into an all-new entity – today, 1,300 trains are still beckoning two million travelers daily to enter its concourses.

Train stations are abodes of wanderlust

Train travel anticipates what we call globalization today. Railroads pave the way into continents, overcome distances and make it possible to experience cultures in other parts of the world: The Orient Express invites travelers to visit Constantinople. Between New York and Seattle, Los Angeles and Miami trains with names like California Zephyr, Flying Yankee, Silver Meteor or Empire Builder rush through the United States. Many of them are headed for the Grand Central Terminal of 1913, the world's largest train station with 67 tracks. The

Antwerp

Antwerpen-Centraal (opened in 1905)

75 meters (246 ft)

high is the dome of the main concourse, modeled after the **Pantheon** in Rome, to which the platform concourse is connected (185 m/607 ft length, 66 m/217 ft width, 43 m/141 ft height).

In 1835

the first train stopped in Antwerp. At that time, the Astridplein, still the central station's address today, **was on the outskirts of the city.**

From 2000 to 2009

Antwerpen-Centraal, **one of the world's most beautiful train stations,** was thoroughly modernized and modified, including two new subterranean levels, to accommodate high-speed train service.

Liège

Liège-Guillemins (opened in 2009)

312 million

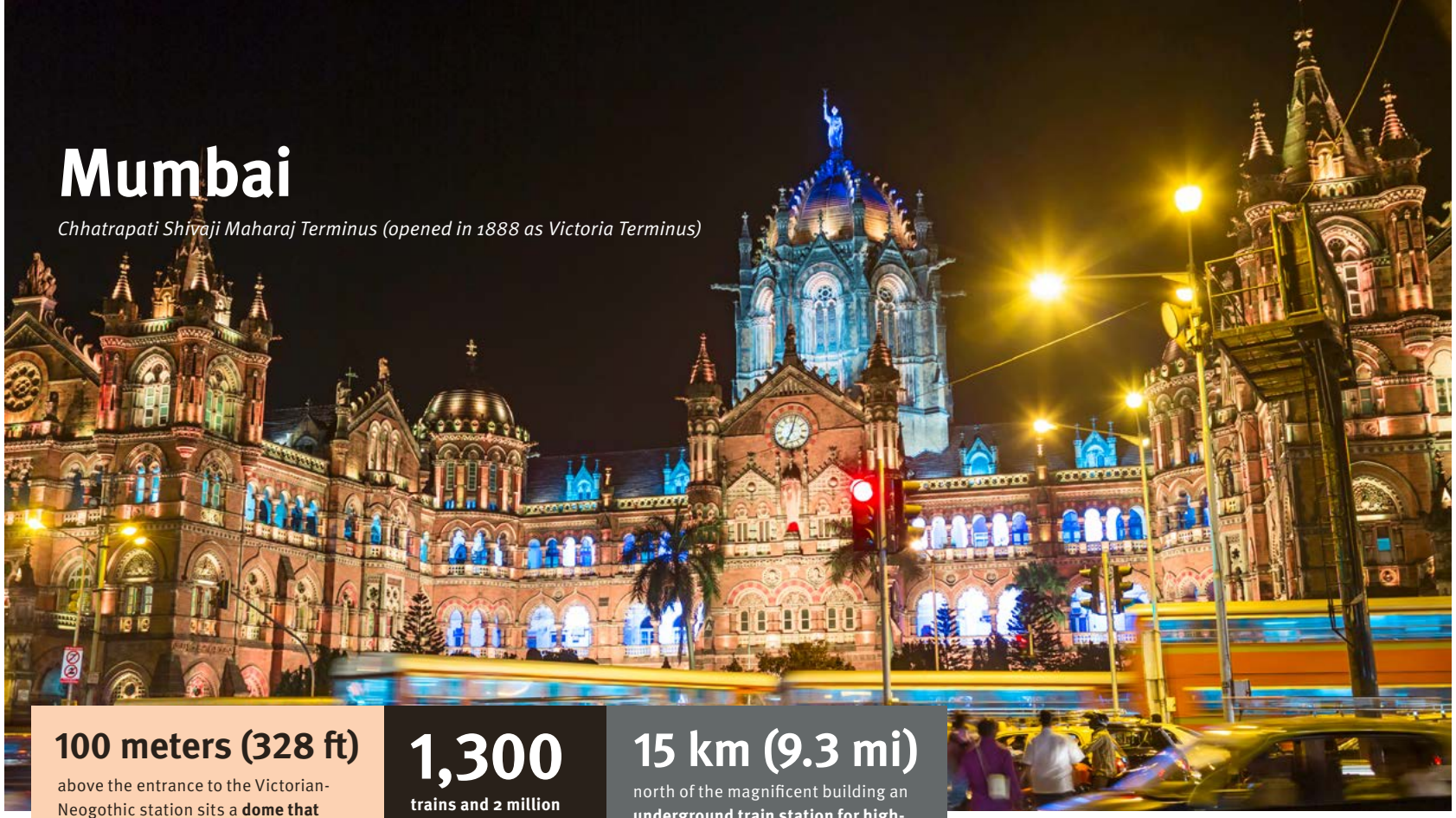
euros were invested in the **new construction project.** The 200 meter long domed roof with 39 steel arches is so transparent that no additional lighting is required during the day.

100 instead of 40 km/h

(24,9 mph) is the **permissible speed at which trains may enter** this station compared with the previous one (a functional building from the 1950s).

Mumbai

Chhatrapati Shivaji Maharaj Terminus (opened in 1888 as Victoria Terminus)



100 meters (328 ft)
above the entrance to the Victorian-Neogothic station sits a **dome that can be accessed.** Perched on it is the "Progress" statue.

1,300
trains and 2 million people per day use the 18 tracks.

15 km (9.3 mi)
north of the magnificent building an **underground train station for high-speed trains** is in planning – start of construction TBD.

Trans-Siberian Railway connects Moscow with the far eastern lands of the Russian Empire and in 1957 the Trans-Europ-Express begins to traverse at high speed countries that are just slowly beginning to grow together politically.

Even to those who couldn't afford to travel in those days train stations would offer the chance to indulge in a little bit of wistful wanderlust – by walking through awe-inspiring portals, window shopping in the classicistic sandstone concourses, sharing the dreams of far-away places and adventures with the people in the waiting halls. Train stations provided the appropriate setting for nurturing the hopes linked to departures, feeling the pain of farewells, and the shedding of tears of joy upon the arrival of loved ones returning from a journey.

Train stations in the course of time

And then the automobile appears on the scene and redefines all dreams of long-distant travel and mobility. From the 1950s on, its triumph causes one rail service after another, one rail line after another to disappear and train stations are falling victim to the mass of cramped suburban trains that degrade from being a symbol of the pleasures of travel to a symbol of the daily grind. Only when high-speed trains make cities increasingly fast to reach and the railroad pits its fortes against the over-abundance of automobiles the tables turn again. Today, masterpieces of engineering – just having traveled as swift as arrows at 300, 350 kilometers (180, 220 mi) per hour – are rolling into the familiar stations, reviving the travel bug inspired by the trains of old and again evoking the feeling that distant places and regions can be reached, except much faster now than even the most imaginary visionaries were able to foresee.

At the end of the 20th century, train stations again become heralds of a new age. Architects like Santiago Calatrava recognize their mission of turning train terminals into symbols of forward-thinking mobility. Modernity and mobility once again are mutually dependent. At Liège-Guillemins – opened in 2009 as a terminal for the Thalys and Intercity high-speed trains – the filigree, modernistic architecture stands for new departures: Trains have long begun to outperform cars and are serious competition for airliners. Calatrava, in 1994, had already expressed this futuristic vision in the architecture of the Lyon Saint-Exupéry terminal and, in 1998, in the Lisbon Expo terminal Estação do Oriente. A little later, this trend was continued in the design of the Southern Cross Railway Station in Melbourne, Australia, and the symbiosis between train stations and shopping malls brought to the fifth continent.

PLEASE UNFOLD ►

Connecting links to a mobile future

Today, both upmarket and normal shopping complement the pleasure of traveling before we nestle into an upholstered seat in the compartment of a train that seems to be flying toward our destination at magic speed. Thus, train stations will continue to be places of transition and transformation, connecting links of stone or steel between the past belief in progress and the future viability of modern engineering achievements.

THE AUTHOR

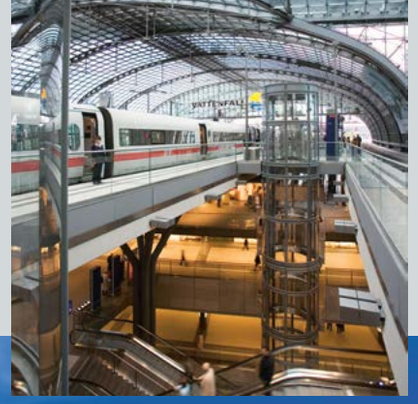
Be it in Alaska or in the Himalayas: As a travel journalist and longstanding editor of the on-board magazine of Deutsche Bahn ***Kay Dohnke*** *has traveled on the quirkiest trains. Ever since he started specializing in sustainability topics, the author from Hamburg has become increasingly aware of the huge future of the iron behemoths.*

Future

The vision of a Transpod Hyperloop terminal

100 % airtightness
of the vacuum tubes is a must during boarding and un-boarding at a Hyperloop terminal: **one of the many technical hurdles** that have to be overcome in deploying this super train technology.

3 times
faster than a current high-speed train: the Hyperloop train operating in a vacuum is supposed to achieve a speed of **up to 962 km/h (600 mph).**



20/20 VISION

Train stations are like icebergs – at first glance, they only reveal a fraction of their total magnificence. *This is also true for the Berlin Central Train Station depicted here. Europe's biggest interchange and split-level station with its 14 platforms is an interchange point between ICE high-speed trains, regional and local passenger service (U/S-Bahn, Regionalbahn, Regional-Express). This is another facility where Schaeffler technology is utilized: the 321-meter (1,053-ft) long East-West roof contains numerous spherical plain bearings/bolt systems.*

Vent stack
for the tunnel of federal highway B96 (height 60 m / 196.8 ft)

Concourse
27 meters (88.6 feet) tall. Inside the hall, underneath the North-South roof, there are ticket counters, shops, restaurants and a "Sky Lounge"

Office buildings
With Deutsche Bahn offices (46 m / 151 ft tall, 183 m / 600 ft wide, 22 m / 72 ft long)

East-West roof
The eastern part of the roof is 107 meters (351 feet), the western part 172 meters (564 feet) long. The gap in between is spanned by the north-south roof. The tracks, up to 430 meters (1,411 feet) long, are covered over a length of about 321 meters (1,053 ft)

S-Bahn
direction of Zoologischer Garten

S-Bahn
direction of Friedrichstraße

Tunnel of federal highway 96 (two lanes in each direction)

Parking garage
with approx. 900 parking spaces

LEVEL 0/ ENTRANCE AREA

LEVEL 2

LEVEL 1

LEVEL 0

LEVEL –1

LEVEL –2

Elevators

Shops

6 panoramic elevators
and 54 escalators connect all levels

North-south connection
in the direction of Gesundbrunnen/ Nördlicher Innenring and Potsdamer Platz – Papestraße
Long-distance and regional travel

U-Bahn line 55
to Pariser Platz and subsequently to Alexanderplatz

S-Bahn line
to Nordring

River **Spree** to Humboldthafen

Source: F.A.Z. graphic/ Karl-Heinz Döring

MAMMOTH MARSHALING OF GOODS

Europe's largest classification yard in Maschen near Hamburg (pictured) comprises 272 km (169 mi) of shunting tracks distributed to 64 in south-north and 48 in north-south direction. *Up to 3,500 rail cars per day can be handled in a total area of 700 meters (2,300 ft) in width and 7 km (4.3 mi) in length. Maschen is an important logistics artery for the metropolis Hamburg and its port. The only classification yard of even more mammoth proportions is Bailey Yard in the geographic center of the United States, in Nebraska, with 507 km (315 mi) of shunting tracks.*

A standard time

for larger regions became a necessity in the 19th century due to the expansion of rail transportation – primarily to avoid train collisions. **Up to that time, all cities and towns around the world had their own local times according to the position of the Sun.** Clocks typically didn't have any minute hands. A universally applicable "world time" was introduced in 1884, then called Greenwich Mean Time (GMT). Since 1972, all time zones have been referenced to the atomic clock based Coordinated Universal Time (UTC) that's still used today.

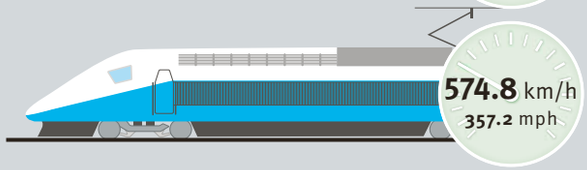
SPEED RECORDS IN THE COURSE OF TIME

2015

603 km/h
374.7 mph

The Japanese **Maglev LO Series** traveling at 603 km/h has held the absolute world speed record for trains since April 2015. In normal service, the train travels at 320 km/h.

2007



574.8 km/h
357.2 mph

A heavily modified **TGV V150** achieves 574.8 km/h in the French Département Marne in April 2017 – the world record for wheeled rail-bound vehicles. The fastest production train in this category is the Chinese **CRH 380A** with 486.1 km/h (302 mph).

2002

256.4 km/h
159.3 mph

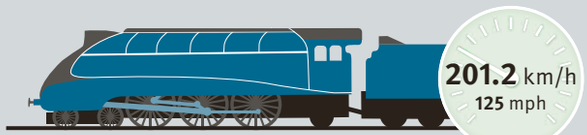
In 2002, the **Talgo XXI** high-speed diesel train prototype pushed/pulled by 1,150 kW-locomotives dashes through Spain at a speed of 256.4 km/h. As the fastest diesel locomotive in regular service a **Krauss-Maffei Class 353** produced for the Spanish state-owned RENFE railroad operator achieves 230 km/h in 1978.

1987

238 km/h
147.9 mph

51 years after the German **DRG SVT 137 "Leipzig class"** in February 1936 was the first diesel-electric locomotive to have broken the 200-km/h (124-mph) mark, the **multiple-unit HST** sets the diesel-electric record that's still valid today: 238 km/h.

1938



201.2 km/h
125 mph

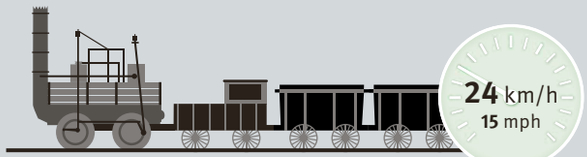
The British **LNER Class A4 4468 Mallard** in 1938 achieves a recorded speed of 201.2 km/h – the unbroken official record for production steam locomotives. The larger and more powerful **U.S. PRR Class 1** steam locomotive purportedly achieved 227 km/h (141 mph) – credibly, though unfortunately not documented.

1931

230 km/h
143 mph

The **rail-bound Zeppelin**, still one-of-a-kind to date, in 1931 travels the distance from Hamburg to Berlin in just 98 minutes, propelled by a twelve-cylinder aircraft engine. Instead of a wheel drive system a propeller accelerates the train to 230 km/h – no train was faster for the next 24 years.

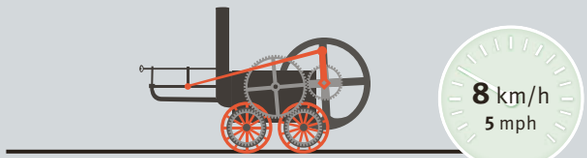
1828



24 km/h
15 mph

The first public train connection is established in 1825 between Stockton and Darlington in North East England. The **Locomotion** achieves 24 km/h. Besides steam locomotives horses continue to be used for pulling trains.

1804



8 km/h
5 mph

The first locomotive was developed by Richard Trevithick. In February 1804, the steam locomotive that's used to haul iron achieves a speed of 8 km/h in Wales.

ROLLING GIANTS – SCHAEFFLER IN RAIL TRANSPORTATION

As a central development partner of traction system and vehicle manufacturers Schaeffler makes rail transportation more sustainable, efficient, quieter and safer. *The portfolio extends from axlebox bearings, traction motors and transmission bearings to wheels and components for vehicle articulation joints, braking and door systems. In addition, railroad operators are able to capture condition data of entire bogies using the Schaeffler Condition Monitoring System to achieve longer mileages and maintenance intervals while increasing operating reliability.*

» Rail transportation in and between conurbations requires shorter and shorter passenger-service intervals, enhanced riding comfort and more eco-friendly technologies. We support traction system and vehicle manufacturers with increasingly powerful components and integrated systems, also, by the way, as mileage-extending retrofit solutions

Dr. Michael Holzapfel
Vice President Business Unit Railways Europe

FORWARD-THINKING SIGNAL

With a research team on the campus of the Chinese Southwest Jiaotong University (SWJTU) Schaeffler is intensifying its collaboration in research and development of axlebox bearings for rail-bound vehicles. *SWJTU is regarded as one of the world's leading universities in the field of railway engineering. "The challenges facing future extra-urban mobility are enormous, as interurban transportation is heavily increasing," says Professor Peter Gutzmer, Chief Technology Officer at Schaeffler and visiting professor at SWJTU. "With its expertise in manufacturing bearings for rail-bound vehicles Schaeffler has been active in this industry for more than 100 years. The collaboration with SWJTU makes it possible for us to create solutions for interurban mobility of tomorrow. We bring together the university's research expertise and our mechatronics know-how as well as our expertise in systems for predictive maintenance of axlebox bearings."*

THE LEADING HIGH-SPEED TRAIN NATIONS

Country	km/h – record/service (mph – record/service)	High-speed portion of rail network	Population near high-speed trains	Ø Fare €/km	Overall ranking
1. Japan	603/320 (375/199)	13.23 %	36.55 %	0.20	100.00
2. South Korea	421/300 (262/186)	1.62 %	44.67 %	0.14	83.79
3. China	501/350 (311/218)	29.22 %	10.70 %	0.22	69.25
4. France	575/320 (357/199)	6.79 %	12.69 %	0.19	49.39
5. Spain	404/320 (251/199)	20.05 %	20.51 %	0.12	41.99
6. Taiwan	300/300 (186/186)	21.84 %	36.25 %	0.12	37.81
7. Germany	368/320 (229/199)	4.75 %	18.28 %	0.19	32.90
8. Italy	400/300 (249/186)	7.91 %	18.47 %	0.15	25.55
9. Austria	275/230 (171/143)	7.06 %	27.55 %	0.18	23.85
10. Turkey	303/250 (188/155)	8.08 %	7.00 %	0.03	22.15

Source: goeuro.com/trains/high-speed

THE CITY WINS THE RACE

Motorsport in the heart of the city: a worldwide trend, pioneered by Formula E. The first fully electric racing series competes exclusively on circuits in big cities like Zurich, New York or Hong Kong (pictured). Here's a look at what makes city races so popular and what their future looks like.

— *by Leopold Wieland*

There's one thing that's always in short supply in races held in the center of cities: space. Not enough for out-braking and overtaking opponents or for accelerating and drifting out of turns because walls – of concrete or metal – confine the street circuits. Brutally, unmercifully. A shoulder to swerve on? No chance! Perhaps an occasional emergency exit, but other than that, just lack of track.

More thrill, more fun

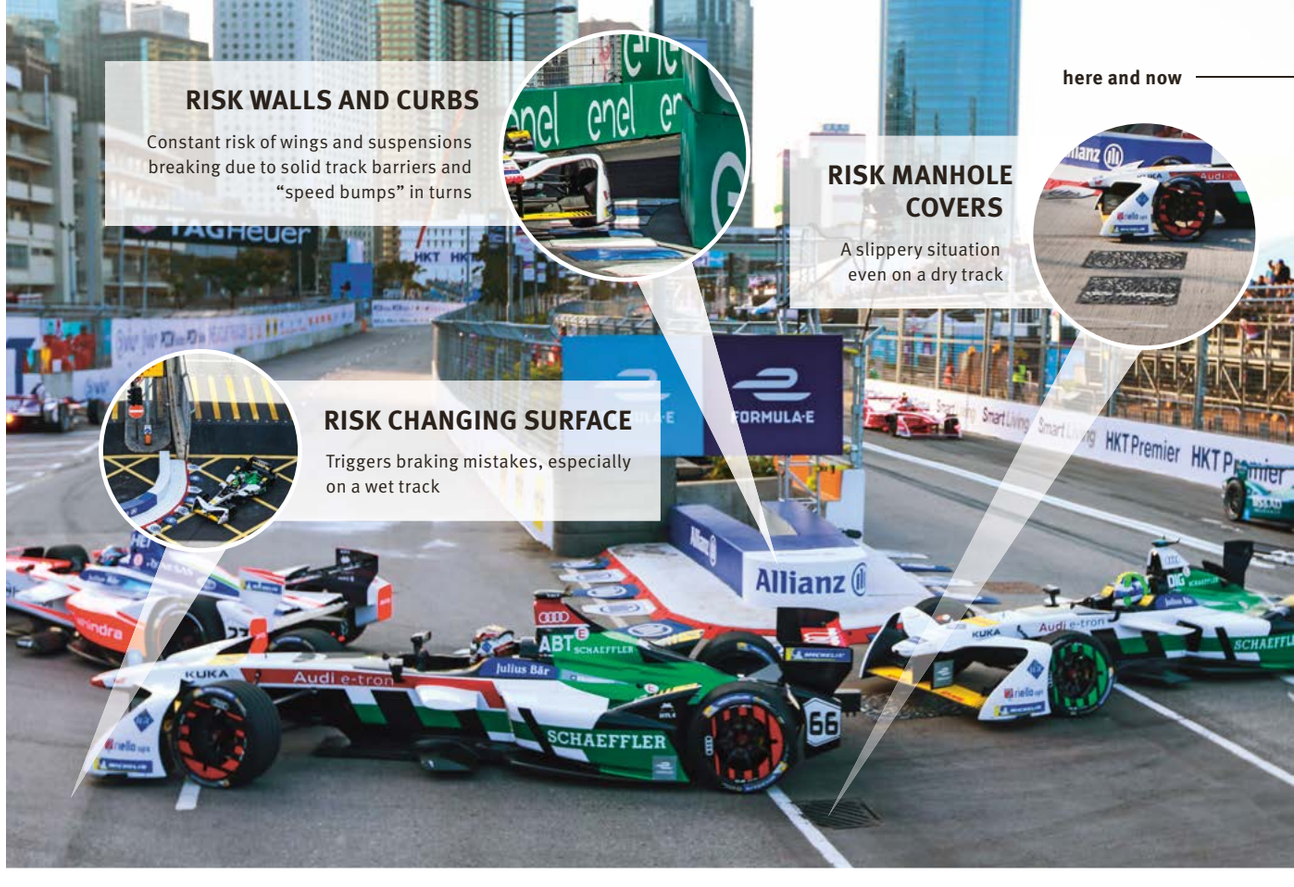
"Every driving mistake, no matter how small, will immediately be punished," says Lucas di Grassi putting the topic of city circuits in a nutshell from the cockpit perspective. The Brazilian from Team Audi Sport ABT Schaeffler is the reigning Formula E Champion and a Schaeffler brand ambassador. "Actually, as a racer, you use free practice to test your way forward from 95 percent to 105 percent in order to find the limit for qualifying and the race, but on a city circuit, you have to stop at 99 percent max," the Formula E title defender adds.

Those who risk more will crash, with suspensions, front and rear wings bending or breaking. For the drivers, this means one thing in particular: even more pressure than usual. A slight slip on the steering wheel and a city race is lost – and often over for good. "Another special characteristic of a city circuit, which consists of normal streets, are differences in the surface," emphasizes Daniel Abt. The German from Kempten is Lucas di Grassi's Formula E teammate in Team Audi Sport ABT Schaeffler. More precisely, Abt goes on to explain: "In Hong Kong, for instance, we have at least ten different types of asphalt and concrete. The grip level constantly changes, so you have to be extremely careful about where you start braking."

The greater thrill, though, is also more fun: for the drivers who hardly have better opportunities to display their steering skills and for the fans because city circuits put them in much closer touch with proceedings than venues in the countryside. Squealing tires, smoking brakes, swaying, swerving race cars – a city race delivers a full dose of action, suspense, sensation: Formula E mixes an extra-delicious cocktail of kicks.

» ***To anyone seeking to experience the spirit of innovative mobility of tomorrow I'd recommend visiting Formula E***

Prof. Peter Gutzmer,
Chief Technology Officer
at Schaeffler



A motorsport festival in the heart of the city

Into fascinating cosmopolitan cities, onto newly designed street circuits and closer to other, preferably younger, spectators: This, in addition to electric powertrains, is the second central idea behind Formula E. The FIA, which sanctions Formula E as well as Formula 1, is aiming to promote the forward-thinking topic of electric mobility through this new type of motorsport as attractively as possible in urban areas, in other words the places where the next stage of automotive progress in the form of electric mobility is primarily needed and will

Berlin: At the former Tempelhof airport, Daniel Abt and Lucas di Grassi clinched a one-two result for Team Audi Sport ABT Schaeffler – enthusiastically celebrated by flag-waving Schaeffler employees

3 QUESTIONS FOR FORMULA E'S DEPUTY CEO ALBERTO LONGO

Alberto Longo (43) from Spain is a co-founder of Formula E and Deputy CEO

What is your interim assessment of Formula E season four?
This season has been phenomenal – what racing we've had so far. I love seeing new championship contenders come to the front, and we've had that with Jean-Eric Vergne and Sam Bird, while racing in new cities like Santiago, Rome and Zurich, no-one could've predicted that before we started in season one! To have the addition of ABB come on board as title sponsor was another big milestone for Formula E along with HUGO BOSS and Modis.

How viable has Formula E's concept of creating greater intimacy and contact between the audience and drivers/teams proven?
Formula E aims to be the most accessible series in motorsport, giving fans an unforgettable experience and bringing racing to their doorsteps. From the very beginning, teams have been keen to break down the barriers that suggested motorsport is only for the elite, so their strategies are focused on reaching a younger generation to tell the story of Formula E and our ongoing mission – the uptake of electric vehicles in city centres. If you're talking about the closeness of racing, we've got that in abundance - Formula E offers intense and unpredictable racing.

How are you planning to make Formula E even more attractive in the future?
We have a lot coming up in the next few months, from announcing our season five calendar which consolidates our position racing in the heart of some of the world's leading cities, to the competitive debut of the Gen2 car – which will change the look of racing completely. It's a radical change that will bring a different type of audience to Formula E and gives a distinctive look and identity to the championship. The race format will also change next year, to bring more excitement and put the onus on drivers to manage their strategy from inside the cockpit.

Zurich: Formula E's newest city circuit partly runs directly along Lake Zurich

3 QUESTIONS FOR FORMULA E TRACK PLANNER AGUSTÍN DELICADO ZOMEÑO

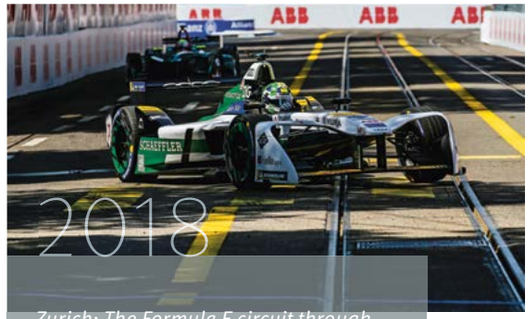
Career changer – the 29-year-old Spaniard was a trumpet teacher before becoming a creative race track planner

Congratulations on planning and running the first auto race in Switzerland in 63 years. What was the greatest challenge?
Regarding the track itself, the biggest challenge was the amount of equipment that was delivered and positioned during the last night on Friday before the cars were scheduled to go on track on Saturday for shakedown. It was planned this way to make sure that the city of Zurich had the least possible disruption during the set-up of the event. There were some other areas along the set-up that had a very tight building schedule due to local regulations in Zurich. This made a challenging 24/7 build to be able to hand over areas such as the pitlane, with hospitality on top of the team garages and the Allianz E-Village.

Are there any figures that document this logistical feat?
Just for the track barriers, we erected 1,400 concrete elements, each weighing four tons. We set up 389 of them on the last night – a new record. This is a number I won't forget for quite a while – until we set the next record.

What was the greatest challenge in four years of Formula E in building the city circuits?
This question always immediately brings back memories of the inaugural race in Beijing – that was a big jump into unknown, deep and cold water. Racing in the middle of a city for the first time and disrupting its rhythm as little as possible always poses a great challenge. Paris, Hong Kong and Zurich are other good examples of this. Yes, it's a mammoth task and a mega challenge every time – but I love every second of it and wouldn't want it to be any other way.

Monaco: Almost 90 years ago, a Grand Prix race was held there for the first time. The track configuration has hardly changed since then. However, the streetcar tracks have long disappeared



Zurich: The Formula E circuit through the financial district is traversed by tram tracks. Schaeffler brand ambassador di Grassi (pictured) won the inaugural Zurich E-Prix

become reality. Thanks to Formula E, electric racing, and then some, can already be experienced today.

That's because Formula E is designed to be a full package of pleasure: Motorsport takes place where most fans live – in the city. They take the subway to get there with the whole family in tow because all – young and old – can expect entertainment galore on and off the race track set up in the city. Spectators aren't only able to give their favorite drivers a power boost for the race ("FanBoost") by online voting but also have the chance to personally meet their heroes at the "E-Village" and even join them for the champagne shower at the podium ceremony – all included in the admission ticket.

Since its inaugural season in 2014/2015, Formula E has raced in nearly 20 metropolises around the globe. London, Paris, Miami, Moscow, Monaco, Marrakesh, Beijing, Buenos Aires and Berlin were and continue to be highlights, as is New York City, the prominent final venue of season 2017/2018. This fourth season encompassed ten events featuring a total of twelve races. Rome, Santiago de Chile and Zurich were new on the calendar.

A trailblazer even for Formula 1

The first Formula E race in the heart of Zurich in June 2018 was a trailblazer in a special way because it was the very first circuit auto race in Switzerland in 63 years. This type of racing has been banned there since 1955 as a spontaneous reaction to the tragedy at the 24 Hours of Le Mans that year. Initially just for electric race cars, this legal ban in Switzerland was partially lifted in 2015 following endless debates. More than 100,000 spectators lining the circuit on the shore of Lake Zurich made for a record crowd and celebrated an action-packed full-boost festival – made possible by progress in electrical engineering and Formula E's innovative concept.

Formula E has even by now become a trailblazer for motorsport of the future for its big sister, Formula 1. Instead of at Silverstone or Hockenheim its new makers would like to present F1 in London or Berlin in the future as well, thus polishing the image and attractiveness of automobile racing's top category. Four of the 21 current Formula 1 tracks are pedigree city street circuits: Melbourne, Baku, Singapore and Monaco. The Grand Prix in the principality on the Côte d'Azur has been the season's pinnacle event for 89 years. It was introduced in 1929 in addition to the Monte Carlo Rally first held in 1911. The objective of this race around the casino back then was to attract more tourists. 2018 saw the 65th running of the Monaco event as an F1 world championship round and 76th in total. No other city race in motorsport has a longer history and none is more famous and popular – and more controversial.

As close as you can get: Fans are allowed to marvel at the Formula E drivers (Lucas di Grassi in this case) even directly in front of the pits

3 QUESTIONS FOR RACE TRACK ARCHITECT HERMANN TILKE

Hermann Tilke from Germany planned nearly 40 race tracks around the globe

What essentially constitutes a good city circuit?
A good city circuit features interesting sights, historic and modern buildings, perhaps a river, the sea or a lake. It's about what the organizers absolutely wish to show to the local spectators and on television. A good city circuit represents the special characteristics of the respective city. What's more, the atmosphere and mood during a city race is totally different than on a permanent race track. It's simply unique because the circuit is set up specifically for this special event. Plus, the city circuit visits the spectators and not vice versa.

How will city circuits in the future differ from today's?
Obviously, safety plays a major role as well – especially in the city. City circuits only have limited space for run-off areas. That's always a tricky matter. However, due to today's complex technical solutions, the challenges can be mastered. Future city circuits will always differ from the existing city circuits – both in terms of track layout and atmosphere.

In the middle of what city would you most like to build a new race track?
There are so many beautiful metropolises in the world that would lend themselves to tremendous city circuits. Big cities always have a lot to offer and a breath-taking setting and atmosphere. Just like Zurich and its lake where we were most recently involved in building the newest Formula E track.

Norisring: The DTM track in Nuremberg is the highlight of the season also for Mike Rockenfeller (pictured)

Macau: This city circuit has treacherous narrow sections. Lucas di Grassi (pictured) crashed there twice in 2017

"Like flying a helicopter in your living room." This is how Nelson Piquet once fittingly described the Formula 1 race in Monaco. In the winding street canyons of the principality where the drivers even race through a tunnel at a speed of nearly 300 km/h (186.4 mph), the three-time Formula 1 Champion was always fighting a losing battle. Other champions turned into losers in the horsepower roulette below the Grimaldi Palace as well: Ayrton Senna, while clearly leading the race, crashed his impending victory into the guard rails and Alberto Ascari deep-sixed his chance of triumphing by somersaulting into the harbor basin.

Eternal highlight Monaco

"Monaco, for me, is clearly the highlight," says Mike Rockenfeller. The German DTM driver and Schaeffler brand ambassador from Audi Sport Team Phoenix belongs to the elite circle of Monaco winners. In 2004, he was victorious in the Porsche Supercup held in the principality but even for him, not every city street circuit is a winning track. At the Norisring, in the center of Nuremberg for example, where the Rhinelander has been competing since he entered the DTM in 2007, fifth place has been his best result to date. A venue that poses an even greater challenge to Rockenfeller is Macau: "Yes, I'd definitely like to race there!" he admits. A start in the gambling metropolis on the South China Sea is still missing on his list. Macau's roller coaster track is trickier than any other city circuit, and that's why drivers love and hate it so much.

Formula E Champion Lucas di Grassi is familiar with Macau's upsides and downsides too: In 2005, he won the Formula 3 Grand Prix there. As a guest entrant in the 2017 GT World Cup, the Audi driver became entangled in a mass crash involving twelve sports cars. A day later, the "city king" from São Paulo slid into a wall on a wet track and was out of the race again. Even so, di Grassi is fond of the Macau monster circuit because nowhere else is city racing fought more closely than there.

Lucas di Grassi's great new love, though, is Zurich where, on June 10, 2018, the Brazilian made history at the event that marked Switzerland's return to circuit racing after more than 60 years. Not only the people between Lake Zurich and the Matterhorn are going to continue enthusing for a long time about the victory Schaeffler's brand ambassador clinched in commanding style with bold overtaking maneuvers from fifth on the grid in the financial district of the business metropolis.

CITY CIRCUITS FROM A TO Z

Adelaide (AUS/touring cars)
Baku (AZ/Formula 1)
Baltimore (USA/single-seater/sports cars)
Beijing (CN/touring cars/**Formula E**)*
*Berlin (D/**Formula E**)*
*Buenos Aires (RA/**Formula E**)*
Detroit (USA/IndyCar)
*Hong Kong (CN/**Formula E**)*
*London (GB/**Formula E**)*
*Long Beach (USA/IndyCar/**Formula E**)*
Macau (CN/touring cars, Formula 3, motorcycles)
*Marrakech (MA/touring cars, **Formula E**)*
Melbourne (AUS/Formula 1)
*Mexico City (MEX/Formula 1, WEC, **Formula E**)*
*Miami (USA/IndyCar, **Formula E**)*
Monaco (MC/Formula 1)
Montreal (CDN/Formula 1/**Formula E**)*
*Moscow (RUS/**Formula E**)*
*New York (USA/**Formula E**)*
Nuremberg (D/touring cars)
*Paris (F/**Formula E**)*
Pau (F/Formula 3)
*Punta del Este (ROU/**Formula E**)*
*Putrajaya (MAL/**Formula E**)*
*Rome (I/**Formula E**)*
*Santiago de Chile (RCH/**Formula E**)*
Singapore (SGP/Formula 1)
St. Petersburg (USA/IndyCar)
Toronto (CDN/IndyCar)
*Zurich (CH/**Formula E**)*

*These cities have two different race tracks.

THE AUTHOR

***Leopold Wieland** was a motorsport journalist for over 30 years. Be it Niki Lauda or Ayrton Senna, the Rosbergs or the Schumachers, from the 1980s up until and into the 2000s, he accompanied all the great Formula 1 drivers around the globe as a reporter. Most recently, he was editor-in-chief of the "Motorsport aktuell" media brand. The former kart driver also knows what really happens on the race track and is especially fond of single-seater race cars.*

» So I need to figure out a way to grow three years' worth of food here on a planet where nothing grows

Matt Damon alias Mark Watney
in "The Martian"

MARS STATISTICS

— *The diameter of Mars is **6,780 km (4,213 mi)** – half of Earth's.*

— *Temperatures on Mars can drop to **–133 °C (–207.4 °F)** or rise to 27 °C (80.6 °F).*

— *The gravity of Mars is **62 %** less than that of Earth.*

— *The CO_2 content of Mars' atmosphere amounts to **96 %**, O_2 is only present in the per-thousands range.*

— *The ratio between the surfaces on Mars and Earth is **1:1** because there are no bodies of water on Mars.*

— *A Mars day is **40 min.** longer than an Earth day.*

— *A Mars year lasts **23 months.***

— *Mount Olympus is **26 km (16 mi)** high, which makes it the highest mountain not only on Mars but in the whole solar system.*

LIVING IN OUTER SPACE

— *Apparently, whether or not it's possible for humans to live on Mars is no longer the question, but how. The Massachusetts Institute of Technology (MIT) has this vision: a city made up of 200 domes interconnected and supported by an underground tunneling system of "roots." The Mars urbanization called "Redwood Forest" is designed to provide a habitat for 10,000 people. While the human settlers largely live underground – protected from cosmic radiation, impact of micrometerorites and extreme temperature fluctuations – the inflatable domes serve as greenhouses. Their enclosures convert sunlight into energy that would also be used to extract vital water from the Red Planet – the lifeblood for humans as well as fauna and flora which in turn are sources of nutrition for the "Martians."*

“NOT EXPANDING THE CITY INTO NATURE, **BUT BRINGING NATURE INTO OUR CITIES**”

How much “city” can humans tolerate and how much can the world? And how can the urbanization of our planet turn into a story with a happy ending? The notable architect and urbanization expert Carlo Ratti provides answers.

Interview: Volker Paulun

40,000 or even 50,000 people per square kilometer – particularly in Asian and African cities like Dhaka or Lagos, the urbanization of the world leads to extreme population density. Can modern technology be of help if densification continues to increase?
Only marginally. The possible population density depends more on socio-cultural factors. What is tolerable in terms of proximity varies across cultures.

What type of growth is healthier for a big city – the horizontal kind as practiced by London or Los Angeles or the vertical kind which can be seen in many Asian metropolises?
This is a recurring question. In terms of sustainability and energy consumption, the dense city that reduces urban sprawl is definitely to be preferred – also, by the way, over living in the country.

By densification you mean vertical growth?
*Not necessarily. Who would guess that Barcelona has one of the highest densities in the world? It looks like a rather low-rise city. But its courtyards – unlike towers – provide a very effective use of the ground, as proven by mathematical calculations in a pioneering study by Professors Lionel March and Leslie Martin from Cambridge University in the 1960s.**

What speaks against urban sprawl?
The protection of nature. Urban and suburban development concepts from the 20th century like the ‘Garden City’ by the Briton Ebenezer Howard or Frank Lloyd Wright’s ‚Broadacre City‘ helped turn our cities into endless suburbia and contributed to the destruction of the countryside. I think that today’s approach can be different: not expanding cities into nature but bringing nature into our cities.

Sounds good, but is it feasible?
Thanks to new hydroponics or lighting technologies it is. Together with the Bjarke Ingels Group BIG and our

*Based on their study from the 1960s, Lionel March and Leslie Martin proposed a radical redesign of parts of Manhattan. With floor space remaining the same, the average height of buildings would drop from 21 to 7 stories due to construction with residential blocks with light-filled courtyards.

architectural firm CRA we designed a tall building in Singapore that just broke ground. It proposes an unprecedented integration between nature and office spaces. The tower peels open at different heights to unveil green oases where people can work outdoors – a tropical nature in the middle of a bustling metropolis.

Especially in western countries, there's an emerging trend of well-educated (middle-)class citizens moving back to the countryside or at least to the commuter belt. Are you seeing a risk of impoverishment in big cities? Or at least a widening of the gap between the rich and the poor?
Yes, I am very concerned about increasing inequality in our cities. I think that it is a problem that goes beyond planning and deals with the very fabric of our society. We are studying urban segregation in different cities using cellphone data that allows us to better understand the interaction – or better the lack thereof – between populations with different incomes.

What is the greatest challenge faced by modern urban planning?
Bringing together all the stakeholders – and being able to bridge across many disciplines, from design to informatics. In general, I believe that today we find ourselves – as planners – at a utopia-or-oblivion moment as the notable U.S. architect and futurist Richard Buckminster Fuller might have put it. In other words if we keep comfortable and complacent and are unable to tackle the challenges of our times we will end up with oblivion.

Let's not hope that this will happen. What real-world metropolis comes closest to your ideal of a livable city?
I do not think that the ideal city exists. I would imagine it more like a collage of many cities. Perhaps similar to the ideal home of French writer George Perec – split across all the arrondissements of Paris. So, I would say that my ideal city has the climate of Naples, the topography of Cape Town, the fusion cooking of Sydney, the architecture of Manhattan, the frenzy of Hong Kong and – why not – the exuberant nightlife of Rio de Janeiro!

The 280-meter tall "Singapore Tower," scheduled for completion in 2021 brings nature into the city. Office and green areas are integrated. Sensors and other devices connect the building co-designed by Carlo Ratti with the Internet of Things

» My top 3 urban means of transportation? Bike, walking and car sharing

Carlo Ratti

Let's turn to transportation: your top 3 means of urban transportation?
Bike, walking and car sharing – in this order …

And the automobile?
At least with internal combustion engines it will more or less have disappeared from downtown areas in the next 30 years, just like quite a few parking spaces. Instead we'll be able to use mobility-on-demand tailored pretty much to people's needs.

What about drones that are currently the subject of a lot of media hype?
Lightweight drones have already proven their potential across diverse fields, from emergency response to security. In terms of transportation, drones transcend geographical barriers and can bring isolated communities into contact with the rest of the world without the need for large-scale physical infrastructure. However, I would be more cautious about the role of drones in urban mobility. Will the skies above our cities be filled with swarms of miniature helicopters carrying people smoothly and safely to their next destination? Will we all behave like the Jetsons whizzing around 'Orbit City' in a hovercar that then miraculously folds up into a briefcase? Unfortunately, there are both physical and practical reasons why it's unlikely our skies will be filled with such vehicles anytime soon. Anyone who has stood near a helicopter taking off will understand how much noise and air turbulences this creates. In New York, the many tourist helicopter flights resulted in massive complaints that subsequently led to increased regulation. And we're talking about less than 5,000 flights a month before that legislation came in. Now imagine if all of the eight million residents took even one flight a month … That would make the city unlivable. And I don't even want to imagine what would happen if a malfunction caused such a flying taxi to fall from great height onto a densely populated cityscape.

Final question: What in your view are the three key factors that make a city livable?
People, people, people …

THE INTERVIEWEE

***Carlo Ratti** – colloquially speaking – is an all-rounder. The Italian, born in 1971, was educated as an architect and engineer at universities in Turin and Paris. He is a co-founder of Carlo Ratti Associati, an innovation and design firm he has been operating in Turin since 2004. In parallel, he teaches at the Massachusetts Institute of Technology (MIT) where he's in charge of the "SENSEable City Lab." At the elite university, he investigates how the growing deployment of new technologies will change life in the cities. Ratti has been awarded several patents and is the co-author of more than 300 publications. Many of his projects promote sustainability using new technologies. The "Copenhagen Wheel," he helped to get off the ground is a case in point. The innovation converts every bicycle into an e-bike and promotes urban bike riding in an easy way. "Time Magazine" recognized the "Copenhagen Wheel" as "best invention in 2014." "Blueprint" magazine includes Ratti in the circle of "25 people that will change the world of design." At the 2018 Schaeffler Symposium, Carlo Ratti delivered a keynote speech on urbanization and mobility (right).*

SMOOTH FLOW THROUGH THE CITIES OF TOMORROW

How can more and more people be transported through the world's metropolises in fast and eco-friendly ways? A look at the challenges, systems and potential of local public transportation.

by Kay Dohnke

A stop in Karachi, Pakistan. The intersection of Preedy and Zaibunnisa Street in the historic Saddar Town – yet again – is totally clogged. Pedestrians, mopeds, cars and buses are pushing toward each other from all directions. It's a scene that depicts what urbanization currently means in many places: more people, more mobility needs, more deliveries and more vehicles while traffic areas remain the same or, due to construction sites, are even reduced, almost always resulting in – gridlock.

Inexpensive and effective: dedicated bus lanes

The situation in the megacities of poorer countries is particularly critical because they often simply lack the money to invest in effective local public transportation systems. Karachi's 20 million inhabitants can neither use a subway nor a tram. The trackage of the Karachi Circular Railway is only 30 kilometers (18.6 miles) long and efforts to expand it have repeatedly failed. Consequently, local public transportation is limited to buses – and

In 1974

Curitiba in Brazil was the first city in the world to roll out a **Bus Rapid Transport** (BRT) system with dedicated lanes. As early as in the 1960s, Curitiba began to systematically coordinate urban and transportation planning. Today, the city with a population of 1.8 million is regarded as the environmental showcase among Brazilian cities.

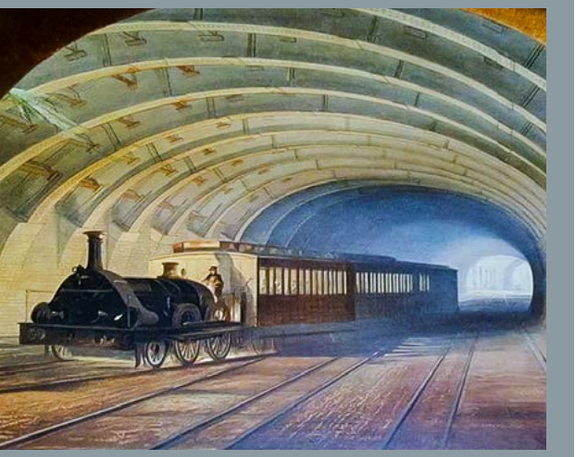
CONQUERORS OF THE AIRWAYS?

Drones appear in many visions of transportation, both in logistics and passenger service. *Besides startups, large corporations such as Airbus, VW, Daimler and Uber are investing in ideas of flying taxis.* ***Quite a few experts, though, tend think that drones will flop: too noisy, too inefficient, too complicated, too costly.***

MASTERS OF EFFICIENCY

Cities are growing together into conurbations and ***trains play a key role in both urban and interurban transportation.*** *No other means of transportation is able to take as many people from A to B with equally minimal space utilization. However, the costs incurred for railroad infrastructure are high and the environmental footprint of rail transportation heavily depends on the type of electricity consumed and capacity utilization.*

WHEN THE RAILROAD **CONQUERED** THE CITY



The first London underground trains were pulled by puffing steam engines

As early as in 1863, London sent the first trains pulled by steam locomotives through tunnels – marking the birth of the first subway that was subsequently copied by countless cities. *In 1875, service of the Tünel underground funicular line covering a 573-meter long (1,880-feet) distance started. This system was possibly inspired by the San Francisco cable cars that were rumbling up and down the hills at the Golden Gate, pulled by long cables running below the street. Around 1900, 600 cars served a line network of 160 kilometers (99.4 miles). At the same time, Wuppertal was even twice as innovative: In 1901, service of the Suspension Railway started, a system that not only featured new technology but on its elevated single rail along the Wupper River also circumvented two topological obstacles: lack of space on the ground and unfeasibility of an underground system due to instabilities caused by nearby mining operations at the time.*

they are trapped in the same traffic jams as other vehicles. Indonesia's capital is more advanced in this respect. Jakarta – with a population of 26 million – is the world's biggest city without a subway. As there are currently no funds available to invest in one, the city government chose a less costly alternative to alleviate the burden on the regional train system with its loosely knit network. In 2014, construction of 15 dedicated lanes was started in which buses can bypass traffic jams: a relatively simple yet effective method that works in Jakarta as well as in other cities. Another good example is Mexico City where the local government in 2005 established bus lanes on the permanently congested Avenida de los Insurgentes. Since then, the buses have been rushing past the traffic jams on the world's longest urban street – with half a million passengers on board per day.

The various versions of buses will play an important part in future scenarios of local transportation as well, especially in poorer countries. Their purchasing costs are relatively low, they don't require major investments in infrastructure, and can get around even in narrow spaces and hilly areas. With electric motors – using battery, super capacitor, overhead line or hydrogen technology – buses can operate in the city with zero emissions. A current report by information services provider Bloomberg predicts that as early as in 2025, 47 percent of all buses will be propelled by electric systems. Connecting the buses with their surroundings could enhance efficiency and comfort. Permanent bus stops and rigid schedules are supposed to soon become obsolete. Instead, algorithms, considering current passenger needs, will calculate the optimum route and smartphones will guide passengers to the next boarding point. Ideally, door-to-door service may be arranged or transfers to other means of transportation without waiting periods. Of course, all of these scenarios are conceivable and feasible as driverless solutions as well.

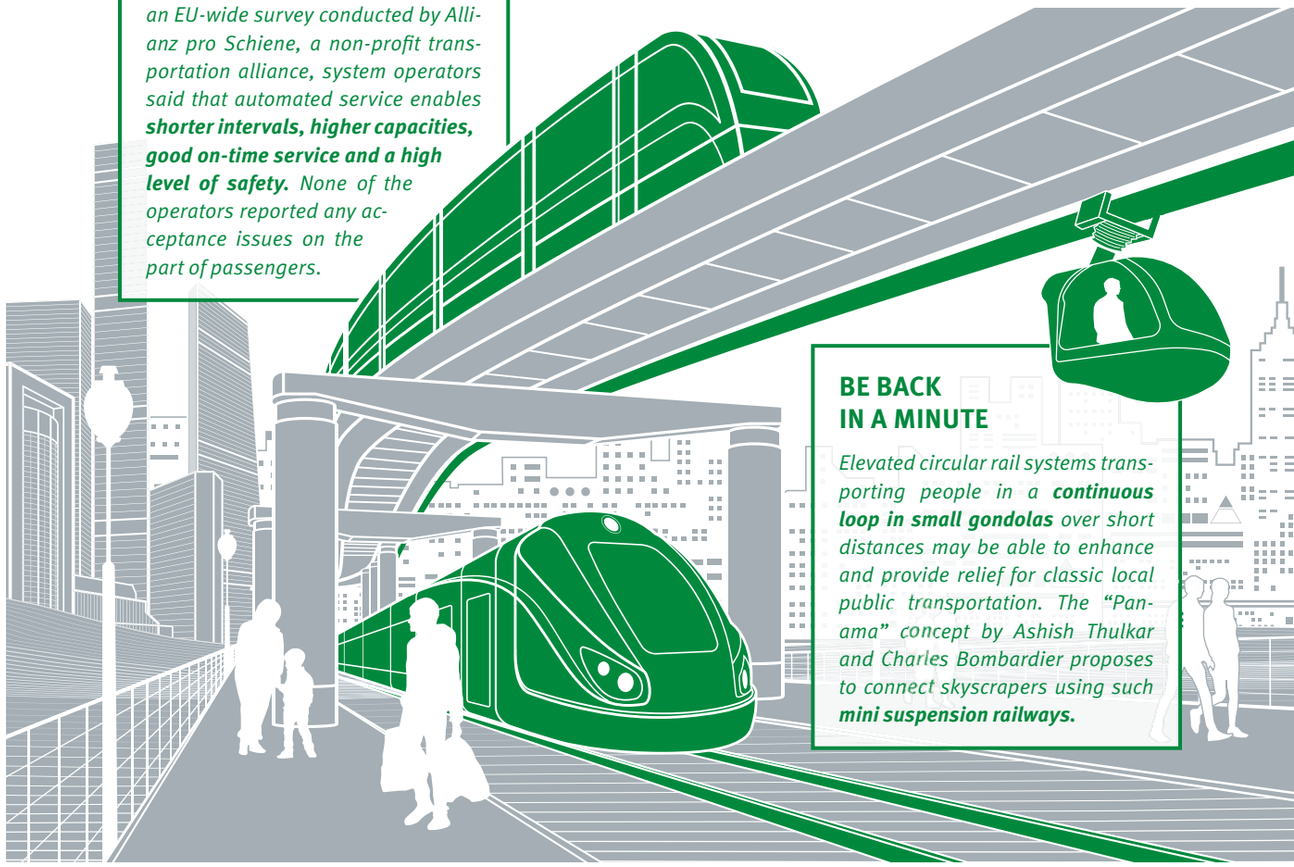
A bus concept from China that, like a rolling viaduct, was to hover 2 meters (6.6 feet) above road traffic made headlines a few years ago as well. However, it has since proved too utopian a vision: The vertical clearance for the cars was too low, the total height too great for many bridges and cornering difficult. Furthermore, the Transit Elevated Bus (TEB) was traveling on rails that would have had to be specifically installed for this purpose, so it was more like a train than a bus. Finally, the initiator of the project has since been indicted for fraud. Even so, the utopian and failed TEB shows that buses still have plenty of potential to be tapped.

Cars finance public transportation

A stop in London: Since 2003, drivers of automobiles have had to pay a toll fee if they want to enter the

SELF-DRIVING TRAINS

In the EU alone, ***one billion people per year – and counting - are already transported by autonomous trains.*** *A driverless train has been traveling through Lille, France, for 30 years. In an EU-wide survey conducted by Allianz pro Schiene, a non-profit transportation alliance, system operators said that automated service enables* ***shorter intervals, higher capacities, good on-time service and a high level of safety.*** *None of the operators reported any acceptance issues on the part of passengers.*

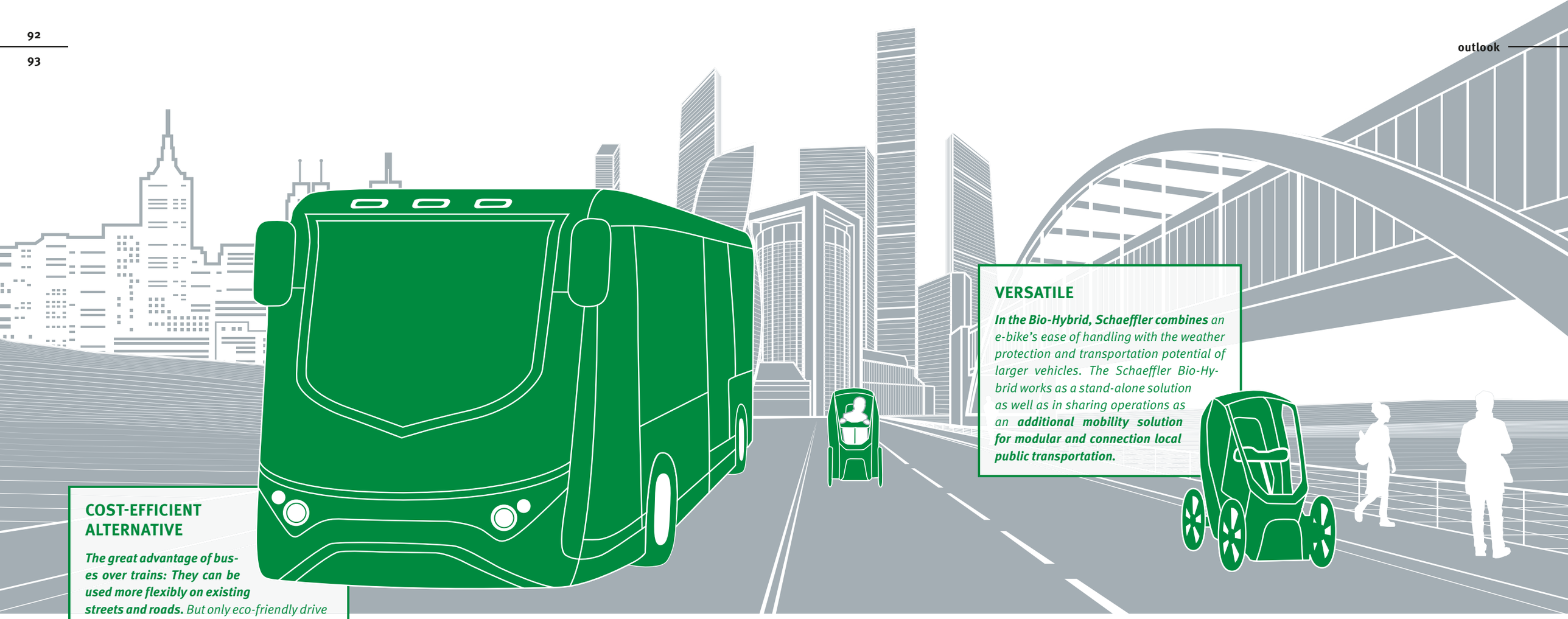


BE BACK IN A MINUTE

Elevated circular rail systems transporting people in a ***continuous loop in small gondolas*** *over short distances may be able to enhance and provide relief for classic local public transportation. The "Panama" concept by Ashish Thulkar and Charles Bombardier proposes to connect skyscrapers using such* ***mini suspension railways.***

» The provision and interlinking of diverse means of transportation is the key element of the entire future transportation development

Prof. Andreas Knie,
transportation expert and sociologist, TU Berlin



COST-EFFICIENT ALTERNATIVE

The great advantage of buses over trains: They can be used more flexibly on existing streets and roads. *But only eco-friendly drive systems make buses a great choice for urban areas. Plus, in dense traffic, they're only really fast when traveling in dedicated bus lanes. Thanks to modern data technology buses are supposed to become even more flexible and serve routes tailored to meet the passengers' needs – also autonomously.*

VERSATILE

In the Bio-Hybrid, Schaeffler combines *an e-bike's ease of handling with the weather protection and transportation potential of larger vehicles. The Schaeffler Bio-Hybrid works as a stand-alone solution as well as in sharing operations as an* ***additional mobility solution for modular and connection local public transportation.***

city, similarly as in Stockholm, Oslo, Milan or Singapore. In London, the current "congestion fee" is 11.5 pounds sterling (approx. 13 euros) which generates sizeable amounts of money for investment in the expansion of public transportation. The reason is that, after people initially switched to buses and trains as the cheaper alternative, traffic density has increased again. In 2017, London reported new record smog levels. The example of London shows how hard it is for many people to switch to public transportation and how much they value driving their own cars. There are several reasons for this. Convenience plays a major role. Lack of direct connections, waiting periods when making transfers, gaps in the network, crowded buses or trains, dark and dirty stations – none of these are good arguments for public transportation. London is trying to improve this by means of a mammoth construction project: The 120-kilometer (74.6-mile) long Crossrail project connects remote neighborhoods of the city – where rents are still affordable – with each other and with the center by means of fast subway trains so that four million commuters will be able to benefit from enhanced mobility.

Switching is a snap

A stop in Hamburg, U-/S-Bahn Station Berliner Tor: a hub of several train lines on two levels surrounded by congested arterial roads. In the Northern German metropolis, many citizens find it difficult to send their cars into retirement as well. The ratio between passenger cars and residents is over 800,000 to 1.8 million. Like other cities, Hamburg is trying to get more citizens to switch by offering connected transportation. At the Berliner Tor station, a switching point ("switchh") has been established that interlinks the U- and S-Bahn (subway and suburban) trains with car sharing and rental bike offers. Intermodal transportation is the magic word. Everyone can find exactly the type of transportation they need or prefer at a particular time. All vehicles can be booked in advance using a single app.

This a concept that's used or planned to be used in other places as well. The American metropolis Denver for instance is planning to develop an app for booking and paying for bicycles, ride sharing, public transportation and taxis. Daimler's subsidiary Moovel is testing such an app in Hamburg and Stuttgart. The project is billed as: "All your city's transit systems in your pocket." The consulting firm Deloitte has developed a scenario in which prices for such intermodal transportation offers are dynamically adjusted depending on demand – like airfares. Service companies such as Uber, Lyft, ZipCar and Via complement the intermodal transportation offering alongside the classic taxi.

Ride hailing, ride pooling and shuttle-on-demand offerings that make it possible for people to join others in vehicles heading for the same destinations fit the intermodal transportation concept as well. Automaker Ford recently acquired Chariot, a startup offering shuttle services using mini buses in San Francisco, Austin and New York. In Nanjing, China, workers in an entire industrial zone are also provided with low-cost riding options. In Hamburg, VW's subsidiary Moia has started a pilot project offering on-demand mobility services in mini-buses – which triggered protests from the local taxi industry.

An initial step: more efficient utilization of existing means of transportation

Peer-to-peer ride sharing takes us to our next stop: San Francisco. The metropolis on the U.S. West Coast with its cable cars (see also info box on page 90) established local public transportation as early as in the 19th century and today makes it possible to efficiently get around the downtown area thanks to a closely knit network. However, like many U.S. cities (as well as metropolises such as London or Paris) the San Francisco metro area has been sprawling. In suburban areas, the public transit system becomes increasingly patchy which is the reason why many people continue to drive their own cars into the city on clogged roads. A simple way to reduce

the number of cars is peer-to-peer ride sharing. Finding the right passengers is easy thanks to smartphone connectivity. Like on some express freeways in Los Angeles, fully occupied cars are able to pass the traffic jams in dedicated car-pool lanes. Smart guidance systems such as car-2-car- and car-2-x communication can additionally assist in balancing traffic density. In a next step, car-pool vehicles equipped with respective technologies might be interlinked to create an autonomously driving "swarm" that saves space and, like a train, travels into the city where the convoy is subsequently dissolved again. Ideally, such a self-driving car will autonomously find a vacant parking place where it'll patiently wait for its next run. Connecting suburban districts poses a challenge to many cities. The Texan metropolis Austin is investigating the possibility of using autonomous vehicles from suburban centers to the downtown area whereas the city government of Columbus, Ohio, is planning the future use of autonomous shuttles in a smart corridor leading to centers where many people work.

Closing the last gap

Be it L.A., San Francisco, Paris, Berlin or Tokyo: A major issue in developing advanced local public transportation concepts is closing the gap between commuters' doorsteps and the nearest bus stop or train station and from the destination stop or station to their place of work. In professional circles, this distance is also referred to as the first or last mile. A visit to Baden-Baden in Germany: At the Schaeffler Symposium held there, the technology group presented two vehicle concepts for short urban distances. The Schaeffler Mover is an electric vehicle featuring a modular design that's suitable for autonomous transportation of passengers and goods. The four drive units with wheel hub motors can be rotated by 90 degrees which makes the Mover extremely maneuverable. Its compact dimensions support the vehicle's utilization in tight traffic areas. The Schaeffler E-Board is even so compact that its user can take it along on a train, allowing for highly individual coverage of the first or last mile (more on the Schaeffler E-Board and Schaeffler's research and development center for urban mobility on page 14).

More and more new roads are no solution

Our next stop is another example which shows that the automobile can no longer play the key role when it comes to efficient commutes in conurbations. Istanbul, Karaköy ferry terminal: The ferries still departing from here used to be the only way to cross the Bosporus Strait in order to get to the other side of the city. Consequently, there used to be long lines of passengers waiting to board. In 1973, a six-lane freeway bridge paved the way to the other side. But traffic jams soon began to develop in front of it as well. A second bridge with eight lanes followed in 1988 – it, too, soon became congested, which proves the assumption that more and better roads entice people to drive more: a vicious circle. Currently, a third bridge is under construction, in addition to the Eurasia Tunnel that was officially opened in 2016, with foreseeable consequences even though a subway tunnel to the other side of the city has also been available since 2013. Or you just take the good old ferry again. Actually, using inner city waterways for local public transportation may well be a viable future option, for instance in the form of autonomous electric ferries with short-interval sequencing and capacity utilization that can be optimized thanks to modern connectivity technologies. In Paris, SeaBubbles is the first company to have tested electric water taxis on the Seine River and Tokyo Water Taxi is planning to direct a fleet of 60 boats by the time of the 2020 Olympics.

SHORT-DISTANCE CLASSICS

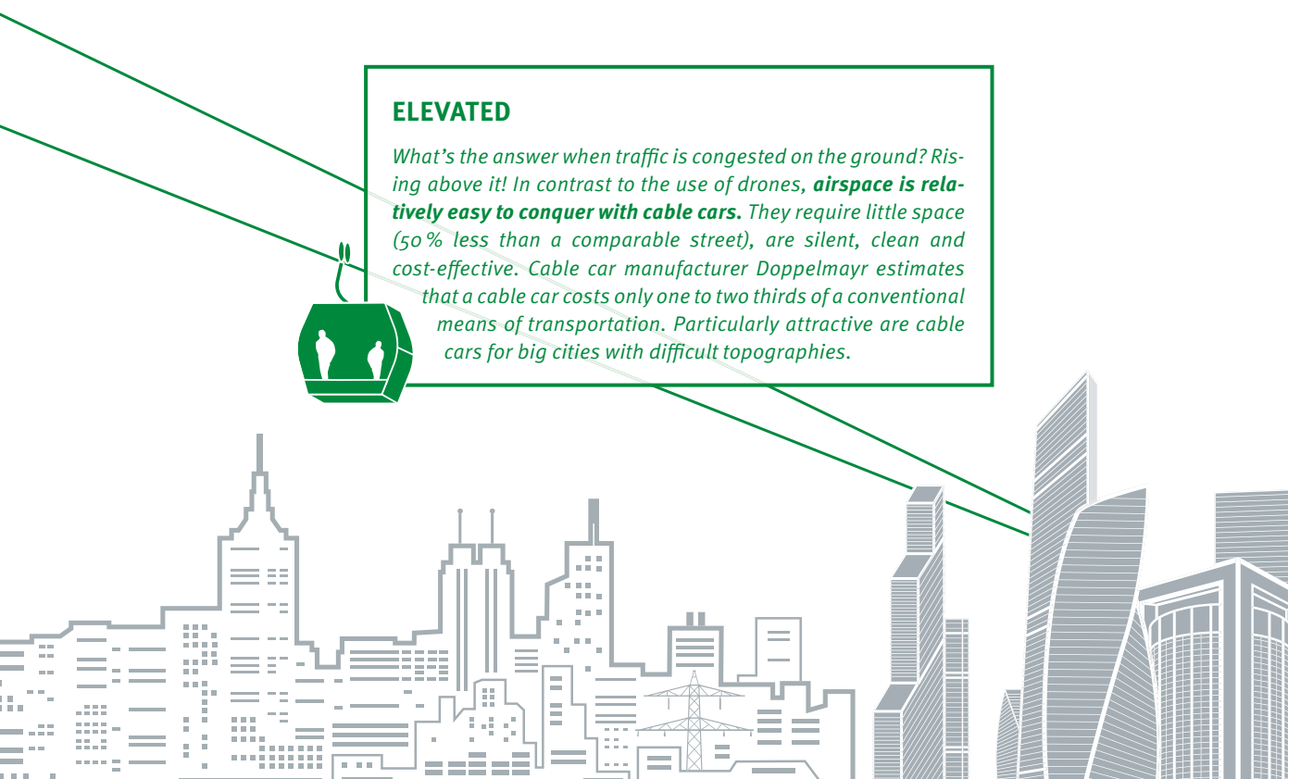
Escalators and elevators are primarily known from buildings, but they can also serve as a means of public transportation. *Portugal's hilly capital Lisbon for instance has elevators that connect neighborhoods at higher and lower elevations with each other. The Central-Mid-Levels escalator in Hong Kong is an 800-meter (2,600-foot) long system traversing an impressive elevation of 135 meters (443 feet) from bottom to top used by about 100,000 people per day. In the poor Comuna 13 neighborhood in Medellín that like many others grew on a steep slope, several escalators with a total length of almost 400 meters (1,312.3 feet) were built a few years ago. Horizontal moving walkways are increasingly used as well. In 2015, Thyssen-Krupp presented a high-speed moving walkway whose pallets move slowly in the entrance and exit areas but reach a speed of 7 km/h (4.3 miles) in the central high-speed area. According to a study of the Swiss Federal Institute of Technology in Lausanne, a speed of 15 km/h (9.3 mph) could be achieved by such a system. Using real data from Geneva, the researchers developed a mathematical model of a moving walkway with a network extending across a total of 32 kilometers (19.9 miles). Transfer points would enable users to switch between the individual moving walkways. According to the university's calculations, such a system could be ten times as effective as private car transportation.*

The Central-Mid-Levels escalator system traverses an elevation of 135 meters (443 feet) from bottom to top on a distance of 800 meters (2,600 feet)

The impressive Elevador de Santa Justa connects Lisbon's Lower and Upper Town

ELEVATED

What's the answer when traffic is congested on the ground? Rising above it! In contrast to the use of drones, ***airspace is relatively easy to conquer with cable cars.*** *They require little space (50 % less than a comparable street), are silent, clean and cost-effective. Cable car manufacturer Doppelmayr estimates that a cable car costs only one to two thirds of a conventional means of transportation. Particularly attractive are cable cars for big cities with difficult topographies.*



Conquering airspace the easy way

Let's turn from the road and water to another traffic area. While Uber, Airbus & company are pursuing the conquest of airspace using costly drones and air taxis that are hardly energy-efficient, examples of how this can be achieved faster and at lower cost have existed for quite some time: a stop in La Paz, the hilly seat of Bolivia's government: Here citizens have simply been taught to "fly". The Teleférico – the world's largest urban cable car system with five lines and a network length of 19 kilometers (11.8 miles) – is able to transport 125,000 people per day. The advantage of such a system is that it hardly requires space and is comparatively easy and inexpensive to build. Medellín, Caracas, Ecatepec de Morelos on the outskirts of Mexico City, Ankara, Berlin and other cities, especially in Latin America, are by now operating aerial transportation systems. African metropolises such as Lagos (Nigeria) and Mombasa (Kenya) are thinking about adapting them. In New York, the East River Skyway could connect North Brooklyn with Manhattan, similar to the cable car system to Roosevelt Island that began to operate in 1976.

Canadian innovator Charles Bombardier has imagined this concept even a few steps further. His "Urbania" proposal is an inner-city chairlift with closed cabins traveling close to the ground. By contrast, his "Panama" idea takes its passengers to lofty heights, traveling between skyscrapers in cabins suspended under a rail.

105.5 m (346 ft)

below the surface: Kiev's Arsenalna subway station is deeper than any other one in the world. **The world's longest subway tunnel** – 47.3 km (29.4 miles) – is the one of Line 5 in Seoul

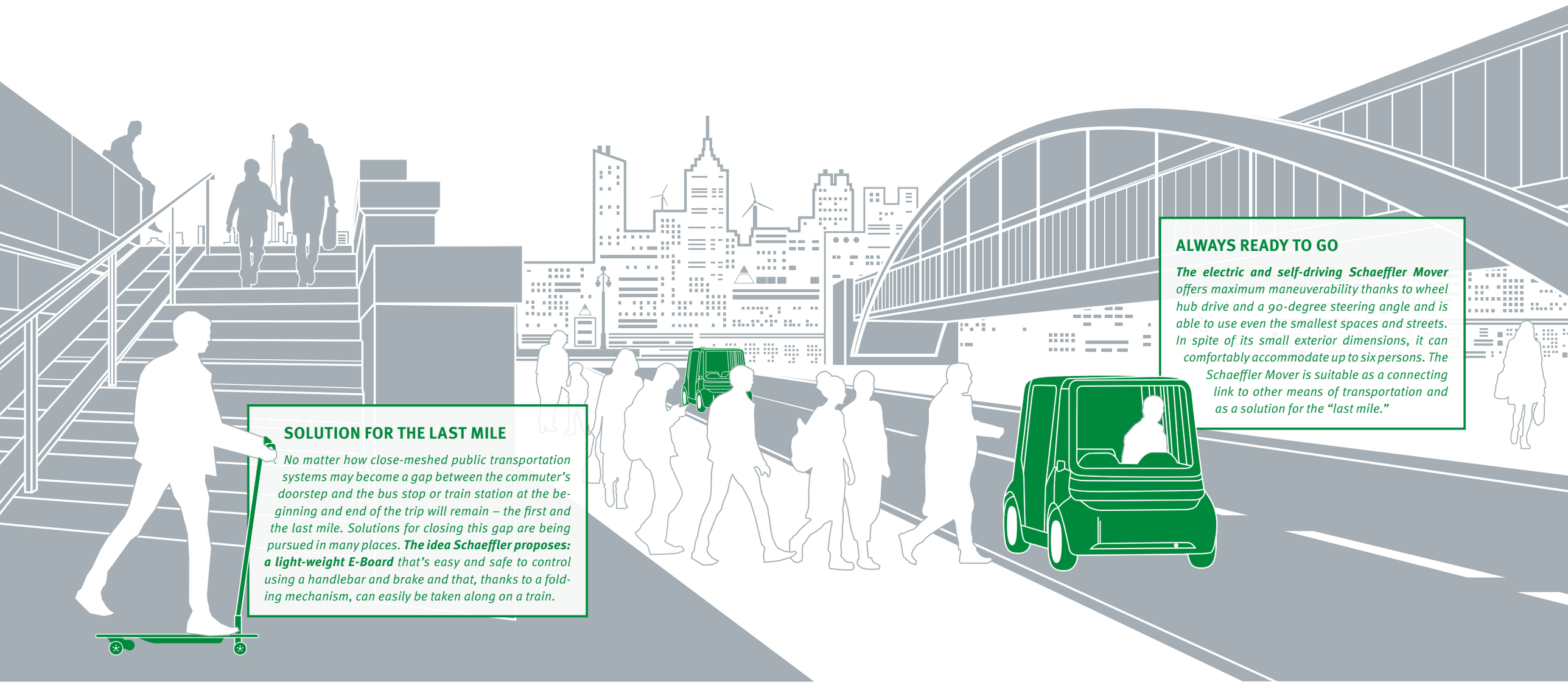
These ideas conquer previously unused spaces which are too high for land vehicles and too low for airplanes and even helicopters.

Exciting prospects

A stop somewhere, 25 years from now: Perhaps we'll be seeing a coexistence of novel systems. Elon Musk's Hyperloop is sending people to their destinations in super-fast tunnel tubes at high speed. His Boring Company is digging its way through the ground underneath cities to clear the way for electric high-speed mini buses. Taxi drones are providing fast aerial passenger transportation. Thanks to electrification and digitalization, the environmental impact of local transportation can be minimized, and schedules and capacity utilization optimized. The remaining privately owned vehicles are efficiently utilized thanks to smart planning and much cleaner due to scaled emissions-based cost of ownership. There are also ideas for piggy-back solutions where cars can "jump onto" trains. U.S. designer Kaan Yaylali has proposed the "Sebrid" car concept in which car-like privately owned "pods" autonomously get on and off trains traveling on dedicated tracks without the trains having to stop. Traffic jams are decreasing and getting shorter because people are using connected means of transportation in smarter ways. Sound like pie in the sky? Yes – but efforts to make it reality are already underway: also at Schaeffler.

THE AUTHOR

*The concept that today is called intermodal isn't a new one – Hamburg author and sustainability expert **Kay Dohnke** has been using the means of transportation enabling him to reach his destinations in the best possible way: trains and buses in the city and his 1976 Volvo wagon when heading to the countryside with his three dogs.*



SOLUTION FOR THE LAST MILE

*No matter how close-meshed public transportation systems may become a gap between the commuter's doorstep and the bus stop or train station at the beginning and end of the trip will remain – the first and the last mile. Solutions for closing this gap are being pursued in many places. **The idea Schaeffler proposes: a light-weight E-Board** that's easy and safe to control using a handlebar and brake and that, thanks to a folding mechanism, can easily be taken along on a train.*

ALWAYS READY TO GO

***The electric and self-driving Schaeffler Mover** offers maximum maneuverability thanks to wheel hub drive and a 90-degree steering angle and is able to use even the smallest spaces and streets. In spite of its small exterior dimensions, it can comfortably accommodate up to six persons. The Schaeffler Mover is suitable as a connecting link to other means of transportation and as a solution for the "last mile."*

PENDING **TRANSACTIONS**

The growth of the cities wants to be fed. With intelligent, interlinked logistics utilizing new technologies.

by Marcus Efler

Distribution of goods in a big city: a nuisance for all road users, residents and the environment. A confusing, uncoordinated, dangerous hustle and bustle. Even so, the infrastructure for the distribution of goods doesn't enjoy a really high priority on the public awareness radar. Dull slogans like "Goods belong on trains" show that the issues relating to the transportation of goods tend to be primarily associated with long-distance hauls although in reality they're highly present in urban areas – the places where people live.

Worldwide there are more than 800 cities with at least one million inhabitants and more than half of the world's population lives in cities. While this meant 749 million people in 1950 it means 3.9 billion today and counting. For 2050, experts are expecting another 2.5 billion urbanites.

Delivery traffic is increasing accordingly. In the northern German port city of Hamburg, for instance, truck traffic can be expected to increase by 40 percent in the next seven years. Today, trucks already account for 25 to 30 percent of urban traffic, many of them not even hauling half of their rated cargo capacity. This leads to congestion: the speed at which vehicles travel on the streets and roads of the world's urban areas has decreased by 50 percent in the space of ten years.

Airborne and subterranean transportation of goods

Im Consequently, the transportation of goods has plenty of potential to relieve the burden on conurbations, to make life safer and cleaner in them. In fact,

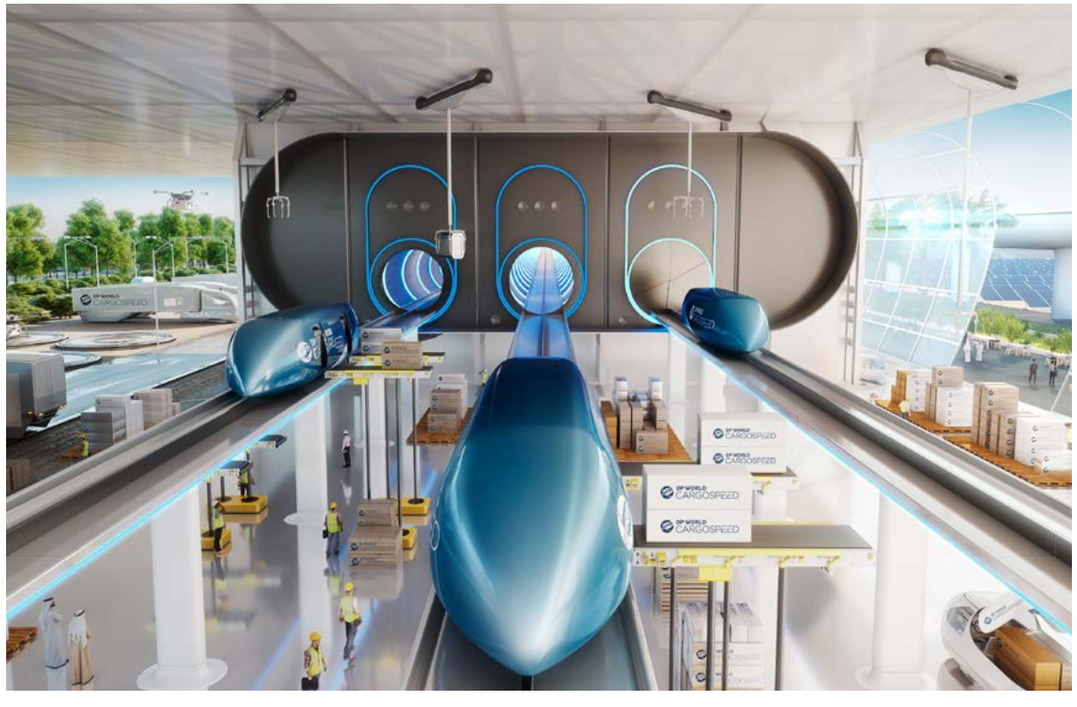
the pursuit of lean delivery traffic has long begun. Obviously, companies whose business models depend on fast and smooth delivery processes – like Amazon – are at the forefront of the quest for new solutions. The gigantic virtual department store would like to deliver orders by aerial drones – a compelling vision at first glance, albeit a controversial one as well (see also interview with futurist Marianne Reeb on page 104). By now we're seeing governments around the world not readily willing to release air space, particularly not in areas where defective or misguided unmanned aerial vehicles might fall on people's heads – in other words in cities. Currently, respective regulations around the globe tend to be tightened rather than loosened, to the delight of the population that's increasingly bothered by the whirring devices.

The scene of other visions of the future is two levels lower but equally subject to controversial debate. The Hyperloop, for instance, that's supposed to shoot people through subterranean vacuum tubes at the speed of sound, following initial hype, has been increasingly raising questions. One of them is who's going to pay for this? The costs for an intercity tunnel network would be exorbitant. And the other one: how would people be evacuated from the tube in cases of emergency?

Transportation of goods as a trailblazer for passenger transportation

A small-scale solution, such as interurban transportation of goods, would not entail either of these issues and might practically serve as a test application for the big vision. After all, rail transportation began as a solution for goods as well before its potential for hauling passengers was recognized.

However, before the first Hyperloop holes are ready for service optimizations of other urban means of transportation are likely to provide relief, such as the time-tested bicycle messenger, currently the fastest door-to-door courier – unfortunately, only for mail and small parcels. However, a solution combining this lean form of locomotion, its minimal requirement for traffic space, and low energy consumption with the capacity to haul larger loads would be a winner! Exactly this is behind Schaeffler's Bio-Hybrid, a four-wheel pedelec with one cubic meter (35.3 cubic feet) of trunk space. And it's already beginning to cross the threshold between vision and reality: the first vehicles are scheduled for delivery to customers next year.



This is the vision which the architectural design and engineering firm Foster + Partners has of a Hyperloop cargo terminal: largely automated and directly linked with other means of transportation like trucks, trains, ships or even drones

One size larger is the Mover, another Schaeffler prototype, and configurable as "People" or "Cargo" versions thanks to flexible body styles. Electric wheel hub motors on the outer corners enable the vehicle to whir through the streets with zero emissions, maximize cargo capacity and – thanks to a steering system with 90-degree turn – makes maneuvering in very small spaces possible. As the Schaeffler Mover is an autonomous city vehicle it could, for example, provide the connecting link in a supply chain between the manufacturer and distributors or retailers – and, thanks to its minimal space requirement, even operate in the aisles between warehouse racks.

Systems evolve and merge

The electric postal delivery vans of Deutsche Post are already a first harbinger of zero-emissions transportation of goods. Generally speaking, it's more likely for the systems, from (cargo) bicycle couriers to

In Hamburg, Volvo has been deploying an electric garbage truck for on-street testing. The vehicle still has a driver and crew on board, but fully automated systems are being planned in the disposal sector as well

180 MILLION FOR ULTRA-MODERN LOGISTICS SYSTEM

In the eastern German city of Halle an der Saale, a new assembly and packaging center for the Automotive Aftermarket Division with a footprint of over 40,000 square meters (430,560 square feet) is being built as one of the 20 initiatives of Schaeffler's forward-thinking "Agenda 4 plus One" program.

From the new central logistics hub – called Aftermarket Kitting Operation (AKO) – automotive spare parts that Schaeffler sells as single products and in the form of repair solutions will be picked and packed in kits for Europe-wide shipping starting in 2020. 900 employees are planned to work there. "Our new assembly and packaging center represents the largest single investment by the Schaeffler Automotive Aftermarket Division to date," emphasizes Michael Söding, CEO Automotive Aftermarket, Schaeffler AG. "And it pays off: by breaking this ground, we're ushering in a new era for our logistics operations, geared toward greater flexibility, speed and on-time deliveries for our customers. In Halle, we've found outstanding economic conditions for this purpose – including an excellent infrastructure and a location that's strategically optimal for us."

Any useful idea of the future should appear ridiculous

Futurist James Allen Dator's Second Law of the Future

autonomous trucks, to continue to evolve and merge than for a single disruptive technology to upend delivery traffic. When futurist Marianne Reeb would like to see half-empty buses haul parcels or the first start-ups are flexibly hiring privately owned passenger cars as delivery vehicles Uber-style the future is already knocking on today's doors.

Plus, due to modern technologies, the number of goods that no longer need to be shipped – because they no longer physically exist – may increase as well. CDs being replaced by streaming are a case in point, or letters having been replaced by emails. Also, more and more recipients, particularly in the manufacturing industry, are now producing parts themselves that used to be supplied to them, 3D printing being a key technology in this context. The raw material requires less cargo space than the finished product. In particularly bold visions, it's even pumped to the users through pipelines – like water and gas.

But whether they're shipped or produced and consumed locally, the obvious disadvantage of all goods is that at some point in time they'll have to be disposed of at the end of their useful life. So the quantity of garbage can be expected to increase in parallel with the goods delivered. How to get a handle on it? Maybe someday with a vacuum tube system similar to the one that has been tested since 2014 in Kalasatama, a new district in Finland's capital Helsinki. For the time being, though, people living in cities would already benefit from less rumbling, rattling and roaring when the garbage truck visits their street at 6 o'clock in the morning. Truckmaker Volvo recently deployed the first electric garbage truck to Hamburg for a test run. Even the previous mechanical and hydraulic systems for collecting and compacting the city's waste are operated electrically and thus reduce noise. Okay, it's just a vehicle for now, but, after all, every future once started as a humble present and the next iterations are already appearing on the horizon in this area as well: autonomously acting and connected garbage vehicles that are systemically deployed when the trash containers have reached a specified fill level, ideally at night when the streets are empty. There are many conceivable solutions: it's not for nothing that the word logistics is derived from the Greek logistikós which means "reasoner."

THE AUTHOR

Marcus Efler *is a graduate of the Axel Springer School of Journalism. His professional career includes stints as chief reporter at "AutoBild" and head of the Sports & Auto department of the news magazine "Focus." Today, he runs his own editorial office and preferably writes about topics relating to new mobility. For this issue of "tomorrow," he also conducted the interview with Daimler futurist Marianne Reeb (page 104).*

SCHAEFFLER MOVER CARGO

- **Autonomous operation,** 24/7 use possible
- 4 e-wheel hub motors **"Intelligent Corner Module"**
- **13 kW** permanent output, 25 kW peak output each
- **90-degree steering angle** enables lateral driving and parking, 5-meter (16.4-foot) turning circle
- Entire powertrain technology in **"Rolling Chassis"**
- **Easily scalable chassis size** thanks to "Intelligent Corner Modules"
- **Customizable body styles** up to and including refrigeration van
- **Body changeable** without chassis modifications

SCHAEFFLER BIO-HYBRID CARGO

- **200 kg (441 lbs.)** payload
- **1.000 l (35.3 cu. ft.)** cargo volume
- **400 kg (882 lbs.)** gross vehicle weight
- **Electrically assisted driving** up to 25 km/h (15.5 mph), up to 45 km/h (28 mph) depending on national regulations
- **Drive-off assistance** (boost)
- **50–100 km (31 to 62-mi)** range
- **Reverse gear** (electric)

The Daimler "Stuttgart 2036" scenario : The geography is very special. The city originally developed in a basin and is now sprawling into the surroundings. Many access routes to the city center are heavily frequented downhill roads. In the vision of the future, access to the city will only be granted to zero-emission vehicles for which toll fees will be charged as an additional control measure. **In the area of local public transportation, a cableway system is conceivable enabling flexible boarding without interrupting the service** as a whole because the pylons will also serve as access points. A tunnel bus will use the empty space above the street to augment public transportation. Sensors and artificial intelligence will enable a harmonious coexistence of pedestrian and vehicular traffic.

"URBAN **MOBILITY** WILL BE ELECTRIC"

How are we going to get from A to B in our cities of tomorrow? Exploring this question is part of Daimler futurist Prof. Marianne Reeb's job. Here she provides some answers.

Interview: Marcus Efler

Ms. Reeb, are you still able to enjoy walking and shopping in the heart of a city completely relaxed or do deficits in urban planning catch your eye around every corner?
Well, you're a futurist 24 hours of the day – and of course the phenomena you describe will also catch your attention. In Berlin, for instance, pilot projects for shared spaces are already up and running …

Shared spaces are streets on which all street users, without separation, utilize the same space and, accordingly, cars have to travel at low speed – a little like living streets, correct?
Yes – and on Maaßenstraße, for example, a street reduced from six lanes to one, the concept doesn't work at all. Everyone is frustrated, people can't find places to park anymore, shops are waiting for delivery vans in vain and patrons are staying away from restaurants: a typical case of good intentions, but with poor results.

Essentially, though, shared spaces are a core element of many future visions of a livable city, aren't they?
Yes, they are, too. But, let's face it, there's no such thing as a concept that fits any and all needs. Arterial roads cannot be converted into living streets. Instead it's necessary to look for solutions that work in the places for which they're intended.

Sharing, for instance, can apply to automobiles as well …
Car sharing is one of the key approaches to easing the burden on cities. There's no need to take one's child to school in the large SUV the family uses to go on vacation in. A small city car is enough. In the future, there'll be a lot more flexible mobility offerings specifically tailored to the respective use case. Obviously, we won't be able to buy all of them. On the other hand, the automobile will retain the fascination it exudes as a technical product people would like to own. One does not exclude the other.

When it comes to acceptance of shared cars, are there any country-specific differences?
Yes there are, due to culture. Europeans tend to act as a group, so the concept works there. Americans see themselves as "lone rangers," so everyone wants their own car. Actually, that's what Asians want too – but in China, for instance, an increasing number of regulations makes it more difficult for people to buy cars for personal ownership, so they use car sharing systems instead.

In the scenarios shown here, you've combined many diverse solutions. For instance, we're seeing a cableway. Those systems are pretty popular in South American big cities …
There they primarily serve to connect the favelas with the downtown areas. But they can make sense in European cities as well. Compared with other systems, they can be built quickly at relatively low cost and don't consume a lot of traffic space.

The city toll you're proposing, though, is not a really low-priced solution: 98 euros … will personal mobility become a luxury product?
No doubt, seeing that is a little shocking at first. But it's based on the idea of a dynamic price model. When nothing's going on, for instance at night, it may even be free. But when everyone wants to drive their own car, then it'll be expensive. At that time, you can switch to another means of transportation.

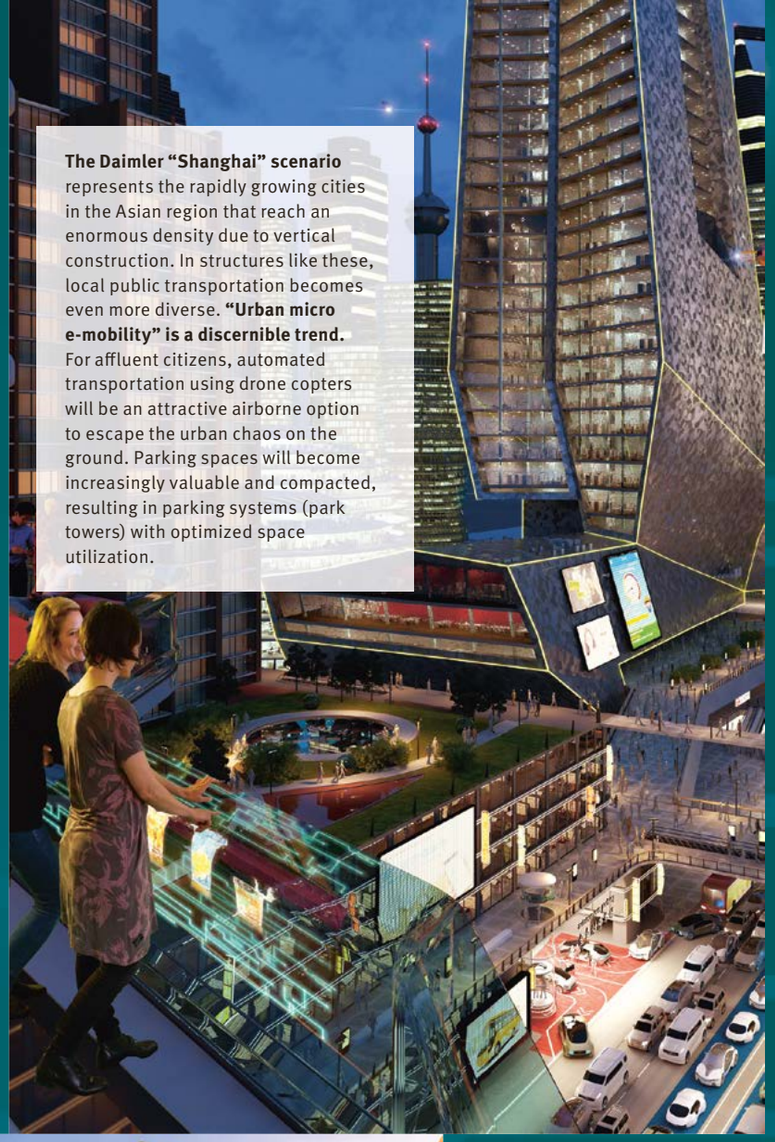
If switching were only so easy …
Hassle-free switching between various means of transportation is very important. Convenience is the key to people's acceptance. It has to be fast, without long walks in between, and payment systems have to be standardized.

> ***» Convenience is the key to people's acceptance***
> Daimler futurist Marianne Reeb

Will new forms of living and working possibly decongest passenger car traffic as well?
Obviously, the growing number of people not working according to a rigid nine-to-five schedule helps as well. Office hours have become increasingly flexible, people can work from their homes and modern forms of communication replace commutes.

Perfect! Everyone stays at home and all traffic problems are solved …
But sometimes you have to be on site. You can't always use Skype. Personal conversations remain essential. I'm just coming from a meeting where it was very beneficial that I was personally present.

Is the commuting system changing – living on the outskirts, working in the city?
Yes, there's definitely a trend of people moving back into cities. It also includes families that would like to live in a house of their own – in developments where many smaller townhouses are built on the same lot. These people then of course have shorter commutes.



The Daimler "Shanghai" scenario represents the rapidly growing cities in the Asian region that reach an enormous density due to vertical construction. In structures like these, local public transportation becomes even more diverse. **"Urban micro e-mobility" is a discernible trend.** For affluent citizens, automated transportation using drone copters will be an attractive airborne option to escape the urban chaos on the ground. Parking spaces will become increasingly valuable and compacted, resulting in parking systems (park towers) with optimized space utilization.

The Daimler "Los Angeles" scenario shows a future city defined to the max by automobile traffic. The extreme extent of urban sprawl will continue to necessitate personal transportation in the future. **However, central areas will only be open to passenger cars and trucks with eco-friendly powertrains** that will be sharing the available traffic space with small and autonomous vehicles for transporting passengers and goods.

Or might be able to walk? Wasn't there also some discussion of an idea to concentrate all the key things of an urban environment – residential areas, offices, shops, cultural life – in small, decentralized neighborhoods?
How much sense would that make? People specifically move to the city because these things are available in the center. You can't put an opera house into every neighborhood.

What role will electric vehicles play in the city of the future?
A crucial one. Future urban mobility will be electric. You can only achieve clean air with locally emission-free vehicles. Everyone who's ever spent a day in the smog of Beijing knows that. With incentives for electric vehicles and bans on vehicles with IC engines cities intend to force people to switch. That's beginning to happen in Germany as well.

Autonomous cars are the other frequently discussed alternative at the moment. How would that affect urban mobility?
Autonomous cars will be part of mobility – as a kind of personal and public transportation mix. When a school bus with a driver picks up children today it could be replaced by kind of a large automated taxi tomorrow – which would still be better than all parents personally shuttling their kids.

Will residents trust autonomous cars cruising around without a driver between their children playing in shared spaces?
Well, first of all, it'll be a while before the technology is ready to be deployed and safe enough. The test drives in urban areas so far have taken place on selected routes under controlled conditions. And it's also going to take some time before people will trust the technology. I remember a funny case in Japan where a subway line was automated. In the first few months, a driver was still sitting in the front seat. Although he had nothing to do, people felt more comfortable. Once he was gone, the seat became the most popular one with the passengers.

4 pillars
form the foundation of **forward-thinking mobility planning** at Mercedes-Benz: Connected, Autonomous, Shared and Electric.

81 children
at a time are planned to be taken to school by **"Jouley," an electric bus** from Daimler's U.S. subsidiary Thomas Built Buses starting in 2019. The vehicle has a range of up to 160 km (100 miles).

Will local public transportation have to reorganize itself?
It'll have to become smarter and more flexible. What would be the sense in having huge buses that in spite of their size were jam-packed during rush hour but near-empty most of the time? That's a waste of resources that could be put to good use. Why not haul goods with them as well? In the context of urban mobility, we always think only of people but goods account for a major part of it as well. In the past, a mail truck would arrive in the morning and today there's a parcel delivery service rushing down the street every few minutes.

A consequence of the growing mail order business …
Yes, too. But many delivery vans and trucks are only half full when they start their runs.

In the future, individual parcels are supposed to be delivered by aerial drones …
I'm very skeptical in this respect. If just ten percent of freight transports were shifted into the air there'd be such a whir up there that you wouldn't want to be or live below it.

On the ground, acceptance of personal mobility seems to be dropping as well. Are the days of the car-friendly city over?
I wouldn't view that in black and white. Often the same people that live in the city are the ones that drive cars. The cities will have to strike a balance. In the future, they'll be facing even fiercer competition for high quality of life than before and a smart mobility offering is a very important part of this.

How fast will cities change?
As our CEO, Dieter Zetsche, says: The way change occurs often resembles the ketchup bottle effect. Nothing will happen for a long time at first, and then it'll happen all at once.

THE INTERVIEWEE

*The "Society and Technology Research Group" has been in existence at Daimler for 30 years and **Prof. Marianne Reeb** has been on board for 20. As "Manager Future, Life, Mobility" of the Research & Development department, Reeb, who has a doctoral degree in business administration, is one of the people responsible for corporate futurology. One of her first forward-thinking topics was car sharing. "But that never really flew because in the 1980s you still had to book a car telephonically three days in advance." She also lectures on topics of cultural and social change for the Cultural Work degree program at University of Applied Sciences Potsdam and lives in Berlin and Stuttgart.*

CITIES IN THE NET OF THINGS

When buildings, streets, cars and traffic lights begin to communicate with each other a new age is dawning. The smart city changes transportation, makes local government more efficient, and assists citizens with better services. New cell phone networks and innovative blockchain applications are the prerequisites for making this happen.

by Torsten Meise

For skeptics, it's only a slow, decentralized database, but for many urban developers and smart city enthusiasts, it's a revelation: the blockchain in which a constantly growing list of transaction datasets is stored (see infographic on page 112/113). What began as a base technology for crypto currencies like Bitcoin is currently inspiring a wealth of ideas for creative applications in the city of the future. The possibility of connecting users via a blockchain and organizing secure payment transfers without a central clearing place acts like an initial spark.

The blockchain as a reliable data guard

In New York's Brooklyn borough, for instance, a small network has been established that serves as a grid for distributing solar energy produced by the participating citizens themselves. User payments are transacted on the basis of a blockchain – completely without involvement of an electric utility. In Taiwan's capital Taipeh, the Berlin-based IOTA Foundation is currently developing a citizen's card that's intended for use of various local government and healthcare services. Here distributed ledger technology – which is the generic term for the various versions of transaction databases such as the blockchain – is used as well. Payments and personal data require special protection and the blockchain seems to be particularly well suited for this purpose.

Very ambitious aims are pursued by Dubai. The city on the Persian Gulf will host the EXPO 2020 world exposition and is aiming to become the leading pioneer in local blockchain applications by that time. All administrative transactions that can be digitized in some form are supposed to migrate to the blockchain. There's talk about the creation of a blockchain

$2.5 trillion

is the **expected value of the global market for smart city technologies and services** by 2025 – five times as much as in 2017.

Source: grandviewresearch.com

Every 21 months

the bandwidth of internet connections doubles – according to "Nielsen's Law" established by Danish IT expert Jakob Nielsen. His forecast was correct in the past 25 years. Thanks to modern fiber optics network **transmission standards of 1 terabit per second** are supposed to be possible in the near future – which corresponds to 5 DVDs ripped per second. The current record is 43 terabits, albeit set under conditions (not yet) suitable for everyday use.

75 %

of all citizens around the world **do not feel sufficiently informed by authorities about the benefits of smart cities,** according to a survey by ISACA, an association for IT security professionals.

industry. More than 20 government and private-sector blockchain use cases are currently in the proof-of-concept stage including rental and sale of real estate, management of vehicle lifecycles, licensing of healthcare facilities, student enrollments at the university, and assurance of food safety.

Citizens co-create smart cities

Whereas the term "smart city" still has a slightly sinister ring to it because at first the idea was primarily driven by major tech corporations and the implemented monitoring functions triggered – not totally unreasonable – fears, the blockchain is welcomed even by many critical groups. "We've been observing for some years now that leading city governments on the road toward the smart city are increasingly focused on co-creation by citizens according to the bottom-up principle. Blockchain technologies offer significant potential on this 'new' way to the smart city," says Bart Gorynski. The co-founder of bee smart city, a digital platform with about 500 smart city solutions, welcomes this development. "Distributed ledger technologies enhance efficiency and significantly promote transparency and co-creation."

Thus, the blockchain might continue a trend that has begun to emerge: Smart cities will also become cities of citizens. Internationally, Barcelona's digital innovation officer Francesca Bria is a pioneer of this approach: "Our smart city is not technology-driven. We ask: What does a livable city look like? And: How can people themselves determine how they'd like to live? Technology only serves to support this," says the Italian in Spanish employ.

This, however, is only one element of the future because the smart city will also be a city of things. The Internet of Things with its connected buildings, streets, vehicles and infrastructures will bring a digital world of its own into big cities. Particularly the future of autonomous vehicles will be driving this technological development. Traffic lights that negotiate green phases with vehicles, smart lampposts that continuously report traffic conditions in the streets, real-time map services that guide traffic around congestions and obstructions, all this will grow into an all-new infrastructure for smart mobility in the next few years.

Dataflow is still a mere drip

Albeit, if will do so only if a major stumbling block can be removed by that time. Many data networks on the basis of which developers are currently building the Internet of Things are merely able to send data droplets back and forth. Even the cell phone network used today is far too weak for the things that inspire the imagination of city and traffic planners.

That's why they can hardly wait for the next generation of mobile communications to arrive. The coming 5G network is expected to have a data rate of 10 Gbit/s, up to 100 times faster than today's LTE. Scientists are even already developing the next – 6G – network. It's supposed to make data rates of up to 400 Gbit/s possible – currently achieved only by fiber optics. Almost more important, though, than the data rate will be the capability of the network to accommodate a lot more devices than the current technology and achieve extremely low latencies. This is ideal for the many new connected things and applications relying on instant responses such as those involved in automated driving.

"The smart city of the future will be based on the Internet of Things. 5G will accelerate this development and even enable many IoT applications for smart cities," Bart Gorynski is convinced. "Data in real time combined with higher data throughput and lower latencies also have the potential to save lives," says the smart city expert. In healthcare settings or rescue operations, every second counts when rescue workers require information. Augmented reality applications in real time that can show the way though a building to a rescue team in case of fire are an example of ideas for sensible uses of the capabilities of the new mobile communications network. The Hamburg port authority is already developing such applications for its pilots who have to guide the large container ships through the narrow, consistently changing Elbe river. The new network is eagerly awaited there as well. Or, more precisely, any kind of network because even today the pilots navigating the North German Plain cannot even be reached by phone in some places.

THE AUTHOR

Torsten Meise *is a journalist and has been writing about technology and urban development topics for more than three decades. He primarily views the smart city as an opportunity for concepts that make better and more sustainable urban life possible.*

BLOCKCHAIN
THE DIGITAL DECENTRAL DATABASE

Counterfeit-proof, neutral and transparent – blockchain technology is ushering in a new age for all types of transactions. This is how it works:

A member within a blockchain system requests a transaction (e.g. a financial payment) with another member via a PC or smartphone.

The requested transaction is not only sent to the recipient's computer but also to those of all the other members within the system.

At specific nodes, the request received is verified and authenticated by means of an algorithm. The order to post a transaction will only be valid afterwards.

The dataset ("block") of the new transaction is encrypted and attached to the "chain" of all transactions.

The new datablock is now saved and cannot be altered anymore. A disadvantage of the complex blockchains: very high electricity consumption.

APPLICATION 1
ENERGY SUPPLY

Using blockchain technology, billings and credit notes between energy suppliers and consumers, for example, will be feasible in simple and secure ways in the city of the future.

APPLICATION 2
SUPPLY CHAIN MANAGEMENT

Raw materials, components and finished products are continuously captured by sensors along the entire supply chain. As soon as the goods have reached their recipients, accounts can automatically be settled by means of a blockchain system.

APPLICATION 3
INDUCTIVE CHARGING

In the smart city, the battery of an electric vehicle is automatically charged while the vehicle is waiting at a traffic light. The traffic light and the vehicle communicate about this transaction. The blockchain automates battery charging and payment transactions.

APPLICATION 4
AUTONOMOUS PASSENGER TRANSPORTATION

Automated payment via the blockchain when passengers board autonomous vehicles used in public transportation systems.

MASTHEAD

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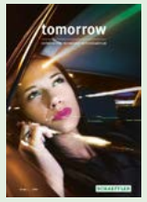
** Be it high-speed or local trains, subways or trams – Schaeffler technologies make traveling in rail-bound vehicles even safer and more economical, for example with the axlebox bearing for locomotives depicted here.*

tomorrow All previous issues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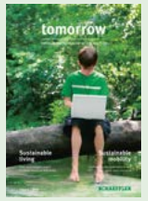
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