
Agora
Verkehrswende
BASED ON THE AGORA STUDY "12 INSIGHTS ON TRANSFORMING TRANSPORT"
A UNIQUE HYBRID BETWEEN A GRAPHIC NOVEL AND INFOGRAPHIC PRESENTATION
PACKED TO THE GILLS WITH INFORMATION ABOUT TRANSPORT
50
64
70
FUTURE AHOY!
AN INFOGRAPHIC NOVEL ABOUT
SUSTAINABLE TRANSPORT
BY AGORA VERKEHRSWENDE AND ELLERY STUDIO

FUTURE AHOY!

An Infographic Novel About
Sustainable Transport

DEAR READERS,

Since releasing “12 Insights into Sustainable Transport” in 2017, Agora Verkehrswende has published more than twenty studies detailing the essential building blocks of climate-friendly mobility.

This publication marks a significant departure from our previous work on sustainable transport. For one, it’s filled with cartoons and colorful illustrations. For another, it does not contain any new findings. Why did we decide to take a different approach?

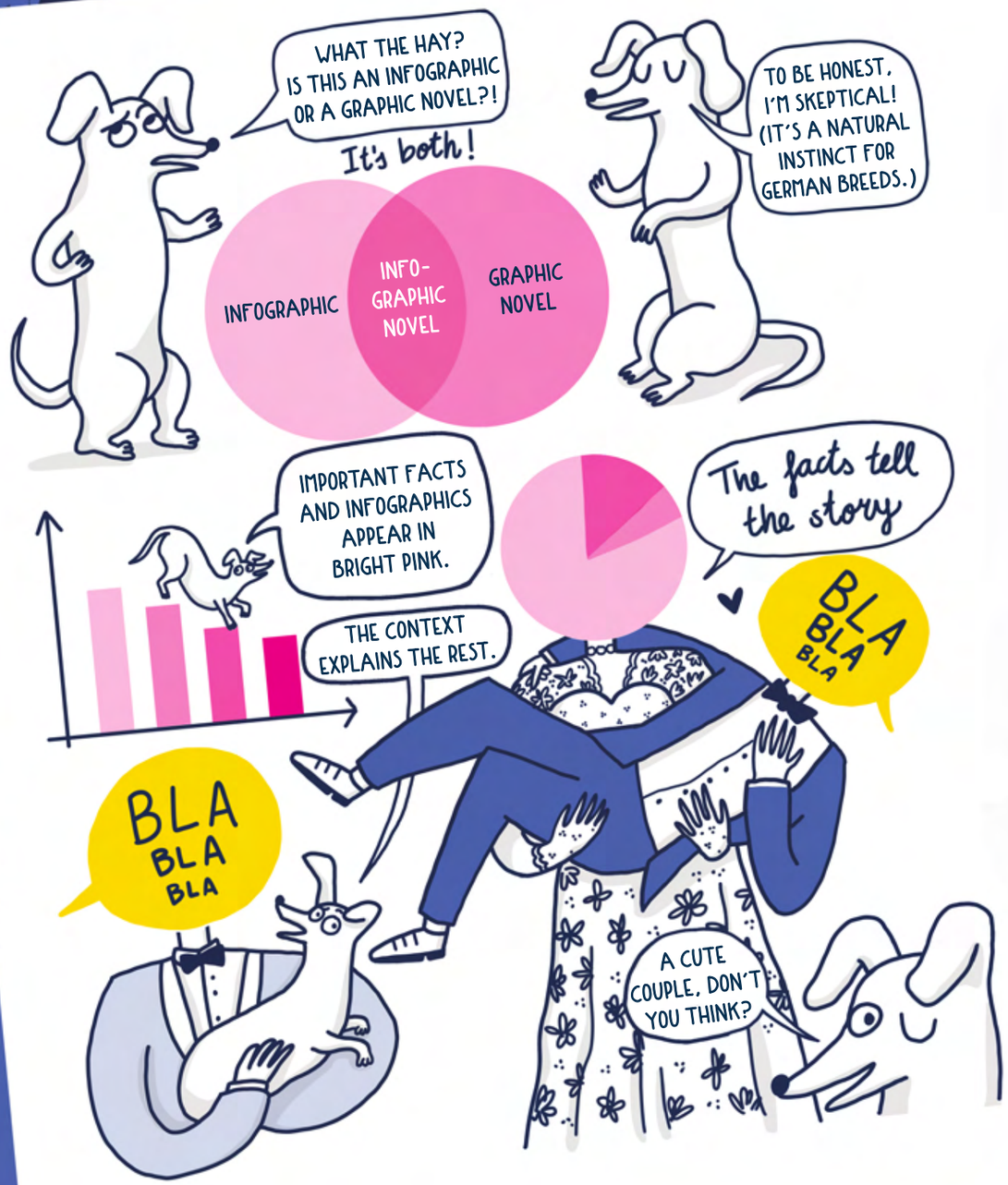
The term "Verkehrswende" ("transport transformation") and the broad range of topics it encompasses have gained enormous polarity over the past three years in Germany. But there has been little progress in plementing policies that will make sustainable transport a reality. in Germany or other parts of the world, although it is becoming increasingly clear that the transport sector is one of the biggest challenges in climate protection.

So instead of another expert report, we have sought to reach a wider audience with an innovative genre: the “infographic novel.” Part infographic, part graphic novel, it draws on our previous insights but repackages them in a fun and accessible format. Its purpose is to raise public awareness of the problems that the transport sector poses for the climate while pointing to real solutions that can help fight global warming. In realizing this ambitious project, we enlisted the help of Ellery Studio, a group of young designers, researchers, illustrators, and go-getters dedicated to making climate change understandable and illuminating prudent paths forward. We spent many gratifying hours with the Ellery team last year hatching ideas and storylines for this novel form of science communication. It was new territory for everyone.

"Future Ahoy!" is the result of our collaboration. We hope that it entertains, enlightens, and ultimately inspires. Its overriding message is that sustainable transport is a collective endeavor. If it is to succeed, each and every one of us must embrace a common purpose.

Christian Hochfeld and Marena Pützschler
Agora Verkehrswende

WHAT IS AN INFOGRAPHIC NOVEL?



CHAPTER 1

WHY WE NEED SUSTAINABLE TRANSPORT

REASON #1 FOR SUSTAINABLE TRANSPORT:

TO PROTECT THE PLANET

In 2021, climate change continues to gain steam.

I'VE ALWAYS DREAMT OF BEING AN ASTRONAUT! ... BUT OUR PLANET SEEMS SO FRAGILE FROM WAY UP HERE.

32 BILLION TONS OF CO_2 ARE RELEASED EACH YEAR GLOBALLY

TODAY

WORLDWIDE CARBON EMISSIONS BY SECTOR IN 2016

- **7%** OTHER
- **8%** BUILDINGS
- **19%** INDUSTRY
- **24%** TRANSPORT
- **42%** POWER & HEAT

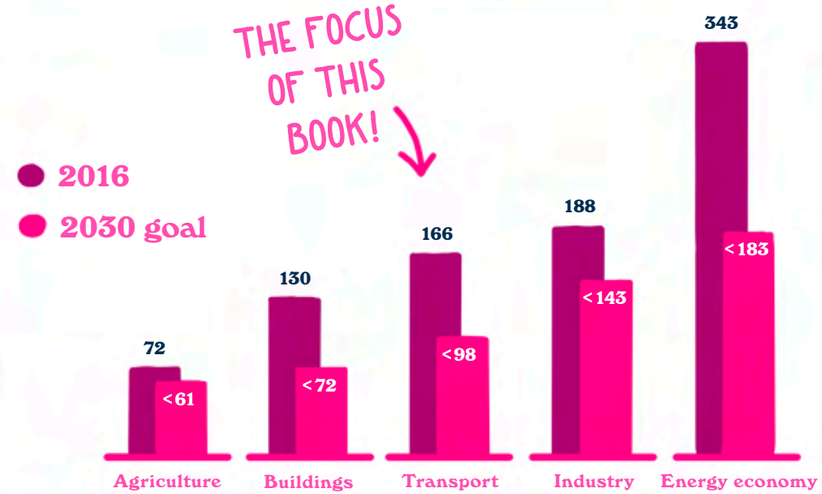
THE EARTH HAS ALREADY WARMED BY **1°C**. IF THIS TREND CONTINUES, WE ARE HEADED FOR BIG TROUBLE!

COOL IT!

WE HAVE TO TAKE ACTION NOW TO AVOID CAUSING CATASTROPHIC DAMAGE TO THE CLIMATE, TO NATURE, AND TO OURSELVES.

IN 2015 THE NATIONS OF THE WORLD SIGNED THE PARIS AGREEMENT, WHICH CALLS FOR GLOBAL WARMING TO BE KEPT BELOW **2°C**, AND, IF POSSIBLE, BELOW **1.5°C**. THE WORLD NEEDS TO ACT NOW!

GERMANY HAS ADOPTED AMBITUOUS TARGETS, AND IS SEEKING TO REDUCE EMISSIONS IN ALL AREAS OF THE ECONOMY.



Which areas of the economy are responsible for emissions? And how much carbon can be released in 2030? (Figures in million tons of CO_2 equivalents*)

*DEFINITIONS CAN BE FOUND ON PAGE 76.

GERMANY'S GOAL IS TO REDUCE EMISSIONS IN TRANSPORT BY **40-42%** RELATIVE TO 1990. IT WANTS TO REACH THIS TARGET BY 2030.

DAMN! I'M LATE FOR MY MEETING! I'LL TAKE THE CAR TODAY. OTHERWISE I WON'T ARRIVE ON TIME.

GRANDPA, DID YOU KNOW THAT ALMOST 20% OF ALL EMISSIONS IN GERMANY COME FROM TRANSPORT? I JUST HEARD IT ON THE NEWS!

!!!

LAST NIGHT I DREAMT AGAIN I WAS AN ASTRONAUT...

!

Experts: Climate change spinning out of control.

FFF

WOULD YOU LIKE A RIDE TO SCHOOL SWEETHEART?

FFF

NO THANKS, DAD

I'D RATHER RIDE MY BIKE – IT'S MUCH HEALTHIER!

FFF

A STRIKE! MORE CLIMATE HYSTERIA!

HMMM

ANYWAY, SCHOOL IS CLOSED FOR A CLIMATE STRIKE!

FFF

Experts: Climate

KIDS ON STRIKE! THAT NEVER HAPPENED IN THE GOOD OLD DAYS!

GOOD OLD DAYS? OK BOOMER...

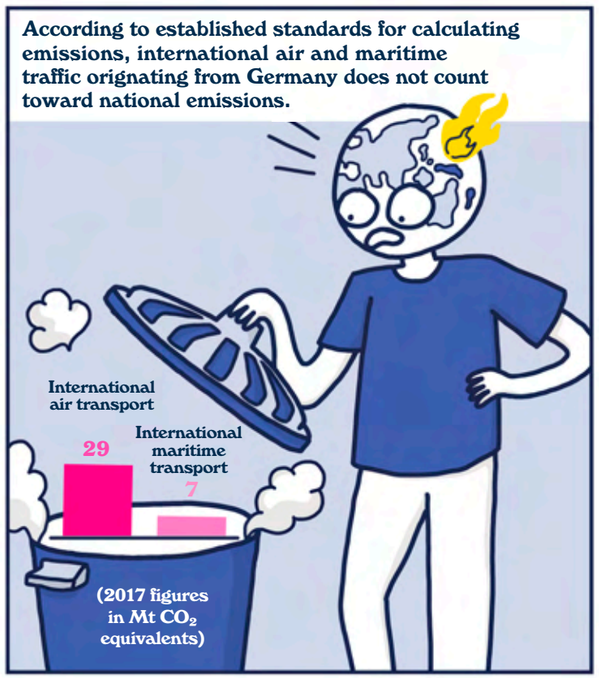
IN THE GOOD OLD DAYS THE SITUATION WASN'T AS SERIOUS.

FFF

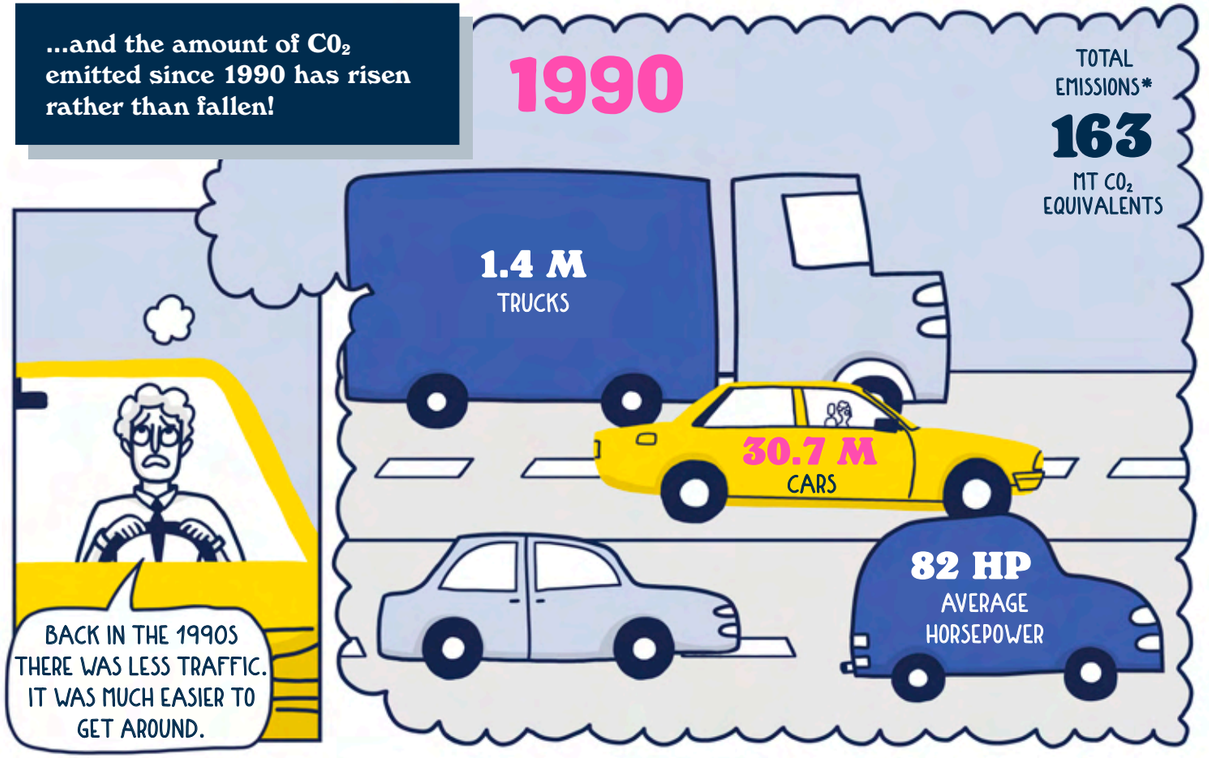
Cars and trucks cause more emissions than all other modes of transport combined...

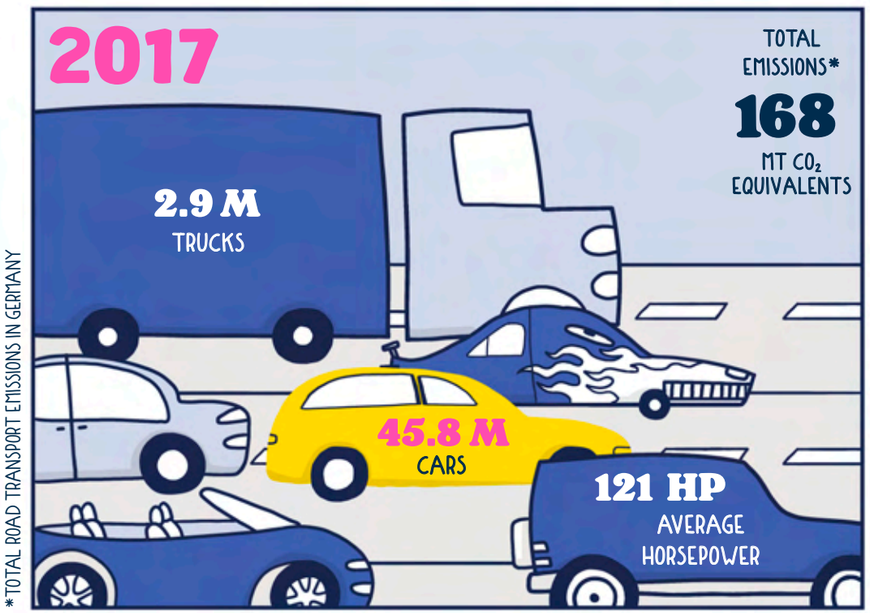
Carbon emissions from all modes of transport in Germany for 2017 (in million tons of CO_2 equivalents)

According to established standards for calculating emissions, international air and maritime traffic orignating from Germany does not count toward national emissions.



...and the amount of CO_2 emitted since 1990 has risen rather than fallen!





*TOTAL ROAD TRANSPORT EMISSIONS IN GERMANY

One thing is clear: Making road transportation climate neutral by 2050 will require radical change.

REASON #2 FOR SUSTAINABLE TRANSPORT:

TO IMPROVE QUALITY OF LIFE

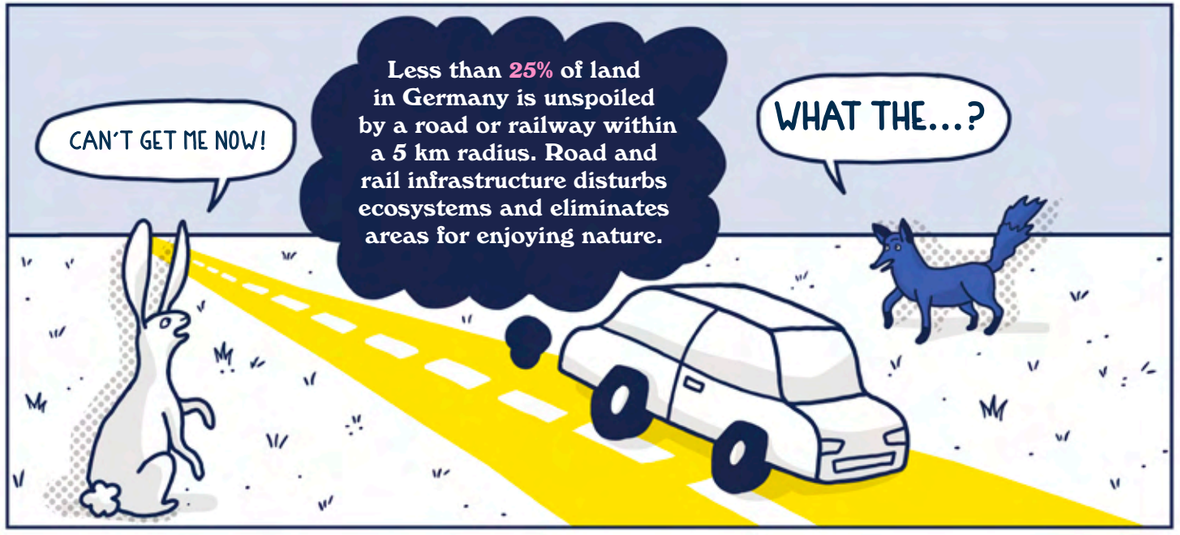
Nearly **5 million** Germans regularly lose sleep because of traffic noise.

Tailpipes release nitrous dioxide, a harmful compound that causes respiratory problems.
61% of dangerous emissions in German cities are caused by road traffic.

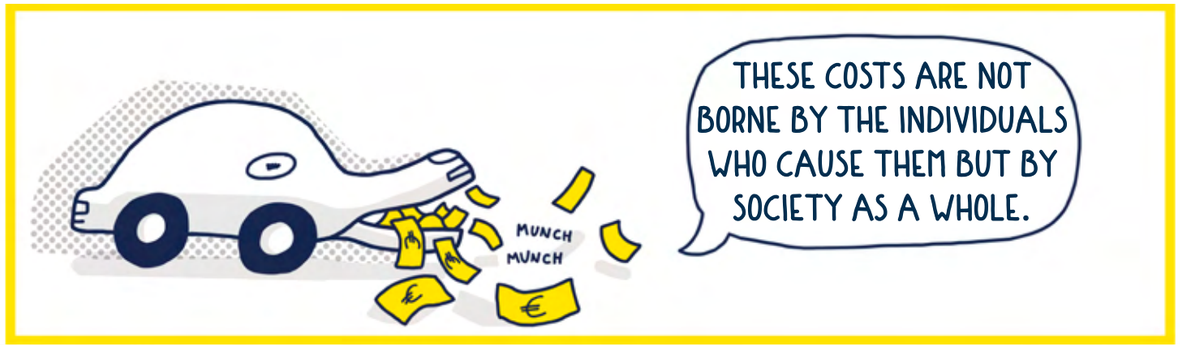
Traffic injuries in 2018:

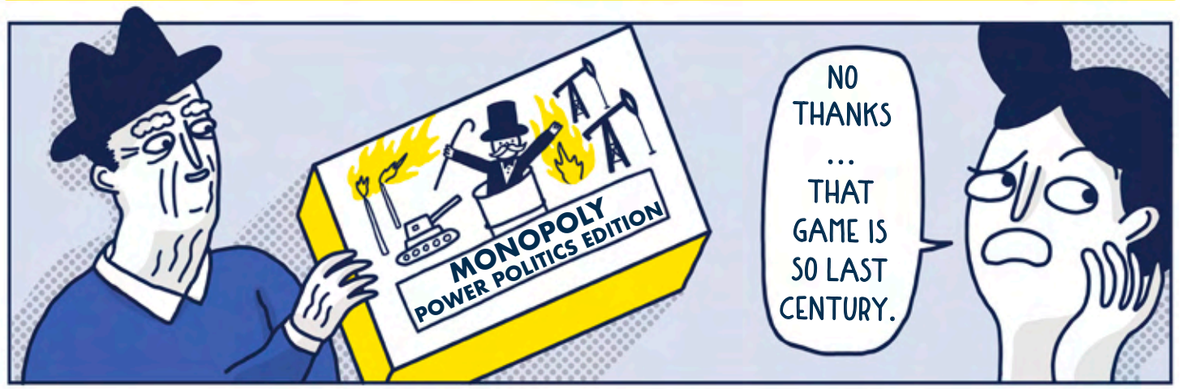
399,293

(including 3,275 fatalities)



The external costs of road traffic to the environment and human health are estimated at **52 billion**.





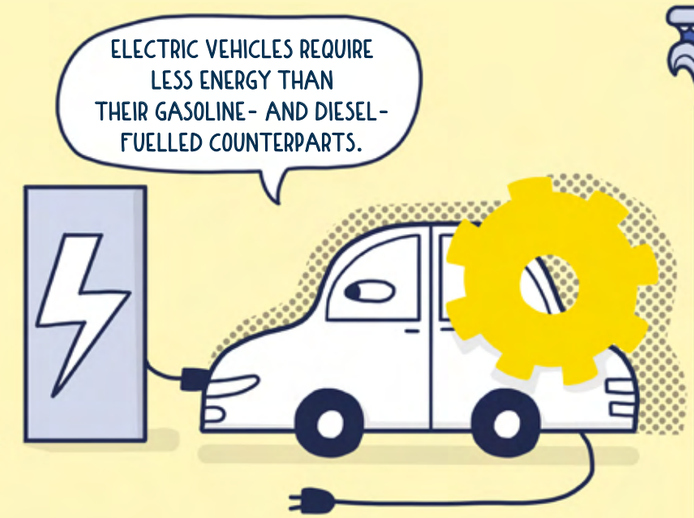
Conventional vehicles are almost totally dependent on petroleum, which has to be imported from abroad.

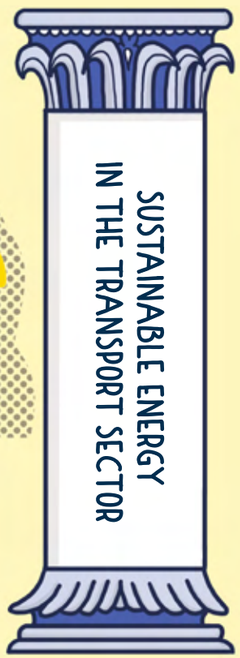
CHAPTER 2

HOW IT CAN SUCCEED

Through collective efforts that seek to improve efficiency, we can make transport sustainable.

Creating sustainable mobility encompasses a range of measures – including efforts to reshape attitudes and beliefs – that will encourage people to use more public transport, rely less on privately owned vehicles, and make more trips by foot or bike. It also involves shifting some freight from roads to rail and waterways.





To be sustainable, the transport sector must rely primarily on electricity for power and phase out combustion engine vehicles. Furthermore, the electricity for e-vehicle fleets has to come from renewable sources. Creating a sustainable transport system requires moving at full speed towards a clean-energy-based power sector.

SUSTAINABLE MOBILITY

**Sustainable transport rests on two pillars.
This section is about the first.**

THE TRANSITION TO SUSTAINABLE MOBILITY WILL BEGIN IN CITIES.

OH NO, I'M RUNNING LATE!

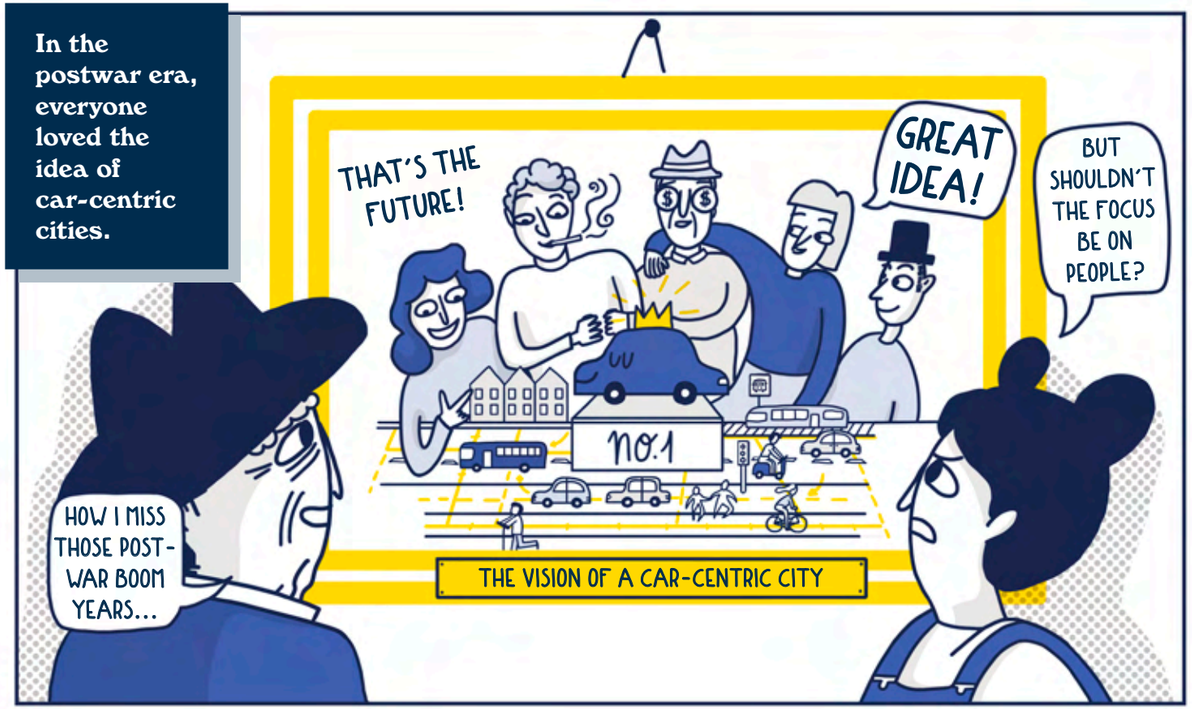
AND NEW WAYS OF THINKING ARE A CRUCIAL FIRST STEP.

ACCORDING TO A STUDY BY THE GERMAN FEDERAL ENVIRONMENT AGENCY, OVER **90%** OF PEOPLE BELIEVE THAT QUALITY OF LIFE WOULD IMPROVE IF REGIONAL AND URBAN PLANNING SOUGHT TO DIMISH DEPENDENCY ON CARS.

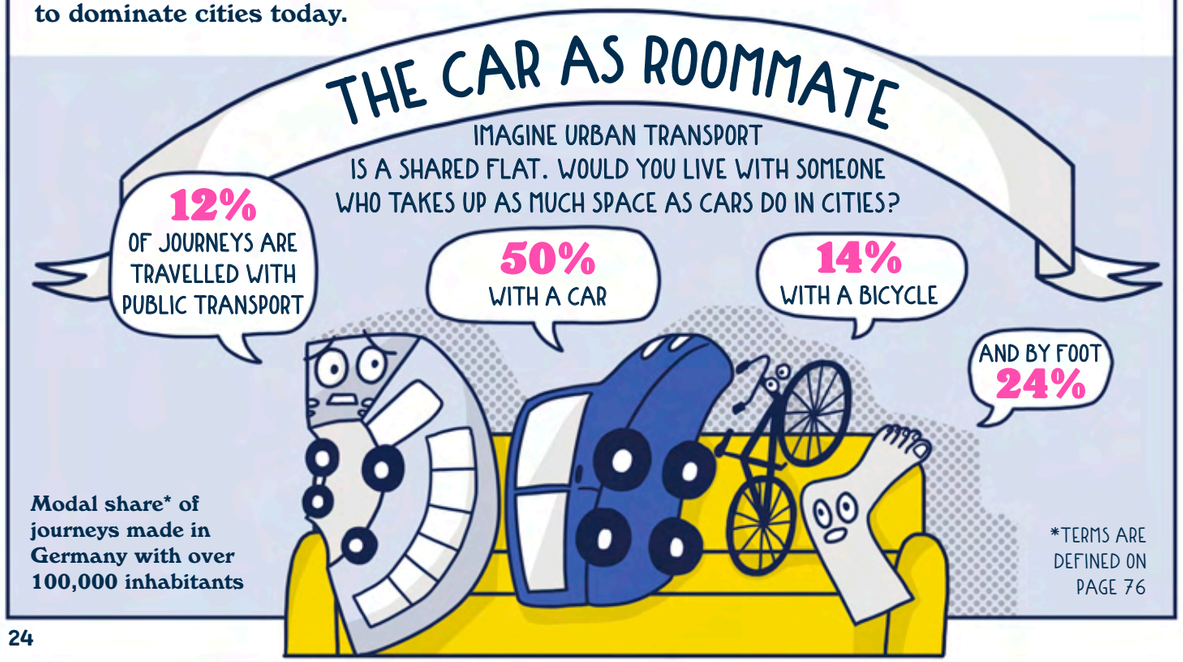
SHARE

In which city would you rather live?

In the postwar era, everyone loved the idea of car-centric cities.



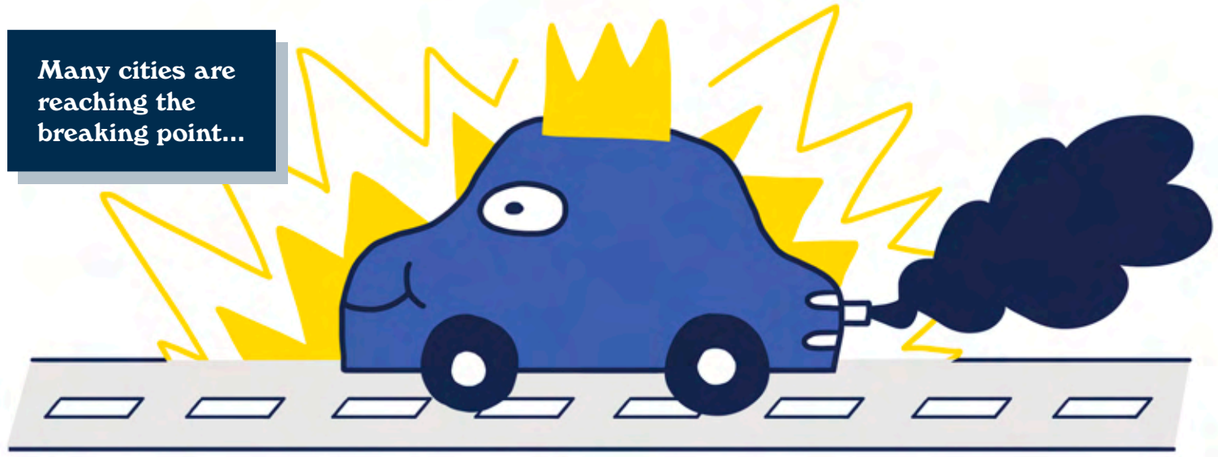
The decisions of urban planners in the 1950s and 60s are why cars continue to dominate cities today.



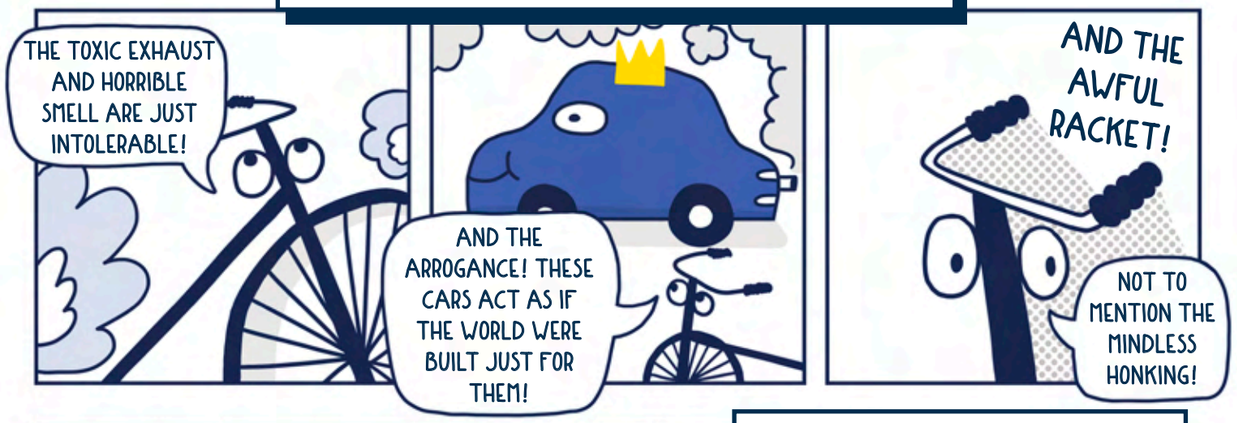
Modal share* of journeys made in Germany with over 100,000 inhabitants

*TERMS ARE DEFINED ON PAGE 76

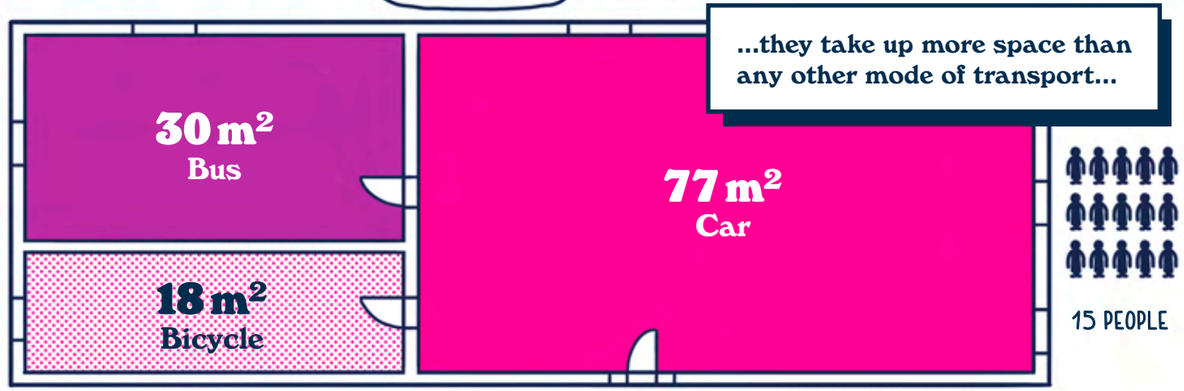
Many cities are reaching the breaking point...



...because cars foul the air and ruin the climate...

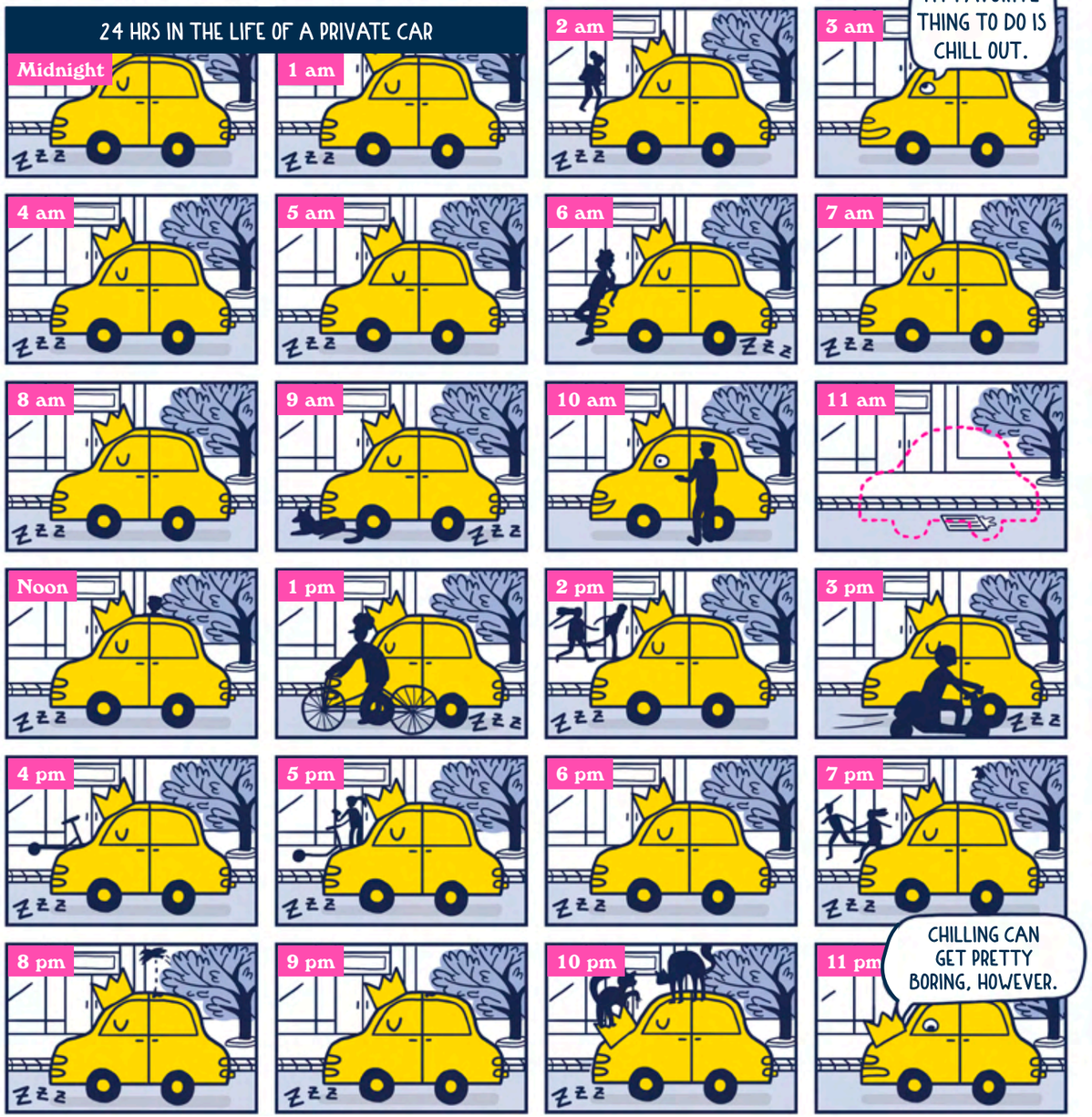


...they take up more space than any other mode of transport...



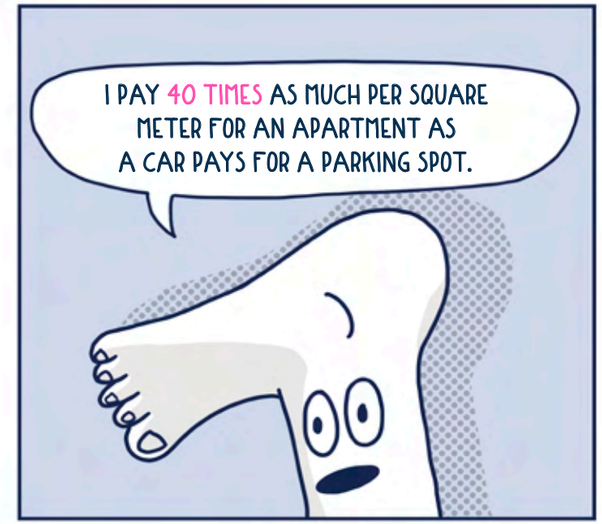
Street space required for the transportation of 15 people using various means of transport (based on the shared apartment analogy).

...cars take up a lot of space even when they are not being used...

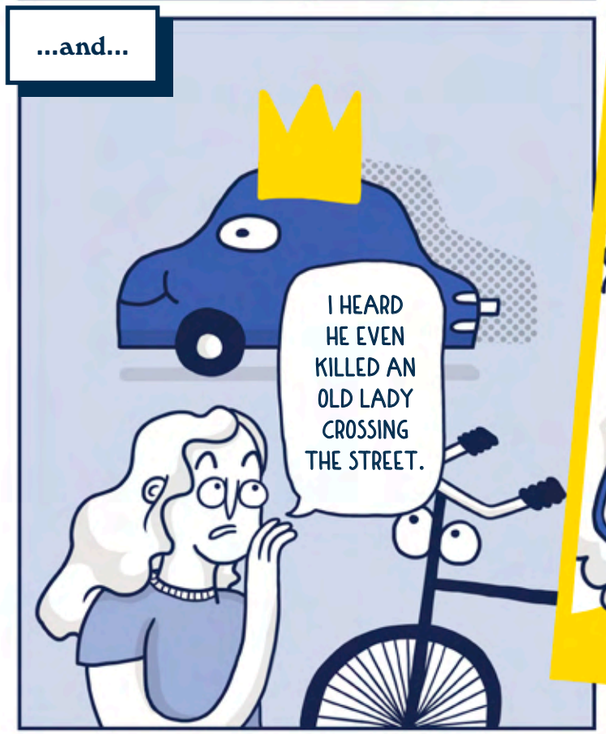


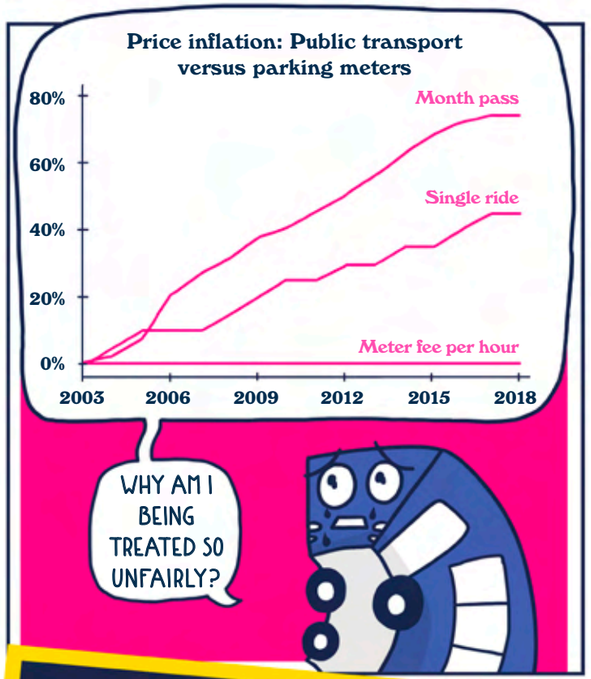
On average, private vehicles are used just 1 hour a day.

...the car pays significantly less than other users of urban space...

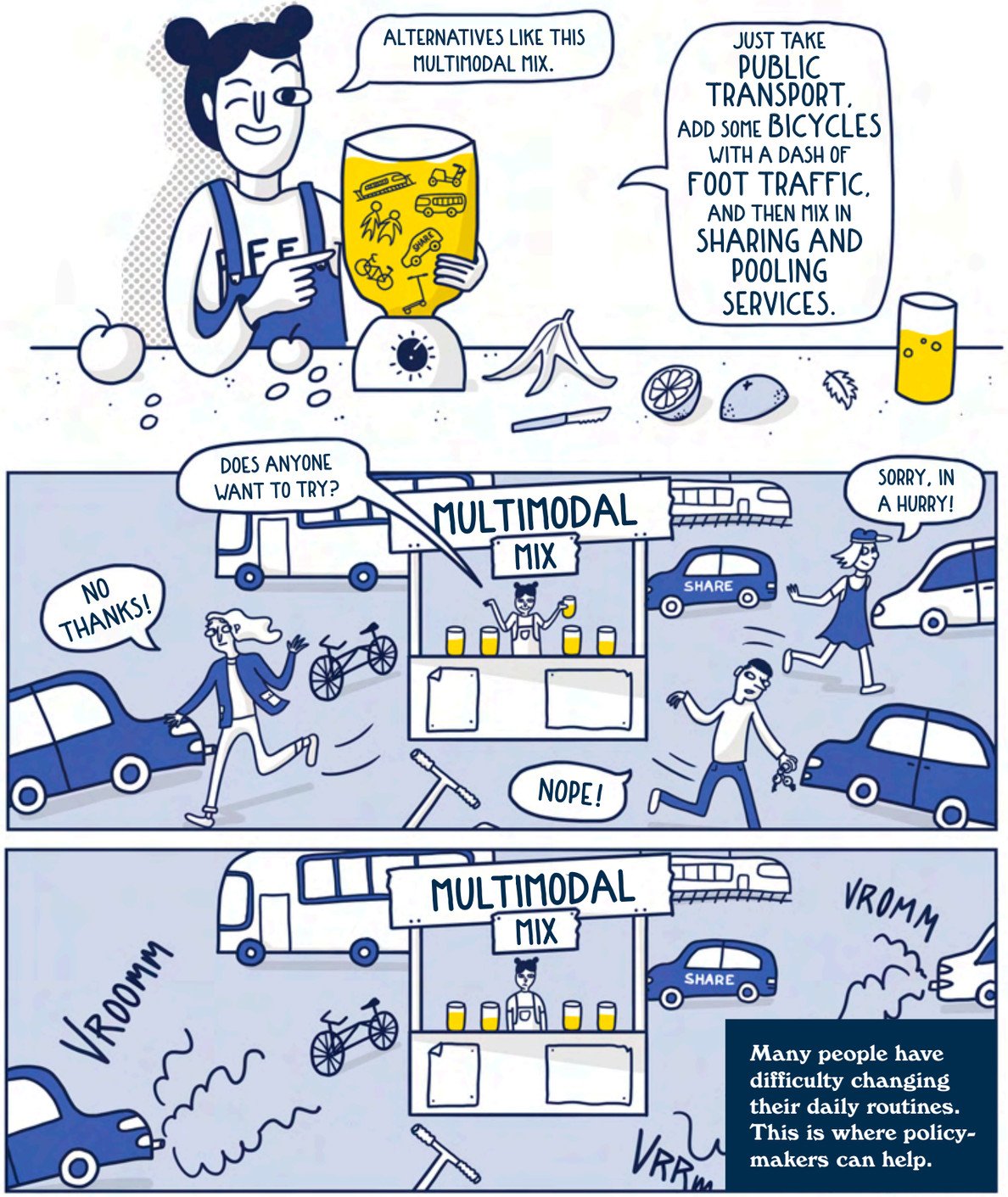


...and...





Alternatives already exist ...



Many people have difficulty changing their daily routines. This is where policy-makers can help.

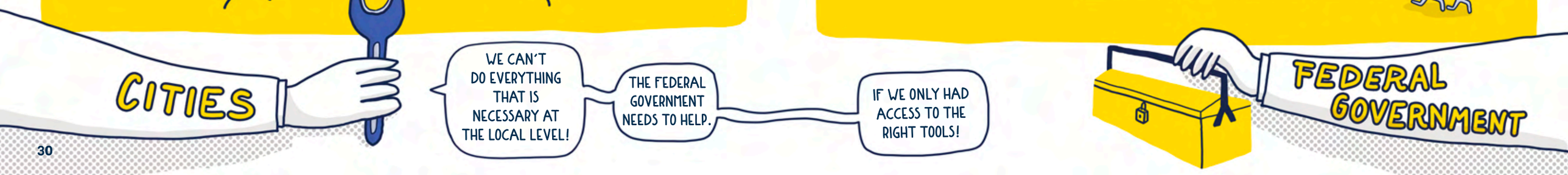
Policymakers need to create incentives to make sustainable mobility a reality.

PUSH

"Push measures" should be enacted that make car ownership less appealing.

PULL

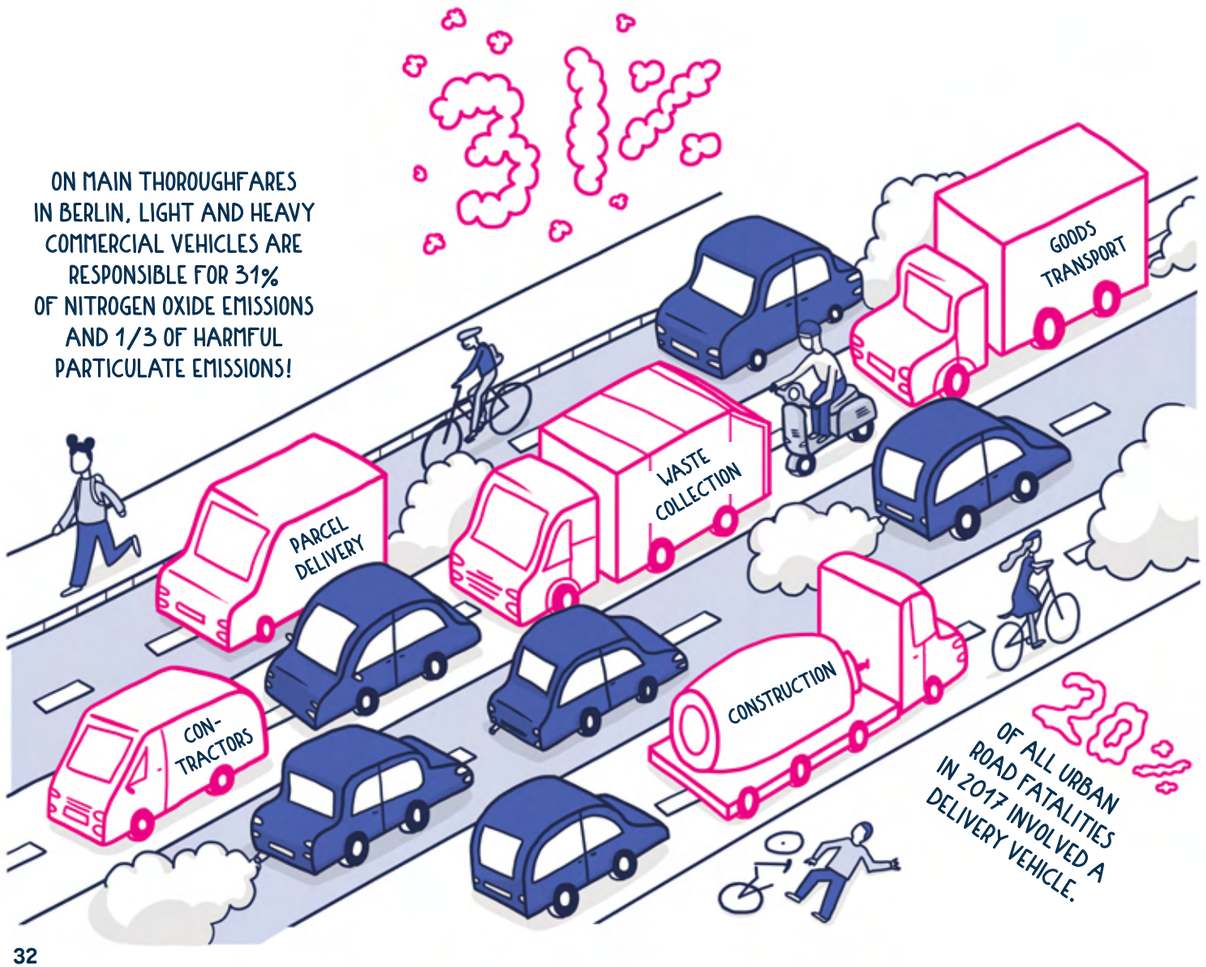
"Pull measures" are designed to make other forms of transport more attractive.



GOODS TRANSPORT IN CITIES

ANOTHER IMPORTANT BUILDING BLOCK OF SUSTAINABLE MOBILITY

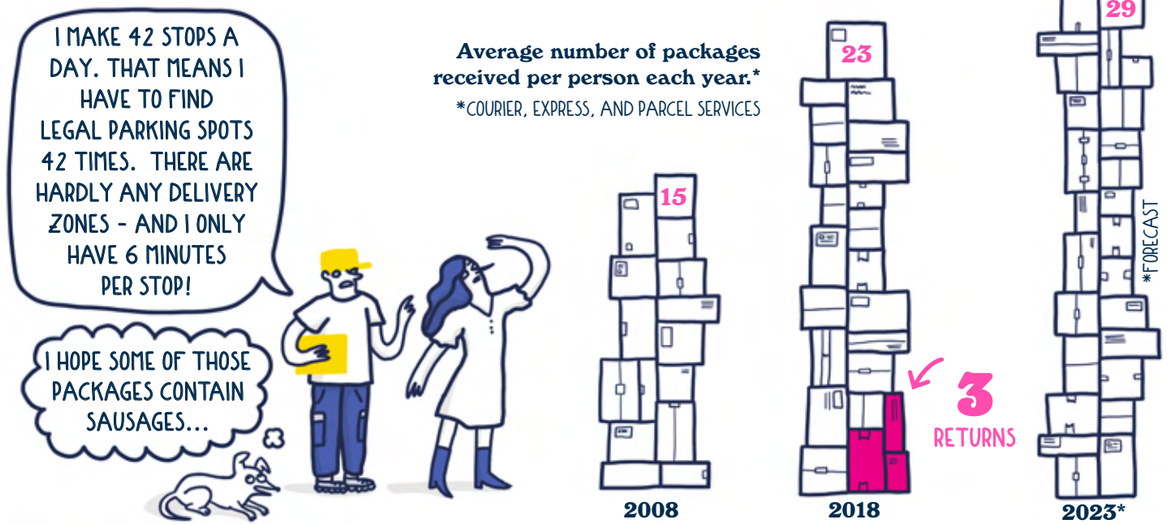
**Our roads are becoming ever more congested with people and goods.
The delivery of goods is essential for daily life, supplying us with food and other necessary items.
However, delivery vehicles compete with cars, buses, and cyclists for scare road space.
Cities will face numerous challenges in this sector in the coming decades.**



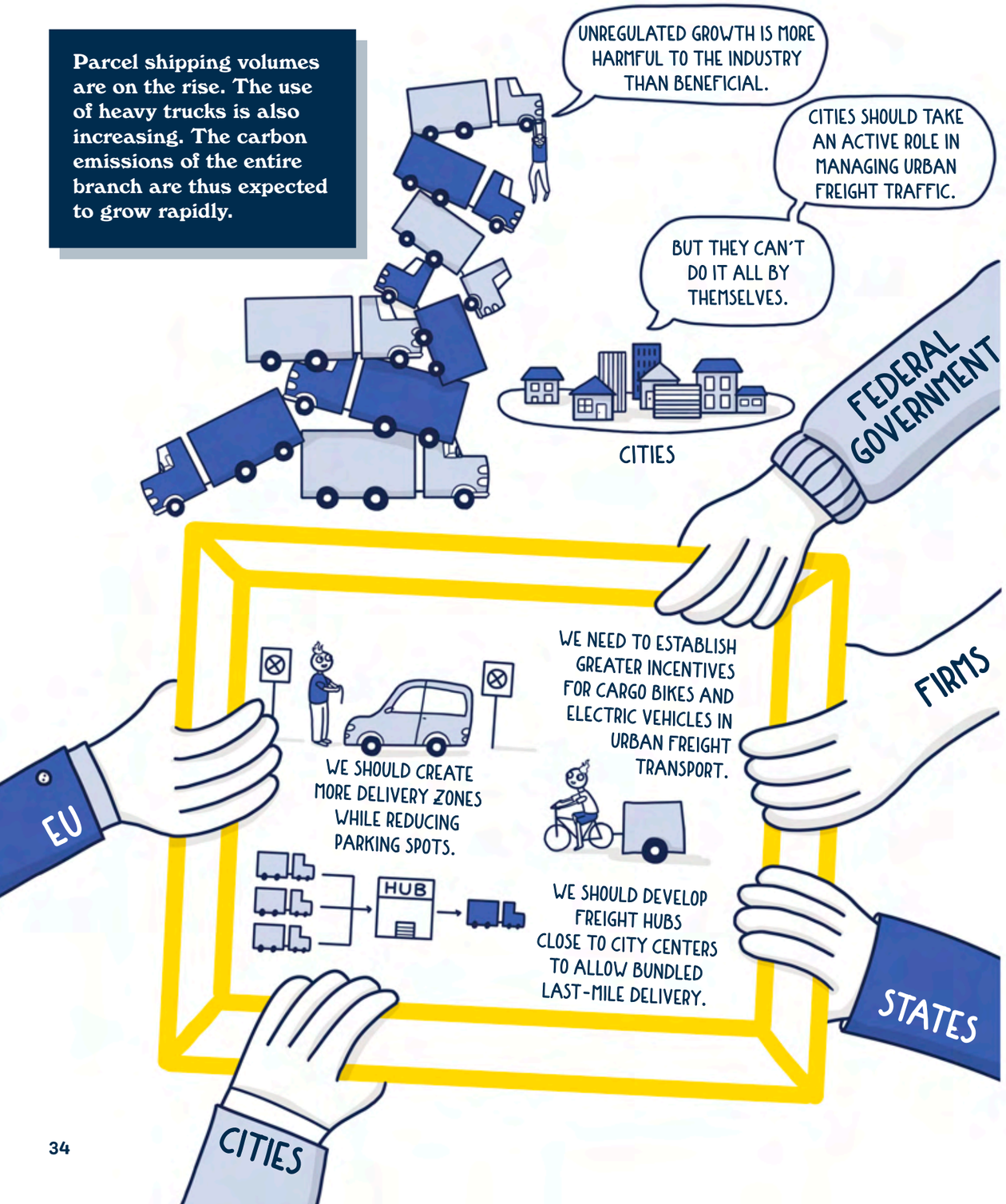
Despite the problems, we rely on deliveries more than ever before, as the following figures show:

Number of daily deliveries (trips) and shipments (dispatched goods) per business (in Wuppertal, Germany)

Households are also ordering more online than ever before.

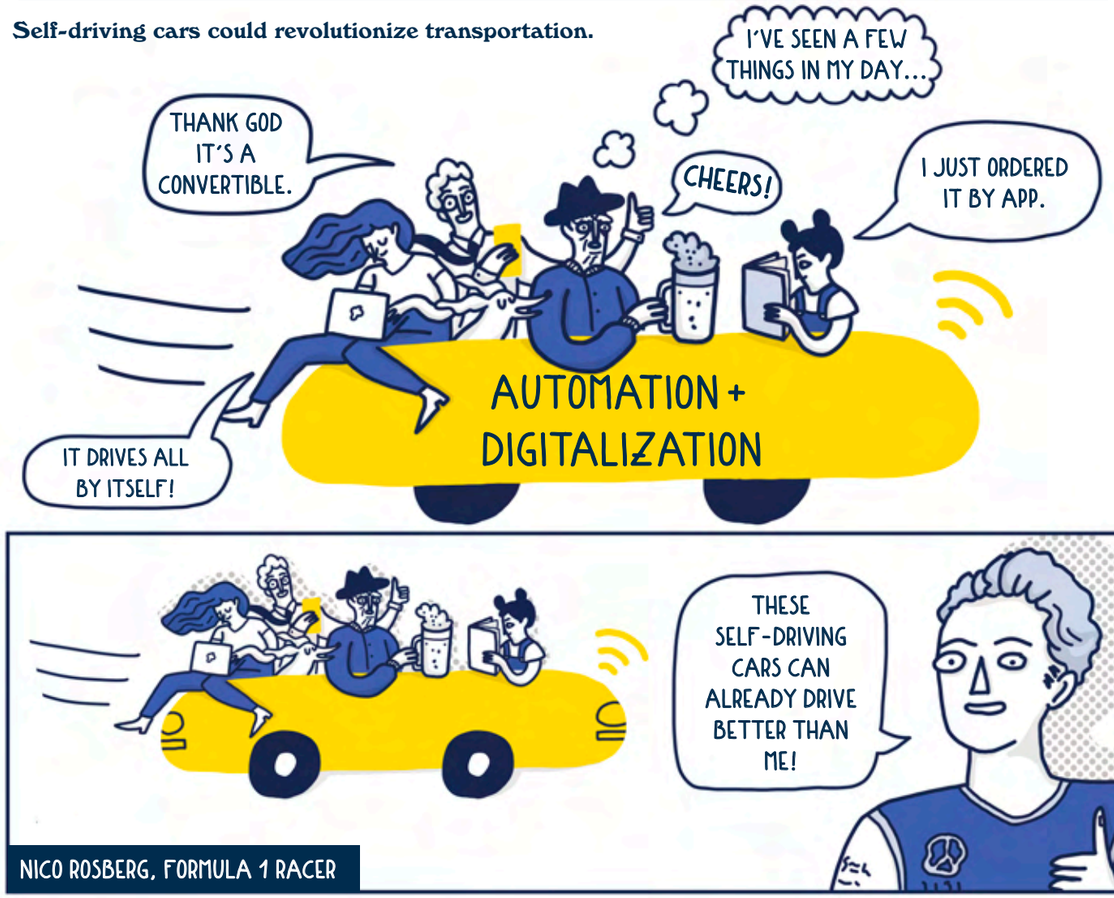


Parcel shipping volumes are on the rise. The use of heavy trucks is also increasing. The carbon emissions of the entire branch are thus expected to grow rapidly.



AUTOMATED SUSTAINABILE MOBILITY?

Self-driving cars could revolutionize transportation.

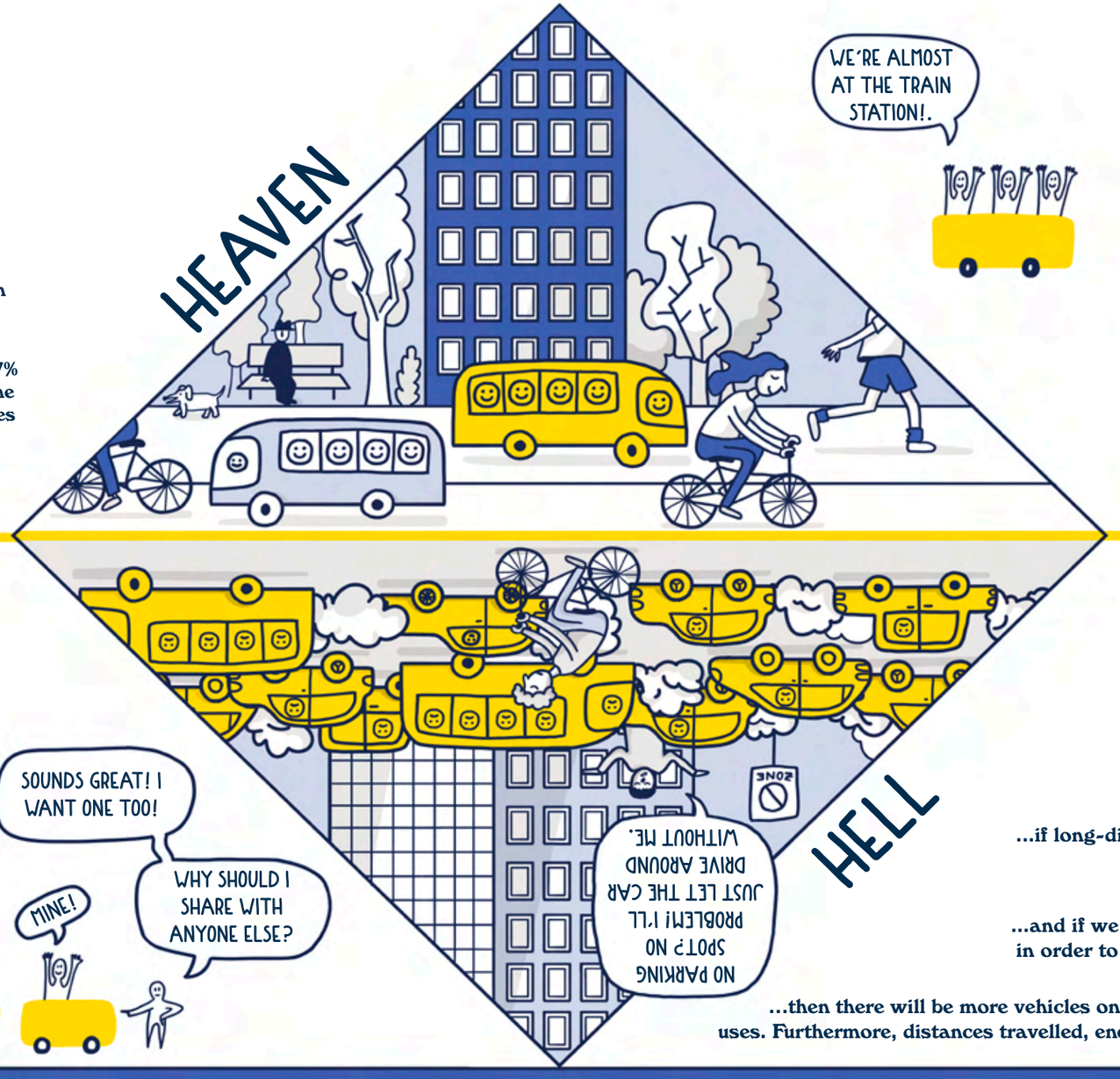


Self-driving cars could create heaven on earth...

...if they are integrated into public transport, particularly for the first and last mile...

...and if they are shared for the transportation of numerous passengers...

...then we could reduce the size of the vehicle fleet by 97% without limiting personal mobility. This would free up the massive amounts of space currently used to park vehicles while also slashing energy consumption and emissions.



...or they could unleash infernal forces...

...if everyone wants to own their own car...

...if long-distance trips become more frequent because people can read or sleep while travelling...

...and if we let self-driving vehicles drive on their own, in order to avoid paying for expensive parking spots...

...then there will be more vehicles on the road and less public space for non-vehicle related uses. Furthermore, distances travelled, energy consumption, and emissions will continue to rise.

IN RURAL AREAS

SUSTAINABLE MOBILITY LOOKS DIFFERENT

Nearly one quarter of Germans live in rural areas.

German population (2015):

18.7 M in cities

34.2 M in suburbs and towns

29.3 M in rural areas

THE TRAIN IS PACKED AGAIN...

OH NO ... I'M GOING TO BE LATE AGAIN.

" DAILY COMMUTERS IN STUTTGART **250,000**

BUT COMMUTING INTO THE CITY EVERY DAY IS A DRAG!

THE COUNTRYSIDE IS SO IDYLLIC!

People living in rural areas are much more dependent on cars than city dwellers...

...because public transport is often inconvenient or unavailable.

FIXED ROUTES

FIXED TIMES

A

...frequent trips mean very few passengers per vehicle

LOW OCCUPANCY

WHAT? THE NEXT BUS DOESN'T COME FOR AN HOUR!

...but infrequent trips mean low availability

B

As a result, the share of trips taken with a car is twenty percentage points higher in rural areas.

Car **70%**

OH GREAT, NOW WE'RE STUCK IN A TRAFFIC JAM. MAYBE WE SHOULD HAVE TAKEN THE TRAIN?

JUST TO GET TO THE TRAIN STATION, YOU HAVE TO TAKE A BUS TO THE NEXT VILLAGE.

Bike **7%**

THAT'S HORRIBLE!

Public transport **5%**

... AND THEN WALK 10 MIN FROM THE BUS STOP...

Walking **17%**

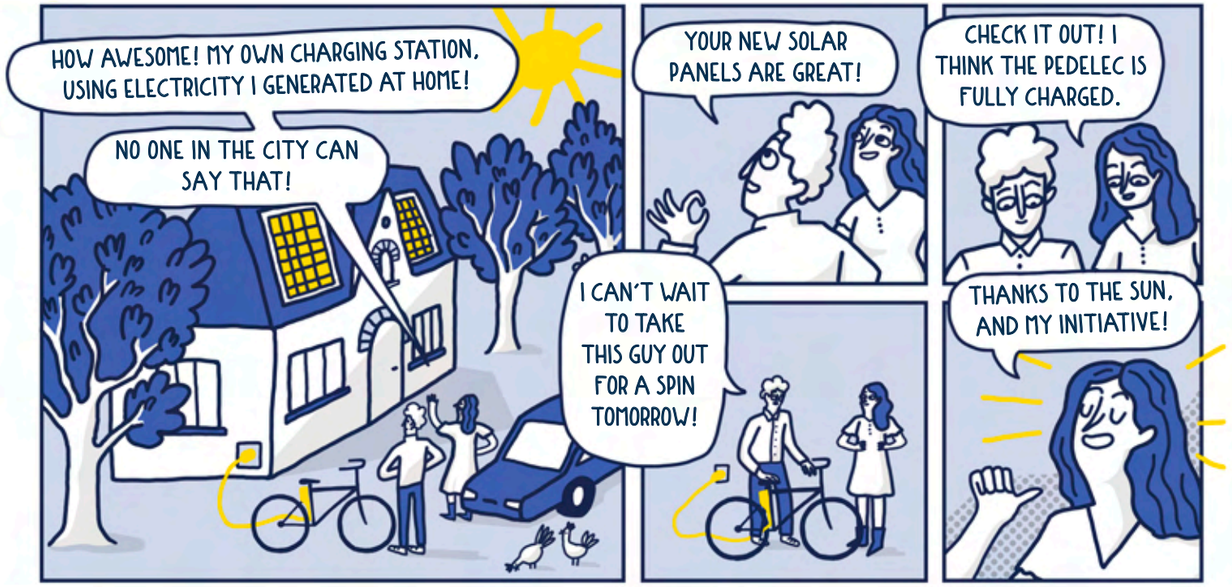
THE BEST OPTION IS TO GO BY CAR.

THAT'S THE COST OF DATING A COUNTRY BUMPKIN!

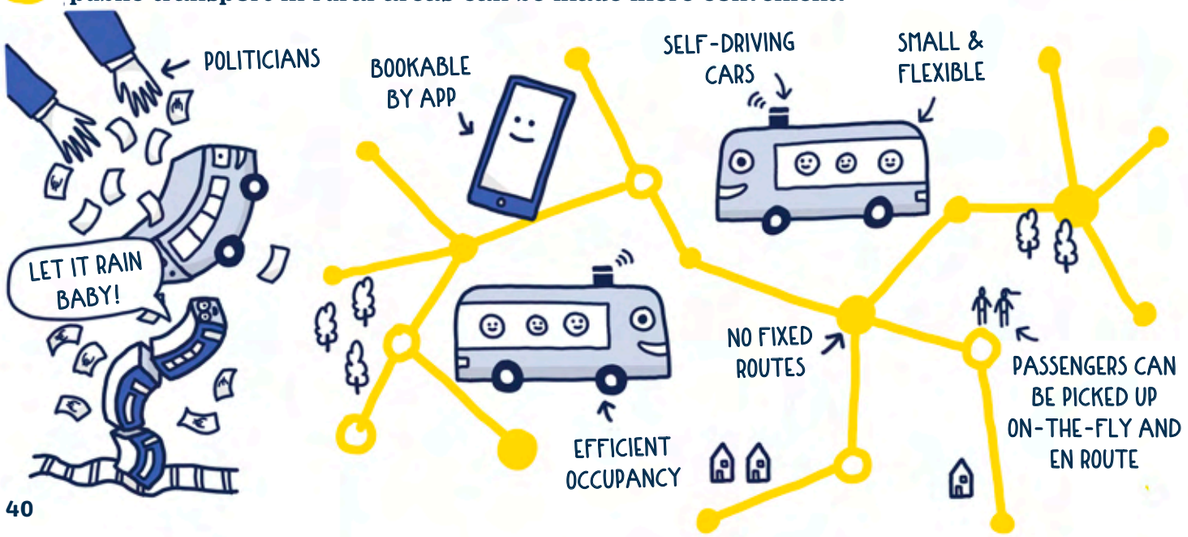
Modal share in villages and small towns in Germany (2017)

BUT how should people in rural areas get from point A to point B in the future?

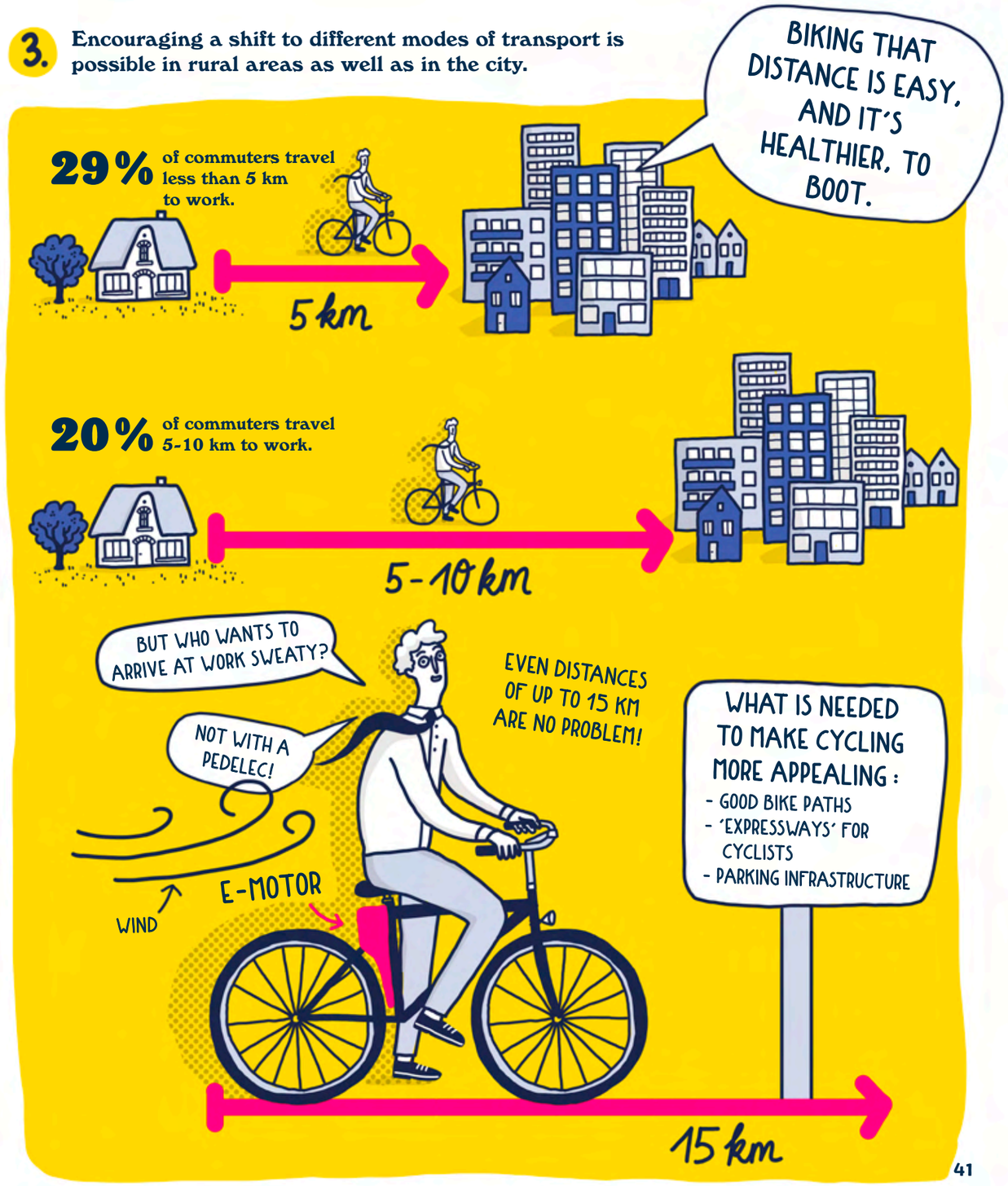
1. **Private cars will remain important for the foreseeable future. What matters is that they are electric.**



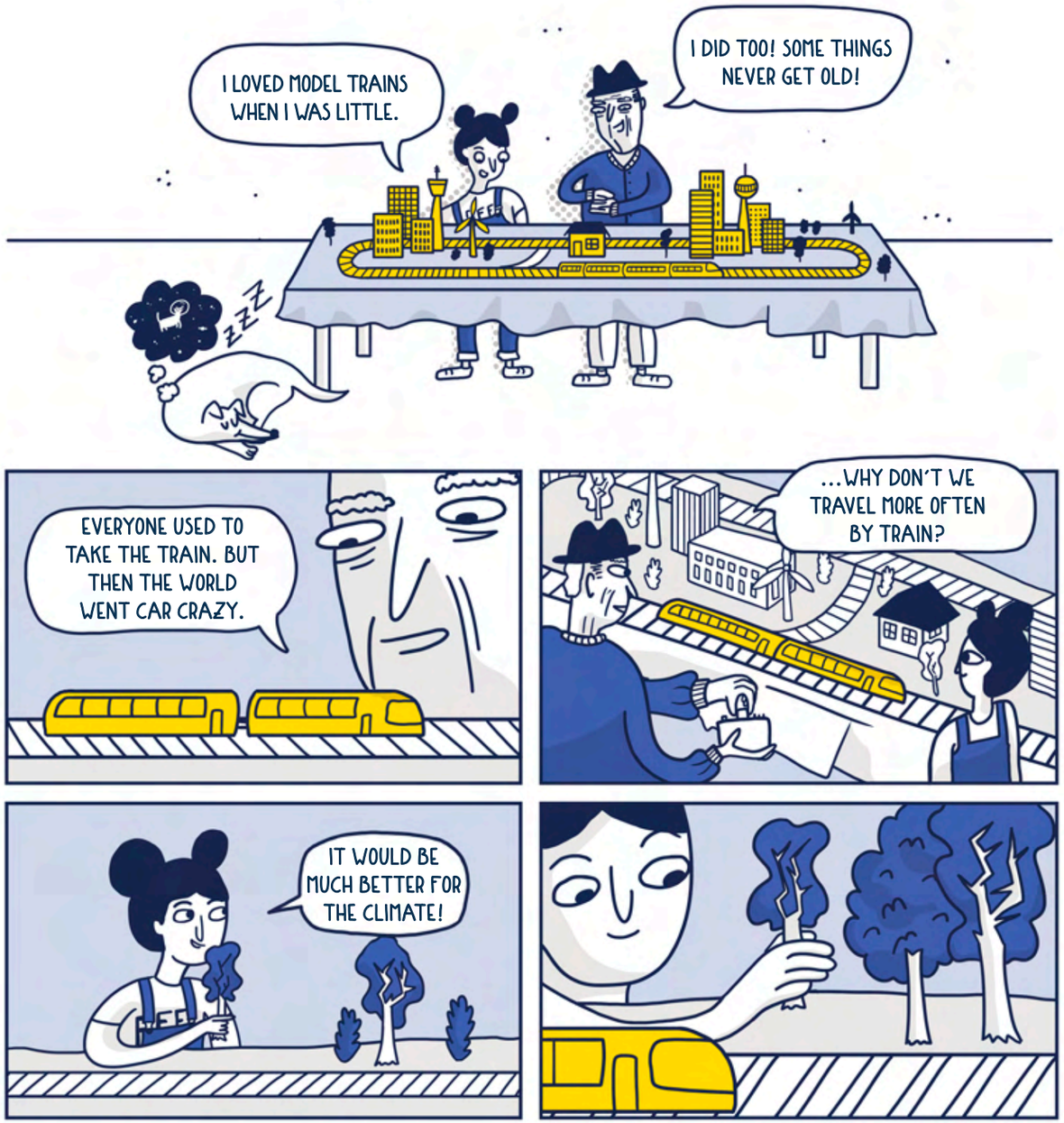
2. **With ambitious investment and new mobility services, public transport in rural areas can be made more convenient.**



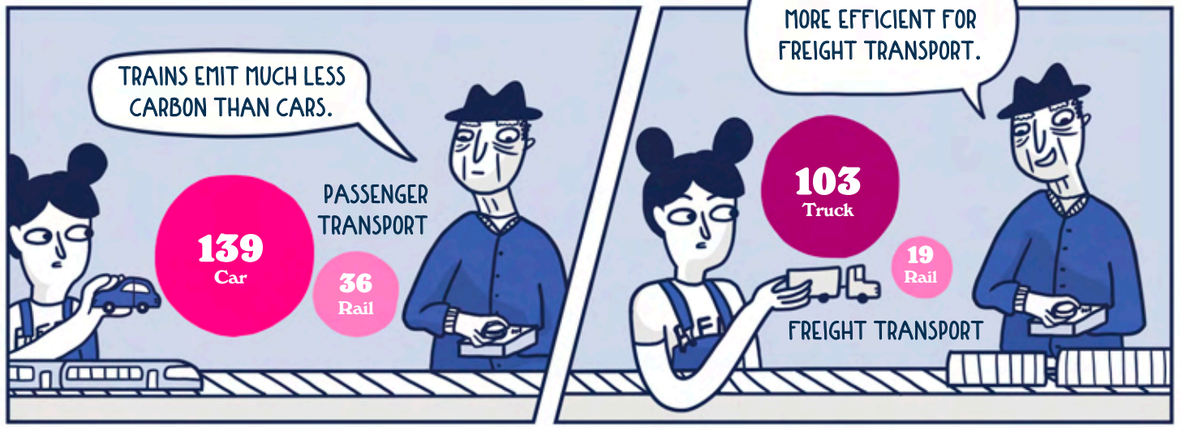
3. **Encouraging a shift to different modes of transport is possible in rural areas as well as in the city.**



FROM ROAD TO RAIL



Rail transport is climate friendly...



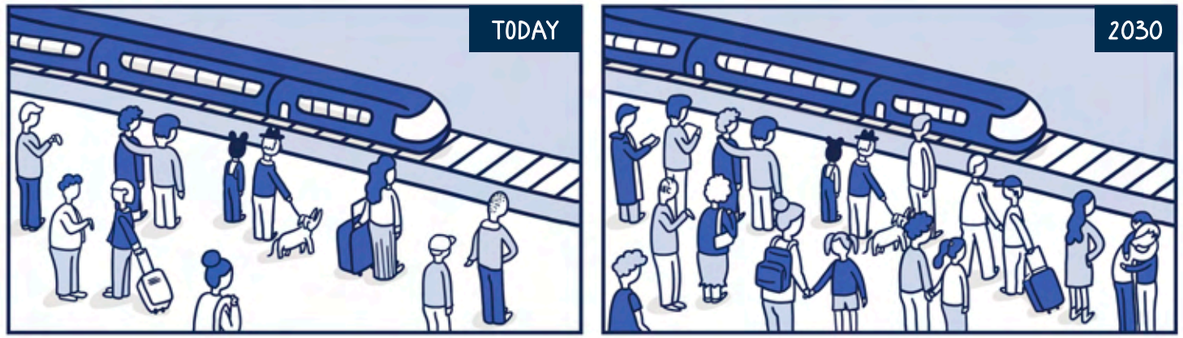
Comparison of greenhouse gas emissions between road and rail (in gram CO_2 equivalents per passenger or ton kilometer, 2017)

*SEE DEFINITIONS ON PAGE 76

Comparison of energy consumption between road and rail (in megajoules* per passenger or ton kilometer*, 2017)

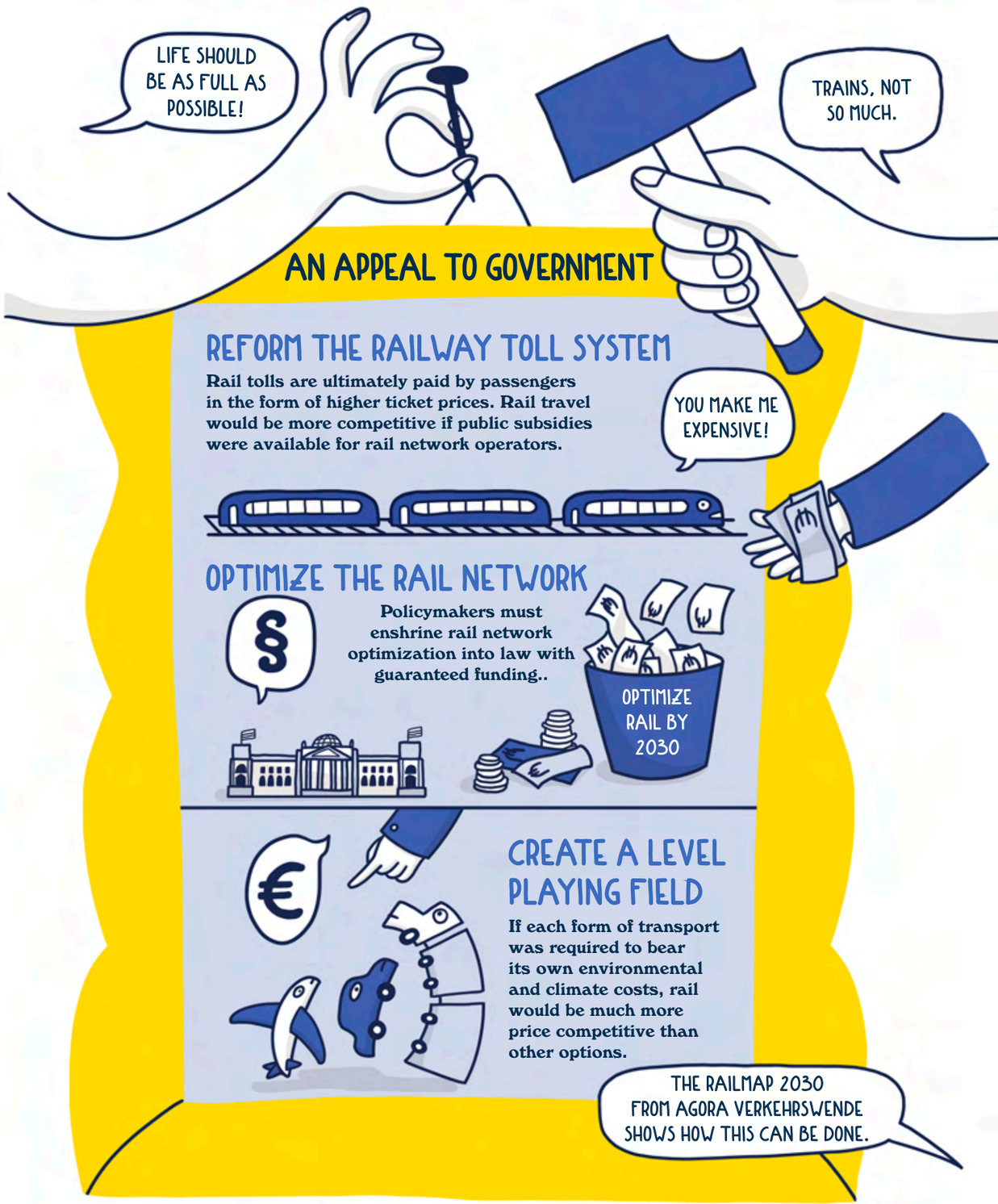
Energy sources in rail transport (2017)

Since rail travel is very climate friendly, the government aims to double the number of train passengers in Germany by 2030.



BUT HOW?

An innovative timetable system and better coordination between regional trains can dramatically improve the efficiency of the rail network. Travellers will be able to get anywhere they want with greater ease. This will require the expansion of the rail network and the construction of new stations.



SUSTAINABLE ENERGY IN THE TRANSPORT SECTOR

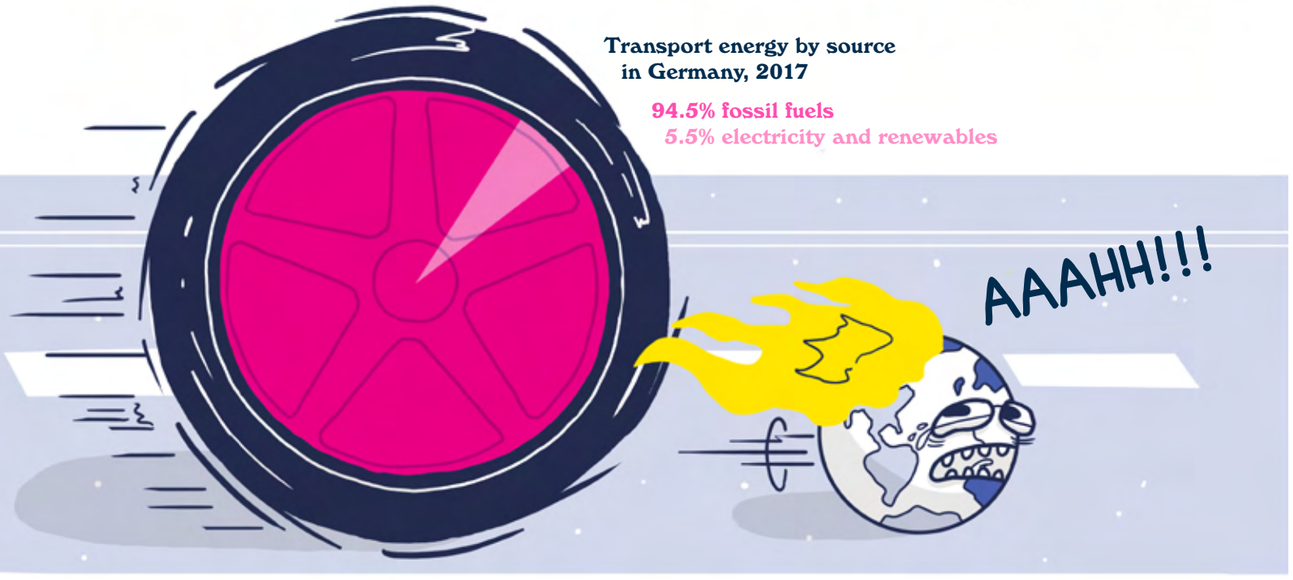
Sustainable transport rests on two pillars.
This section is about the second.

WE NEED ALTERNATIVES TO GASOLINE AND DIESEL

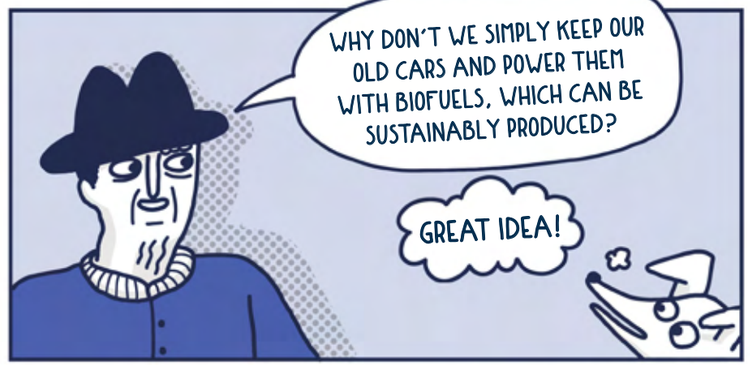
Even if we change the way we travel and use more bicycles and trains, we won't be able to do away with cars and trucks entirely. To ensure that the transport sector is environmentally sustainable, we need to power it with renewable energy and create more efficient vehicles.

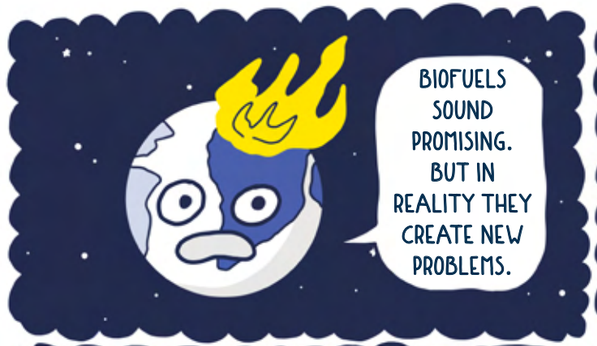
Transport energy by source in Germany, 2017

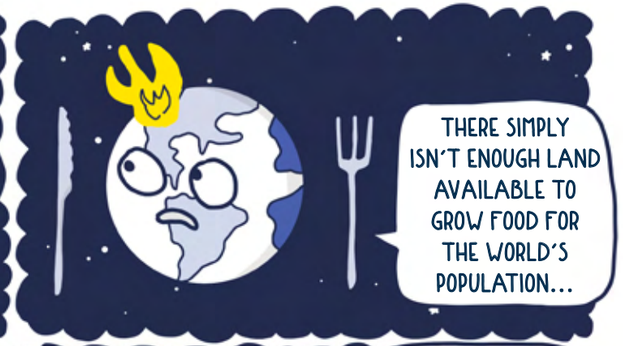
94.5% fossil fuels
5.5% electricity and renewables

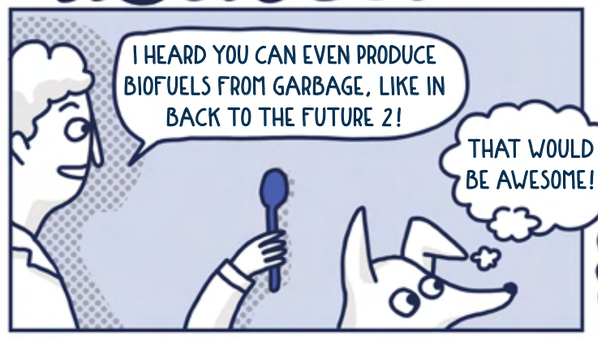


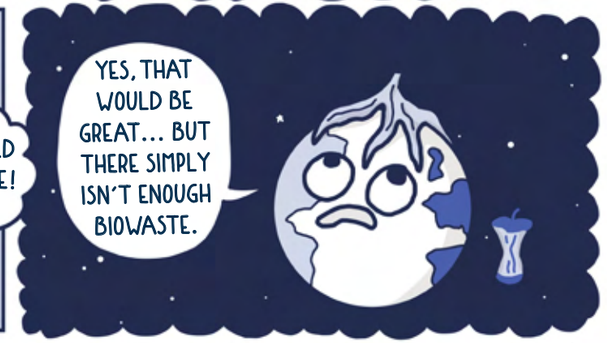
BIOFUELS ARE NOT THE ANSWER



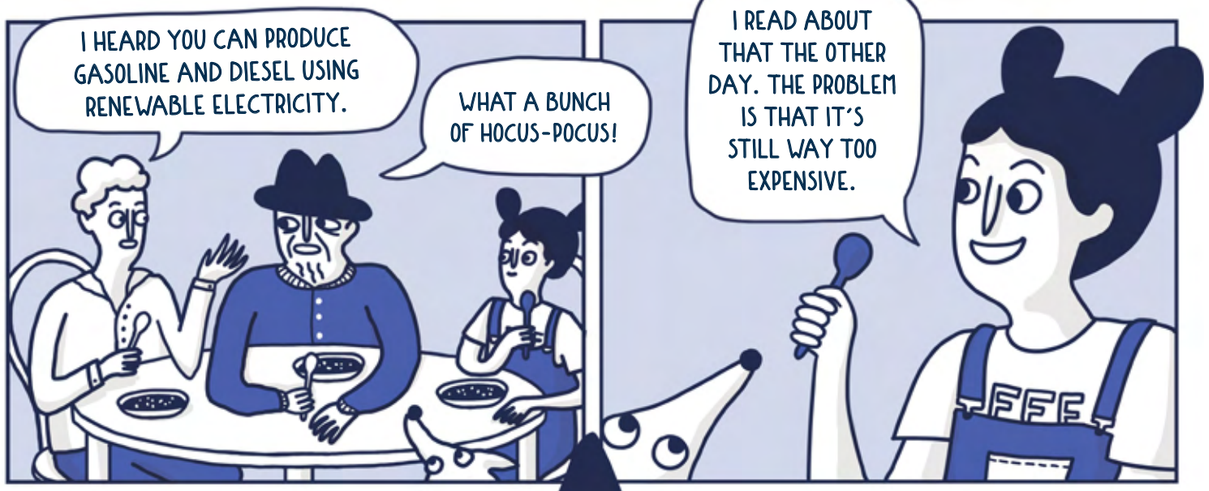




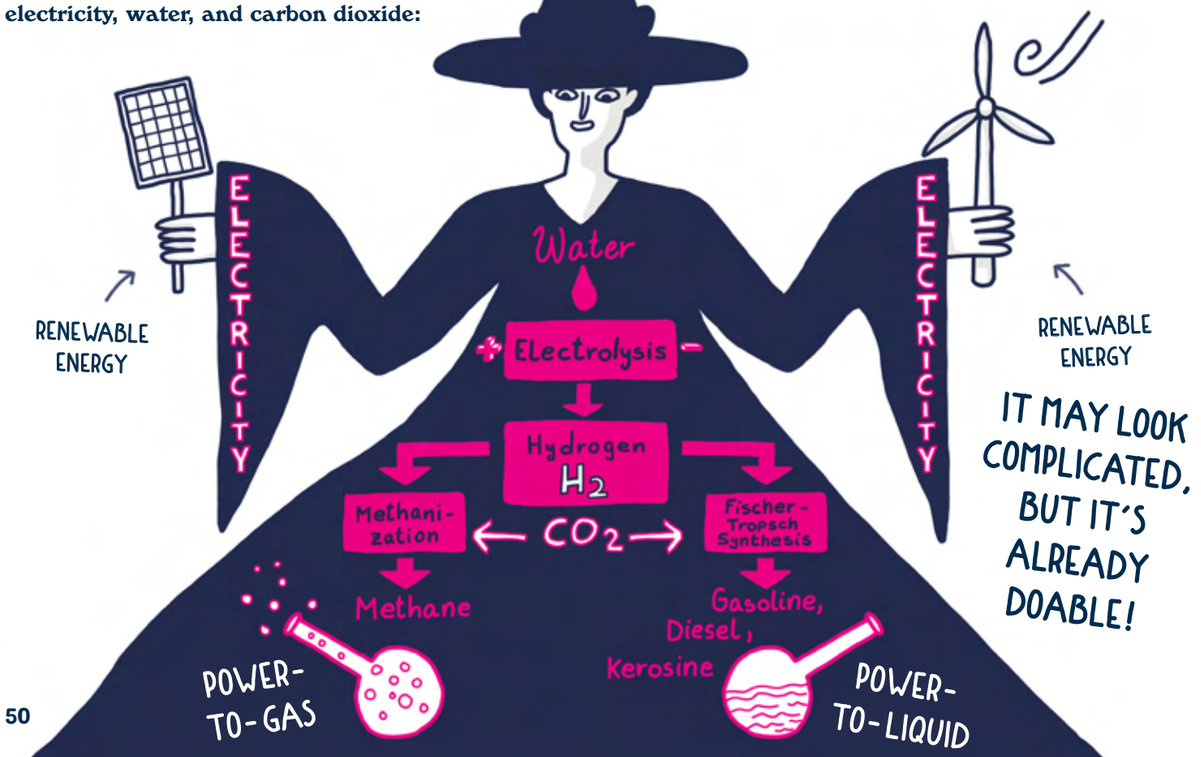




SYNFUELS
INEFFICIENT AND TOO EXPENSIVE



How to produce vehicle fuels from renewable electricity, water, and carbon dioxide:

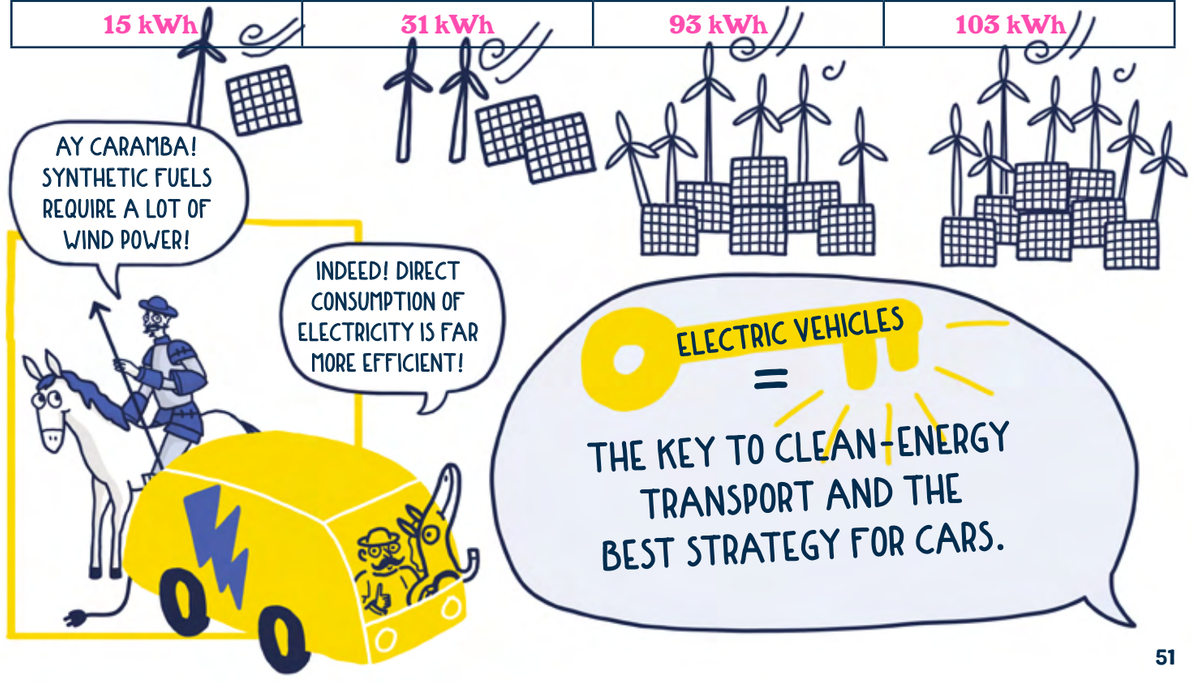


DIRECT POWER CONSUMPTION
IS THE MOST EFFICIENT

The literary masterpiece "Don Nimbyxote" tells the story of a knight-errant and his squire Sancho SUV-Panza and their desperate fight against the ferocious giants known as wind turbines.

How much energy do various types of vehicles require to travel a distance of 100 km?

Battery-electric vehicle	Fuel-cell vehicle	Conventional vehicle (with power-to-gas)	Conventional vehicle (with power-to-liquid)
15 kWh	31 kWh	93 kWh	103 kWh



WHERE BATTERIES GET THEIR JUICE

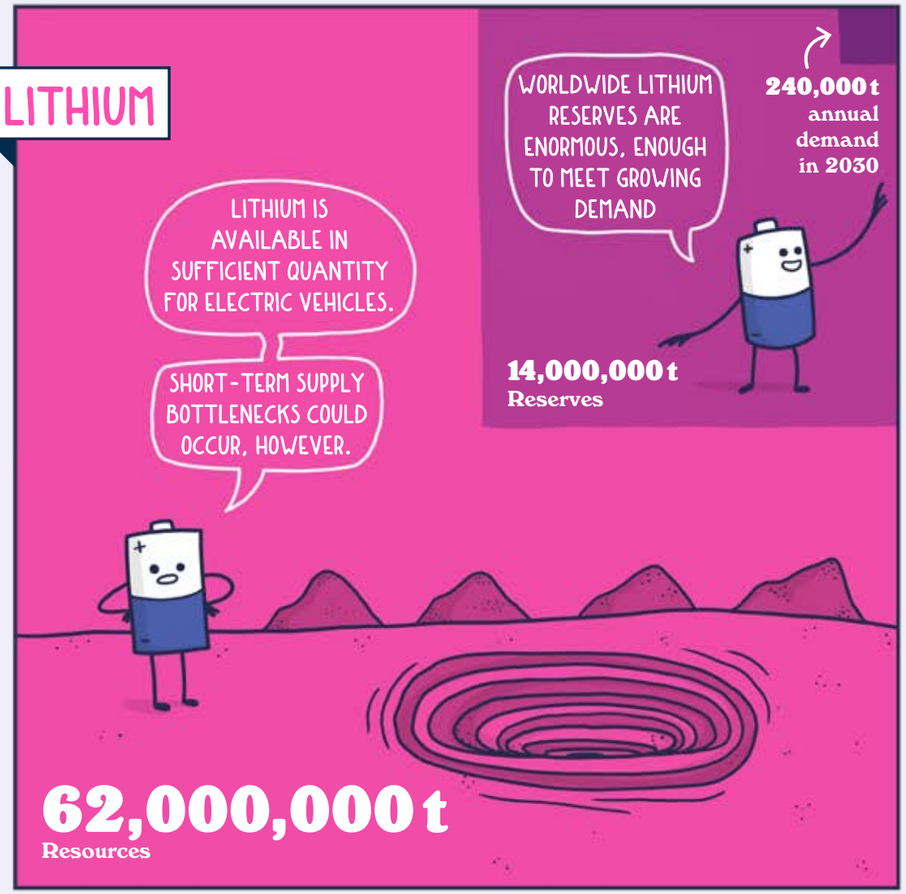
Global raw material deposits (2018) versus demand in 2030

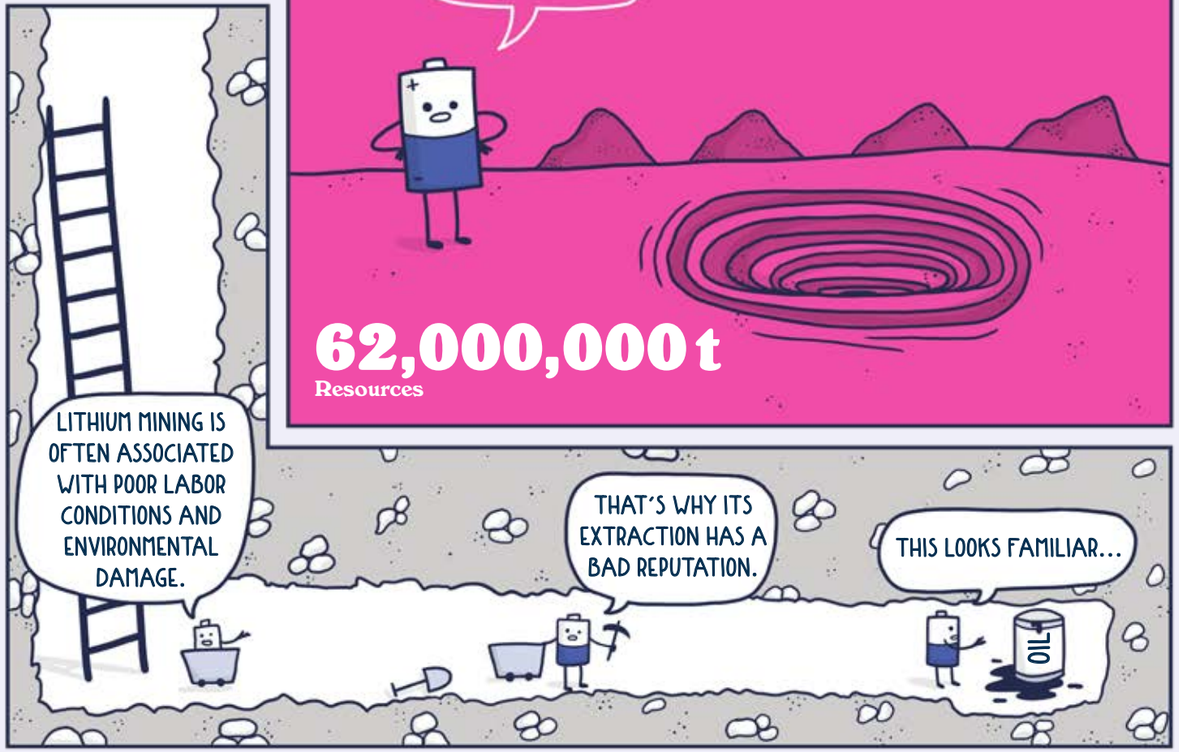
Resources: Total deposits, including those that cannot be extracted economically.

Reserves: Deposits that can be extracted economically using current technology.

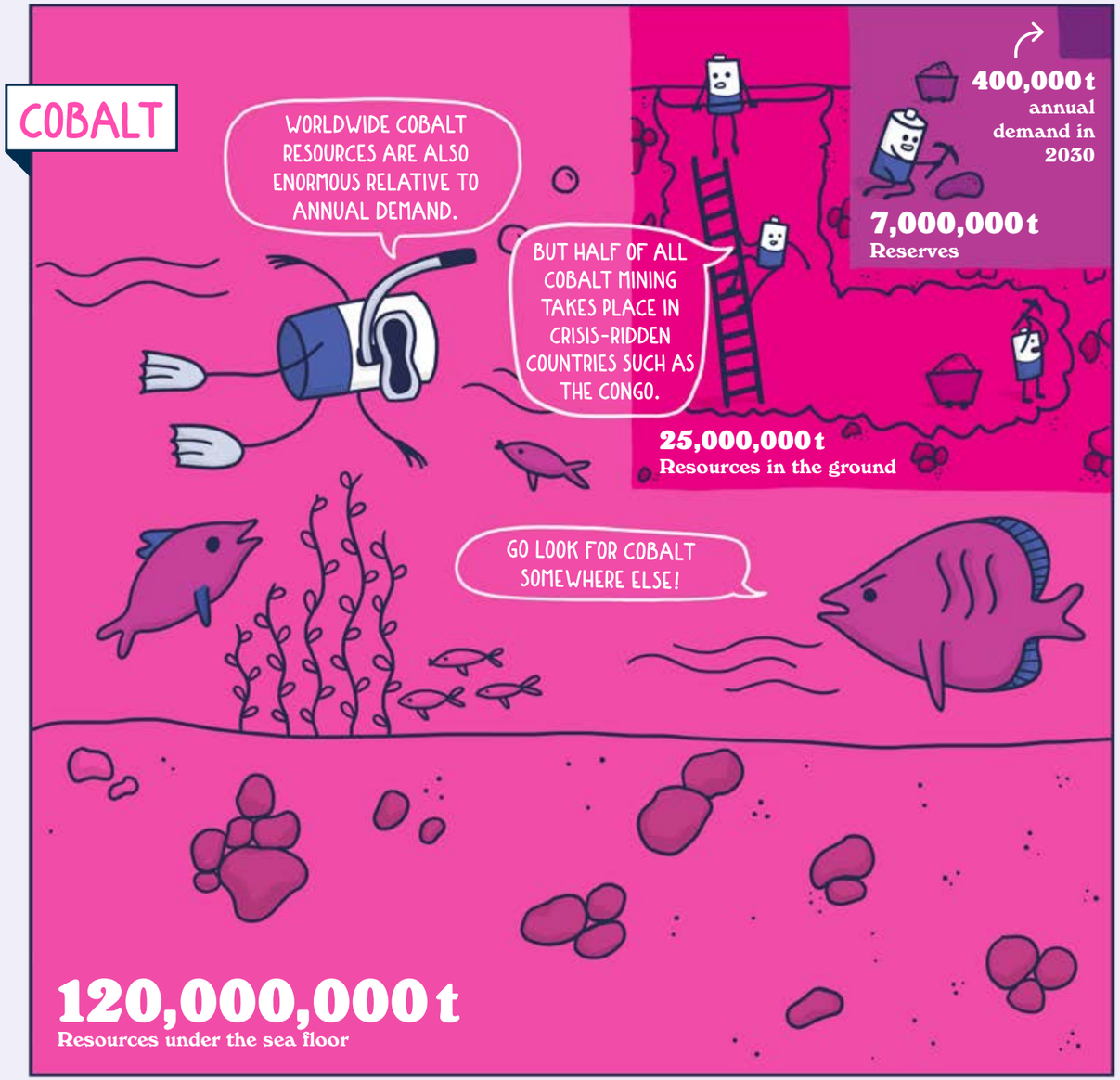
BUT ... are there enough raw materials for everyone to drive electric vehicles ?

LITHIUM



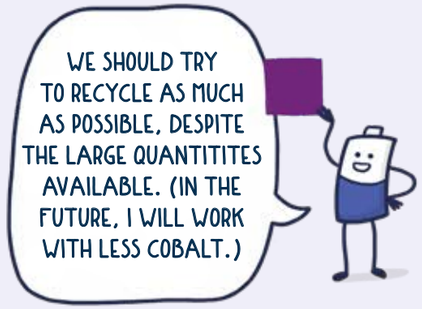


COBALT



TO PROTECT PEOPLE AND THE ENVIRONMENT WHERE MINING TAKES PLACE, WE NEED :

- **Mandatory due diligence for cobalt (via cobalt's inclusion in the EU regulation for conflict minerals)**
- **Partnerships that support sustainable mining**
- **Collection and recycling targets for cobalt and lithium in the EU's battery directive**



BUT...

aren't electric cars much worse for the environment than conventional cars during manufacturing?

In Germany, electric cars are already more climate friendly than their conventional counterparts.

FACTORY

IT'S A PETROLEUM BABY!

IT'S AN E-BABY!

CO_2 FOOTPRINT **7.5t**

CO_2 FOOTPRINT **13.2t**

The carbon footprint of an electric vehicle is higher "at birth".

BATTERY PRODUCTION FOR ELECTRIC VEHICLES CONSUMES A LOT OF ELECTRICITY, HOWEVER. THIS IS PARTICULARLY TROUBLESOME WHEN THE ELECTRICITY IS GENERATED USING FOSSIL FUELS.

WITH AGE, HOWEVER, E-CARS HAVE AN ADVANTAGE.

I'VE TRAVELLED 150,000 KM SINCE I WAS BORN!

1

2

3

INCLUDING EMISSIONS FROM PRODUCTION!

After **150,000 km** the electric vehicle has lower cumulative emissions, however.

Diesel **16%** more emissions than an e-car

Gasoline **24%** more emissions than an e-car

I WAS DROPPED YEARS AGO.

CALCULATIONS ARE FOR A STANDARD COMPACT CLASS CAR.

The greater the share of renewables in the power system, the more climate friendly electric vehicles become.

I'VE BEEN FEELING GREAT ON THIS NEW CLIMATE-FRIENDLY DIET!

MMM, TASTY!

POWER MIX IN 2018 & 2030 GOAL

The adventures of Don Nimbyxote continue...

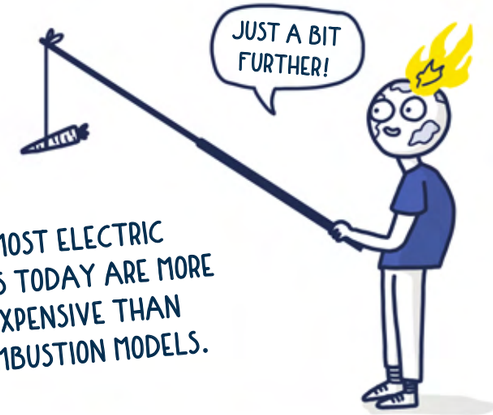
TO MEET THE GROWING DEMAND FOR CLEAN ELECTRICITY IN THE TRANSPORT SECTOR WITHOUT CREATING SHORTFALLS ELSEWHERE, WE NEED TO RAPIDLY EXPAND WIND AND SOLAR ENERGY.

LAWMAKERS MUST ACT!

TECHNOLOGICAL ADVANCES IN CLEAN ENERGY AND BATTERY PRODUCTION WILL CONTINUE TO REDUCE THE CARBON FOOTPRINT OF ELECTRIC VEHICLES.

BUT THESE EFFICIENCY GAINS WILL BE LOST IF CARS CONTINUE TO GET LARGER AND HEAVIER.

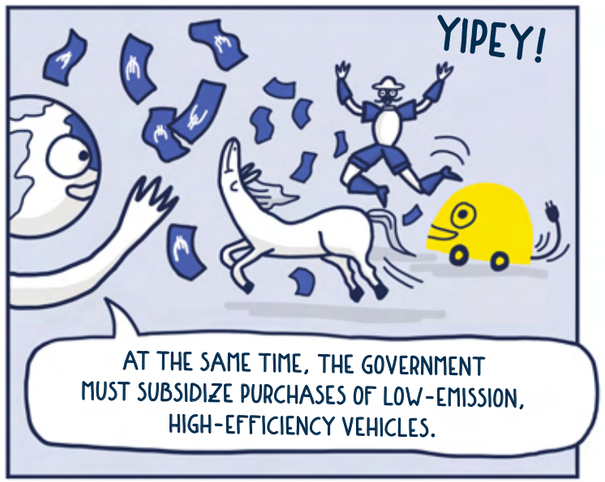
Policymakers must create incentives that accelerate the switch to electric cars.



MOST ELECTRIC CARS TODAY ARE MORE EXPENSIVE THAN COMBUSTION MODELS.

WE NEED TO MAKE IT MORE EXPENSIVE TO PURCHASE HIGH-POLLUTING VEHICLES...

MONEY IS NO OBJECT WHEN IT COMES TO HOW I ROLL!



AT THE SAME TIME, THE GOVERNMENT MUST SUBSIDIZE PURCHASES OF LOW-EMISSION, HIGH-EFFICIENCY VEHICLES.

IMMEDIATE MEASURES SHOULD BE TAKEN TO EXPAND THE NETWORK OF CHARGING STATIONS AND ENSURE NATIONWIDE COVERAGE.

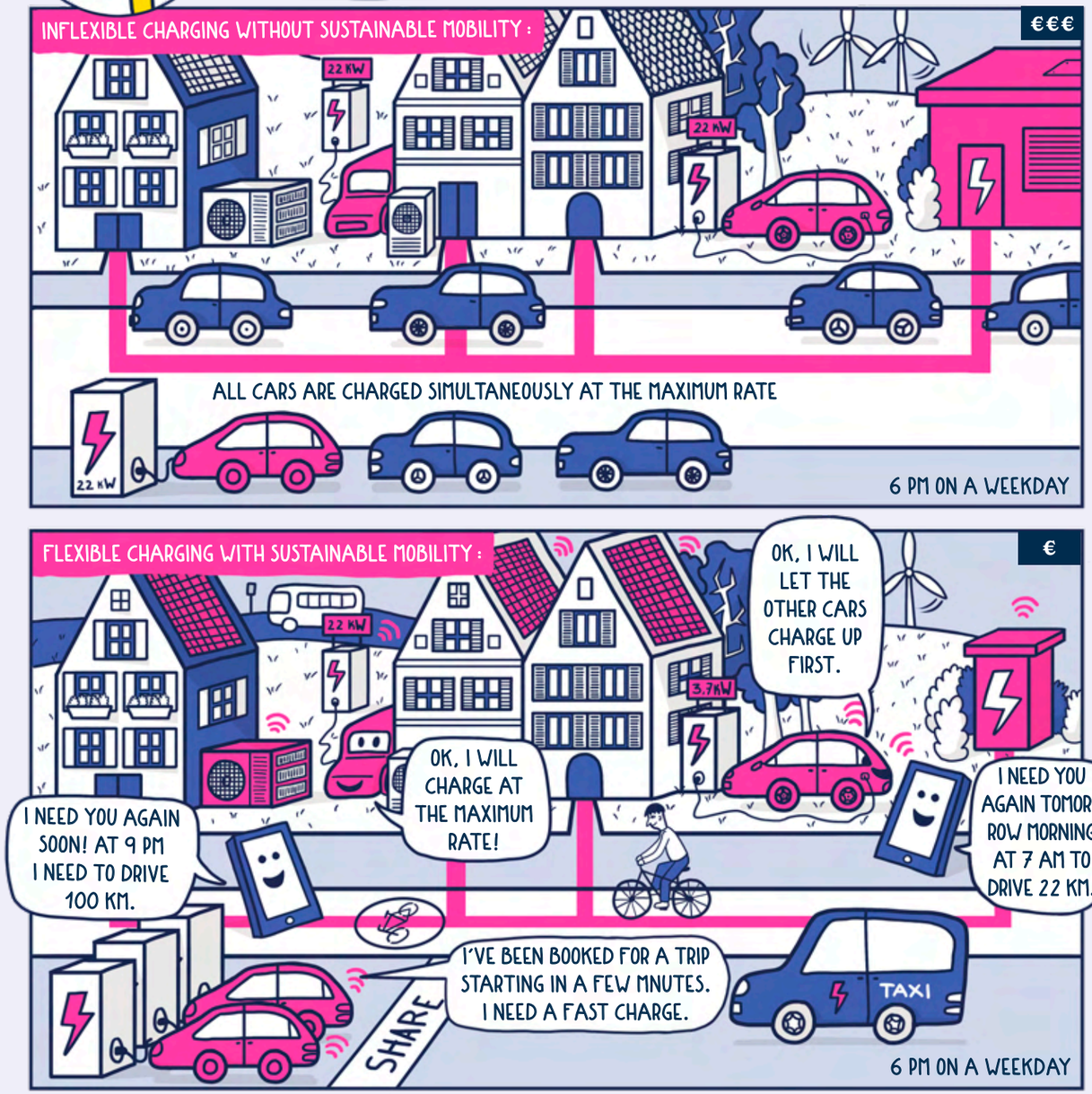
WHERE CAN I WATER MY HORSE?

POLICYMAKERS MUST CREATE A REGULATORY FRAMEWORK THAT ENCOURAGES THESE CHANGES!

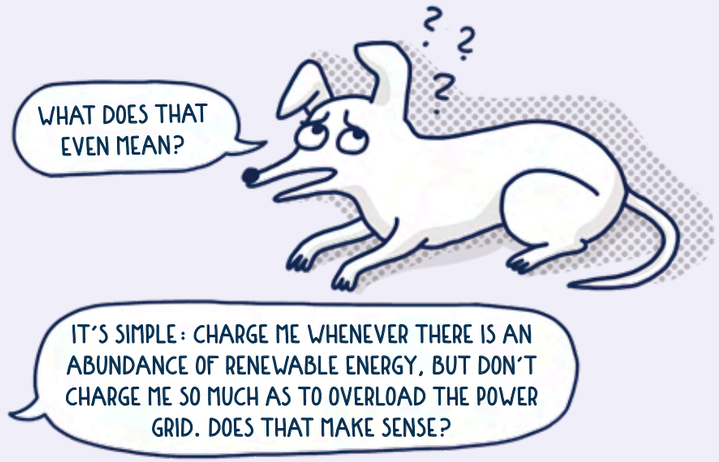
MY HORSE NEEDS A DRINK!

BUT...
how do we get electricity into cars?

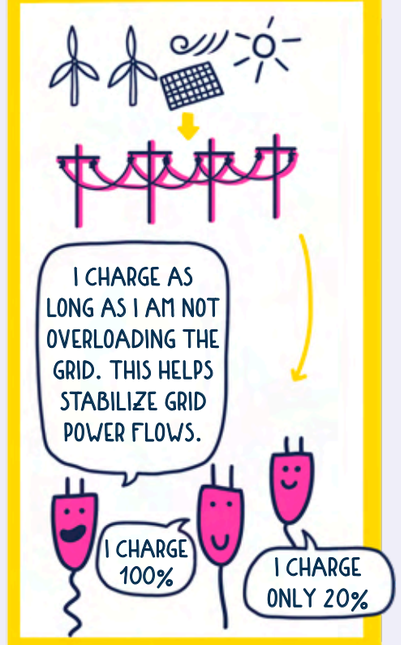
Widespread deployment of electric vehicles in Germany will require the expansion of the power grid. To keep investment costs down, we need flexible charging for electric vehicles in combination with sustainable mobility.



We need flexible charging that accommodates current grid capacity and generation levels.

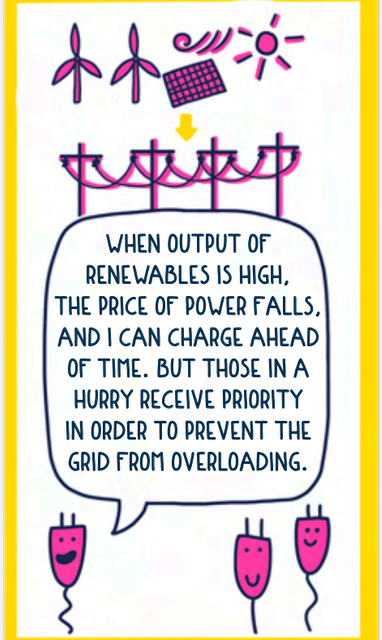


CHARGING BASED ON GRID CAPACITY



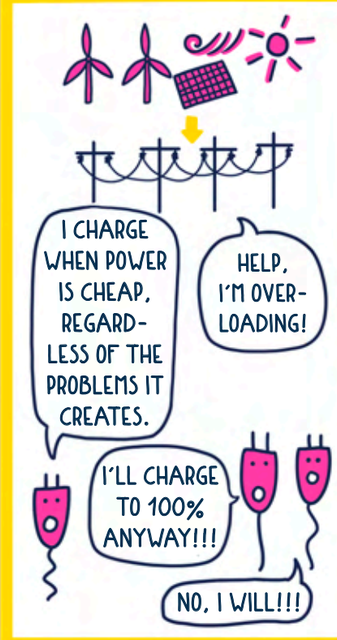
THIS KEEPS GRID EXPANSION TO A MINIMUM!

CHARGING BASED ON GRID CAPACITY AND GENERATION LEVELS



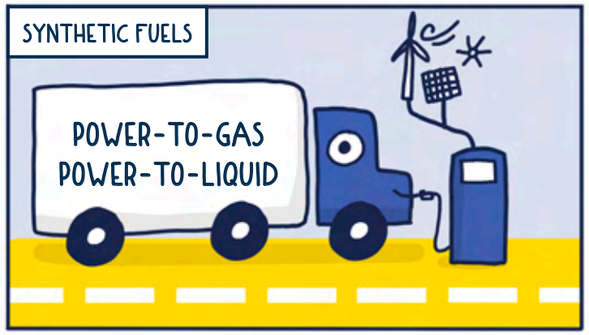
ELECTRICITY STORAGE IS DIFFICULT. THE LESS POWER THAT NEEDS STORING, THE BETTER.

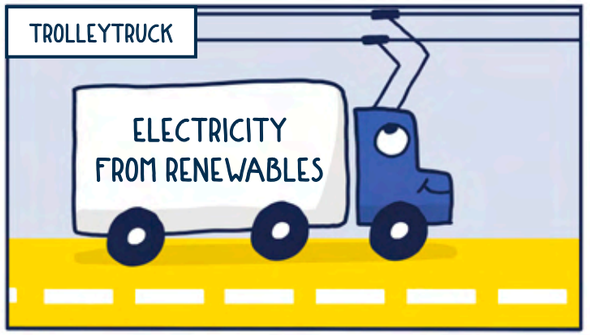
CHARGING BASED ON GENERATION LEVELS

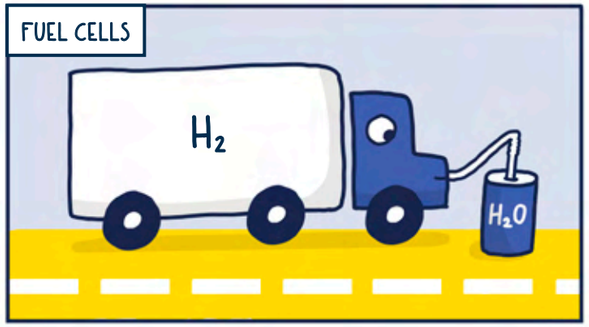


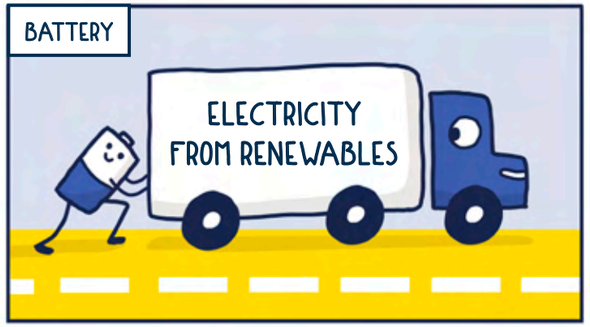
ONE AT A TIME PLEASE. OTHERWISE THE GRID WILL OVERLOAD!

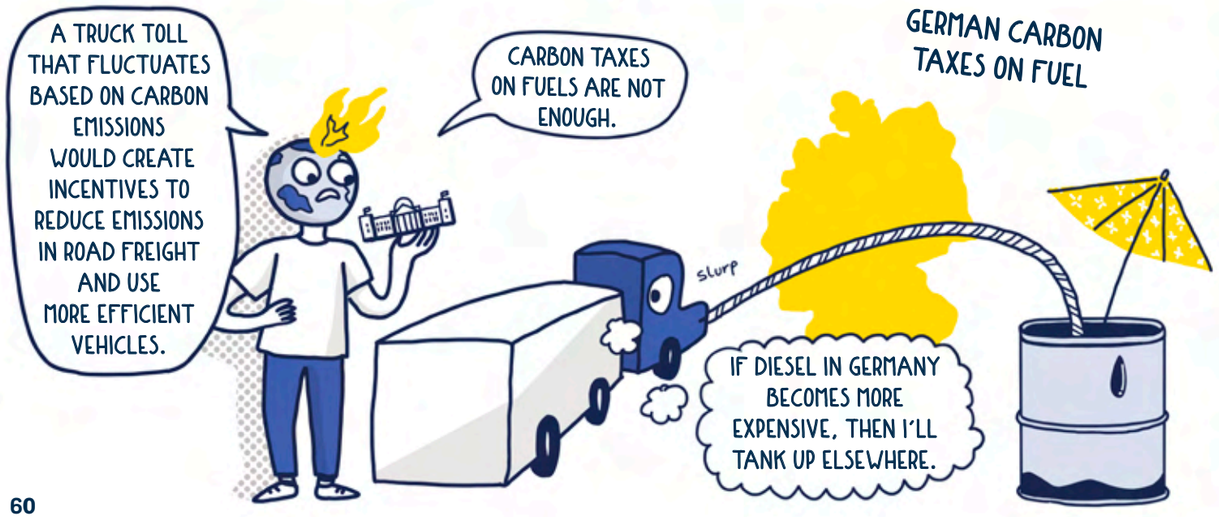
HEAVY TRUCKS
EXPERTS ARE STILL DEBATING HOW BEST TO POWER THEM



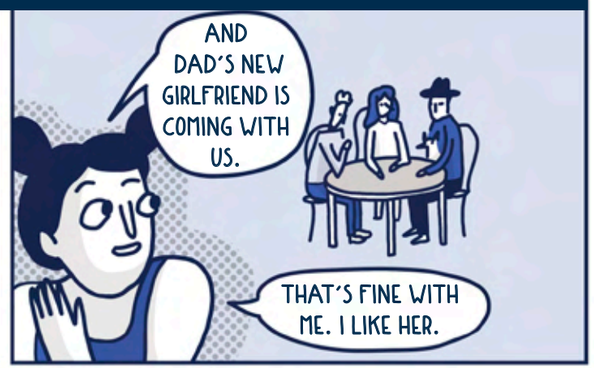


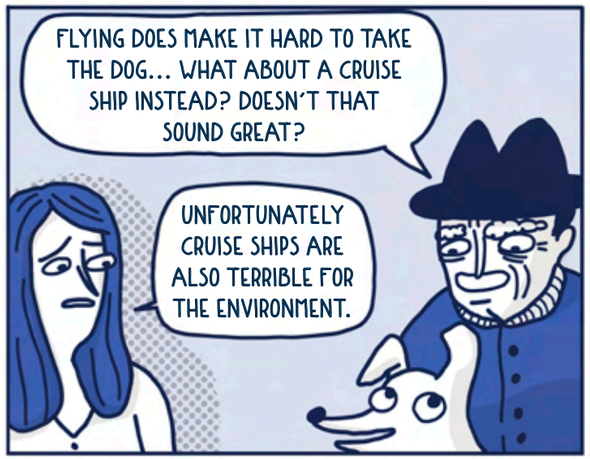


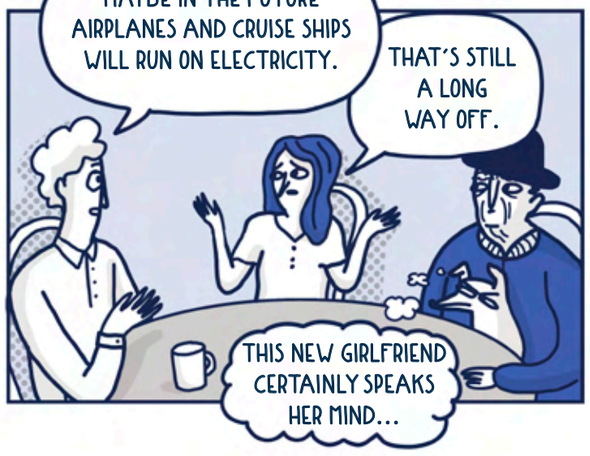




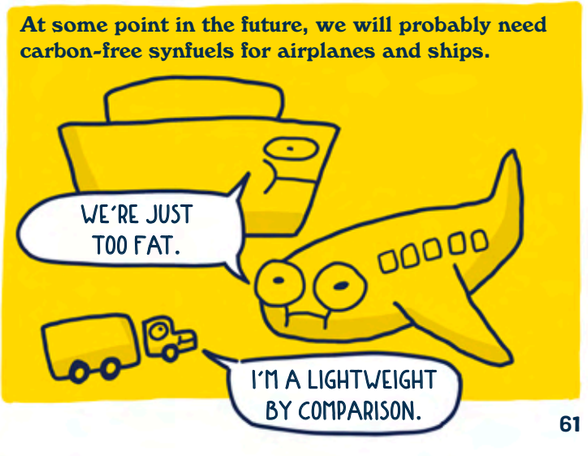
LARGE SHIPS AND AIRCRAFT
THESE VEHICLES PROBABLY CAN'T BE ELECTRIFIED







At some point in the future, we will probably need carbon-free synfuels for airplanes and ships.



The adventure meme is not without drawbacks.

WHY DON'T WE VACATION MORE OFTEN IN GERMANY? YOU ALWAYS SAID YOU WANTED TO GO HIKING IN BAVARIA...

WELL...

OR WE COULD GO CAMPING!

DO I LOOK LIKE AN OUTDOOR DOG? I AM A REFINED CITY DOG!

AHA! MOST FLIGHTS FROM GERMANY REMAIN IN EUROPE. WE CAN TAKE THE TRAIN INSTEAD!

PLUS I DON'T GET THROWN INTO THE CARGO HOLD IN A SMALL CAGE!

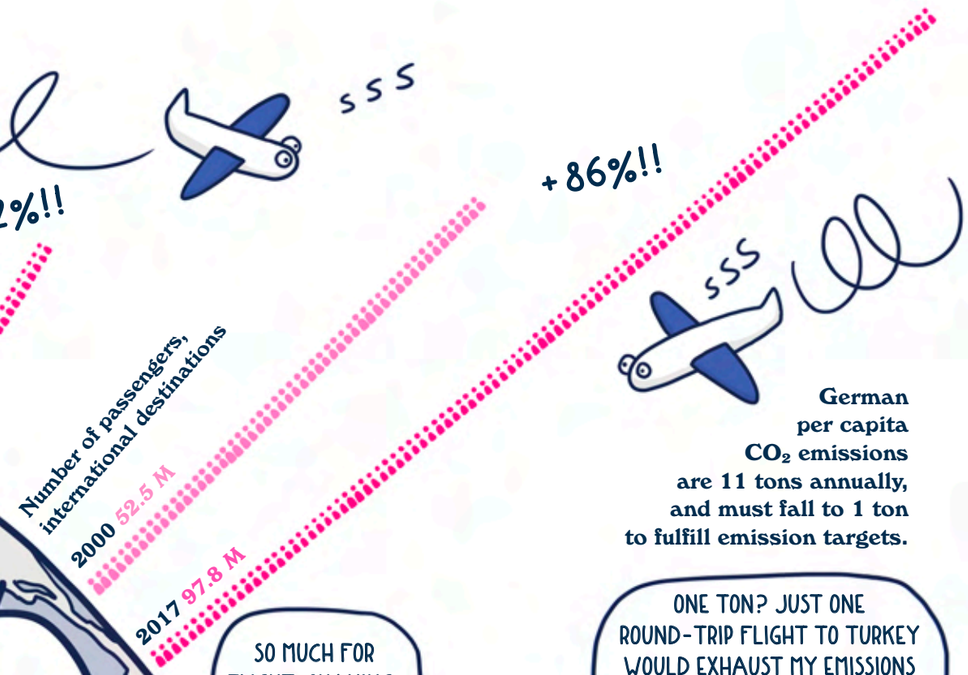
What is the CO_2 footprint of my trip?
(CO_2 equivalent kilograms)

Train Car Plane

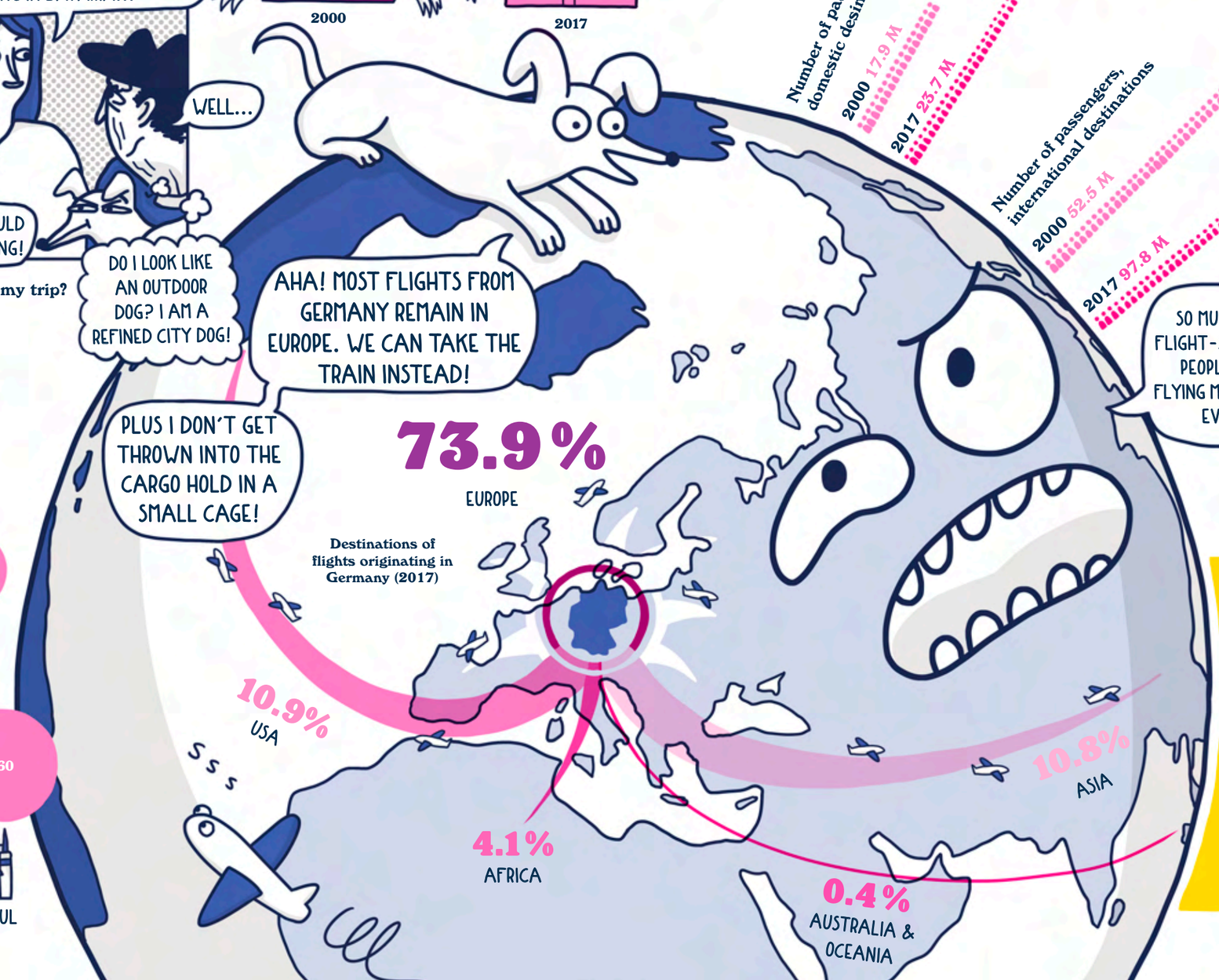
German air freight (Annual freight volume in billions of tons)

Number of passengers, domestic destinations

Number of passengers, international destinations



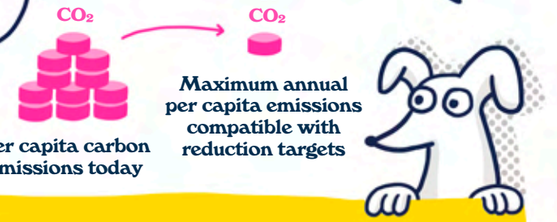
Destinations of flights originating in Germany (2017)



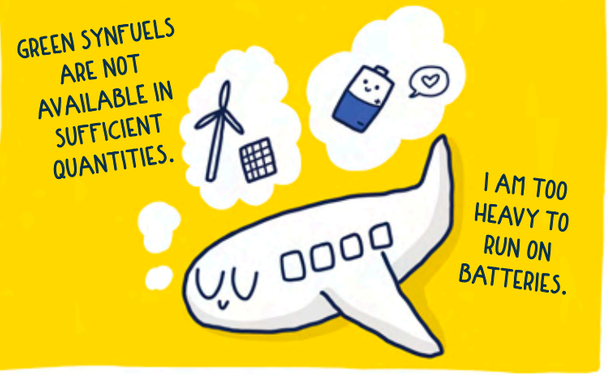
SO MUCH FOR FLIGHT-SHAMING. PEOPLE ARE FLYING MORE THAN EVER!

German per capita CO_2 emissions are 11 tons annually, and must fall to 1 ton to fulfill emission targets.

ONE TON? JUST ONE ROUND-TRIP FLIGHT TO TURKEY WOULD EXHAUST MY EMISSIONS BUDGET.



Carbon-neutral planes remain a distant dream. For now, the only solution is to fly less.

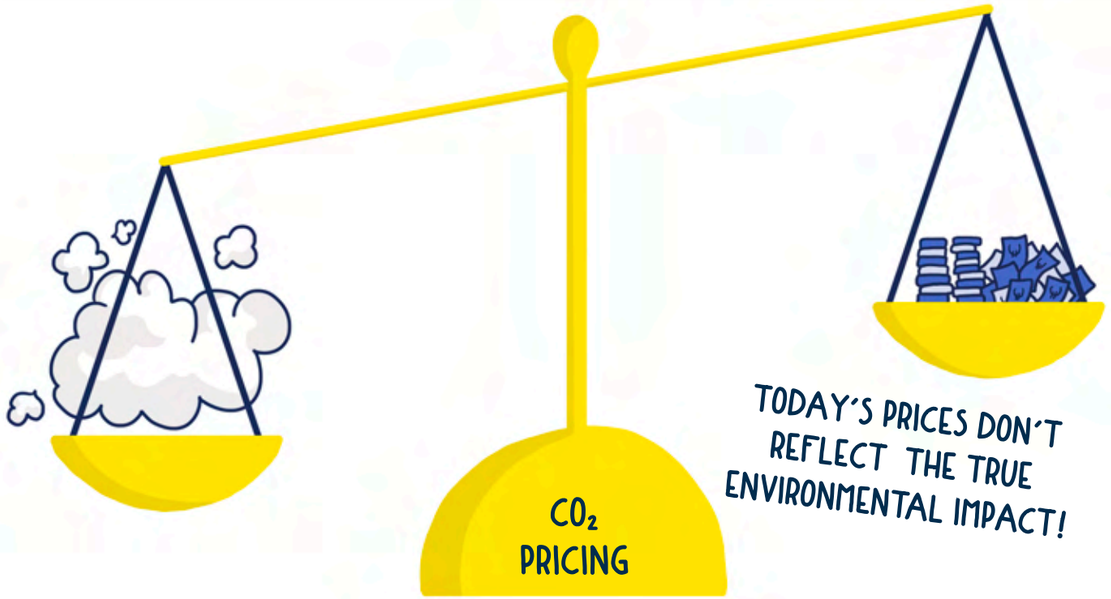


CHAPTER 3

USHERING IN THE AGE OF SUSTAINABLE TRANSPORT

Looking to the future

CARBON PRICING IS ESSENTIAL
FOR SUSTAINABLE TRANSPORT



Polluters should pay for the damage they cause to the environment. By taxing activities that emit carbon, we can discourage pollution while encouraging cleaner alternatives. In this way, carbon pricing can help create climate-friendly transport powered by clean energy.

CHANGE IS INEVITABLE
BUT OFFERS TREMENDOUS OPPORTUNITY

The auto industry is facing the greatest upheaval in its history. Manufacturers who resist change will end up losing out. The future belongs to companies that embrace the development of environmentally friendly vehicles and services.

THIS DECISION TREE HAS FAR-REACHING CONSEQUENCES! TEST IT FOR YOURSELF.

START

Should we manufacture electric vehicles for climate protection?

YES

Electric drivetrains are less complex than their conventional counterparts, and hence require less manpower to build. If 40% of new cars are electric in 2030 and 20% are hybrid, the German automotive sector will have 84,000 fewer employees.

NO

In the "business as usual" scenario (continued manufacturing of conventional vehicles), some 57,000 jobs will disappear by 2030 due to greater mechanization and productivity increases.

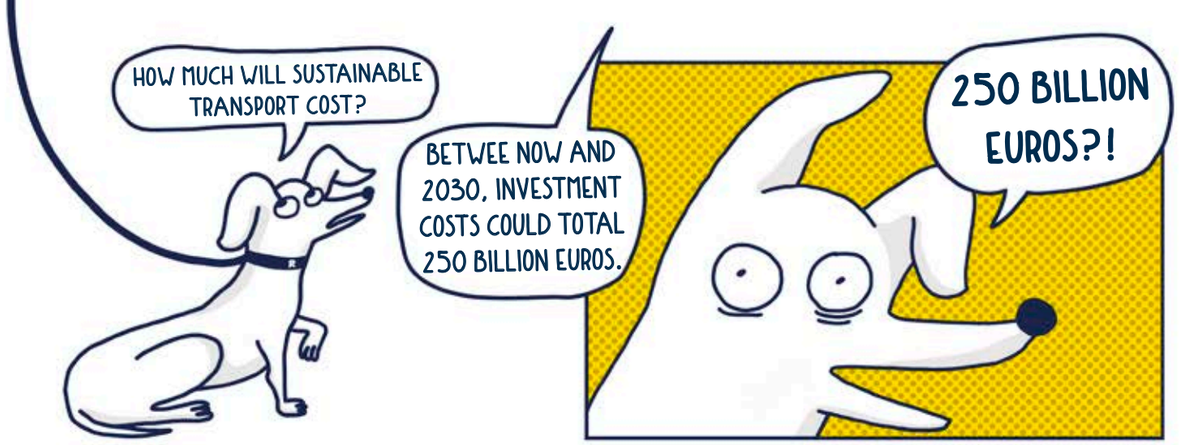
However, only 30,000 jobs will be lost because of e-vehicles. The other 57,000 jobs will disappear regardless of the types of vehicles we produce, due to productivity improvements and further automation. It is also important to consider that the industry currently employs 840,000 people.

If car and bike sharing enjoys success as a business model in Germany, some 200,000 new jobs could be created. However, this would likely reallocate demand for jobs and skills across regions.

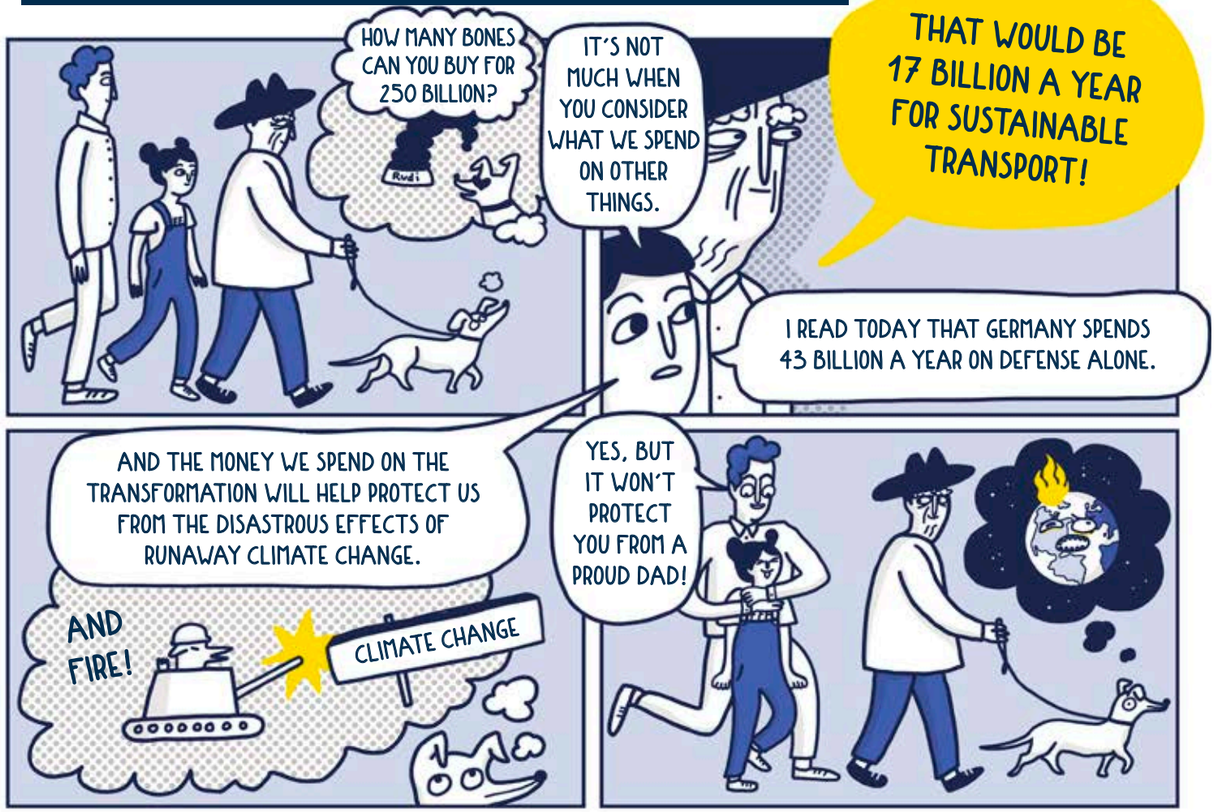
German companies sell more cars abroad than they do at home. Demand for electric vehicles in foreign markets, especially in China, is growing rapidly. If Germany cannot cater to this demand, massive job losses in the German car industry are likely to result.

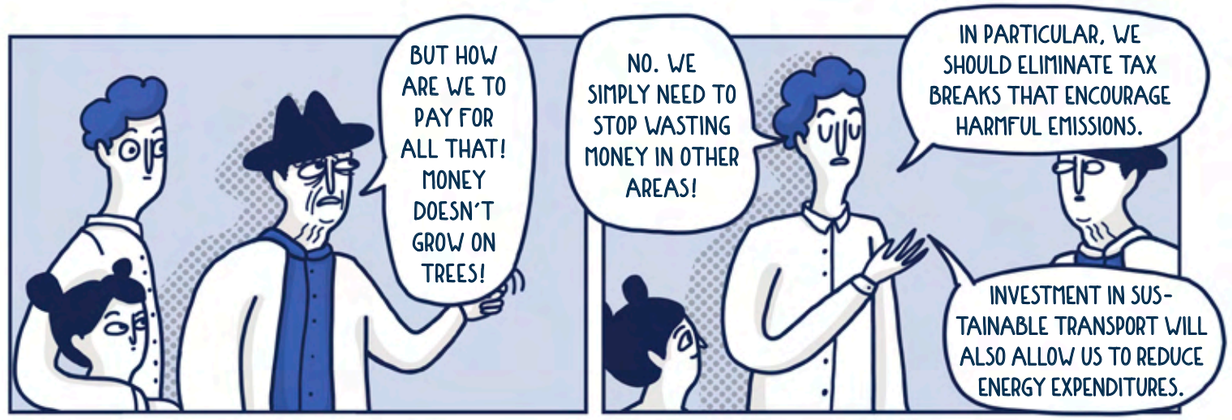
Share of global automobile production by German companies

2016 automobile production and sales figures of Germany car makers



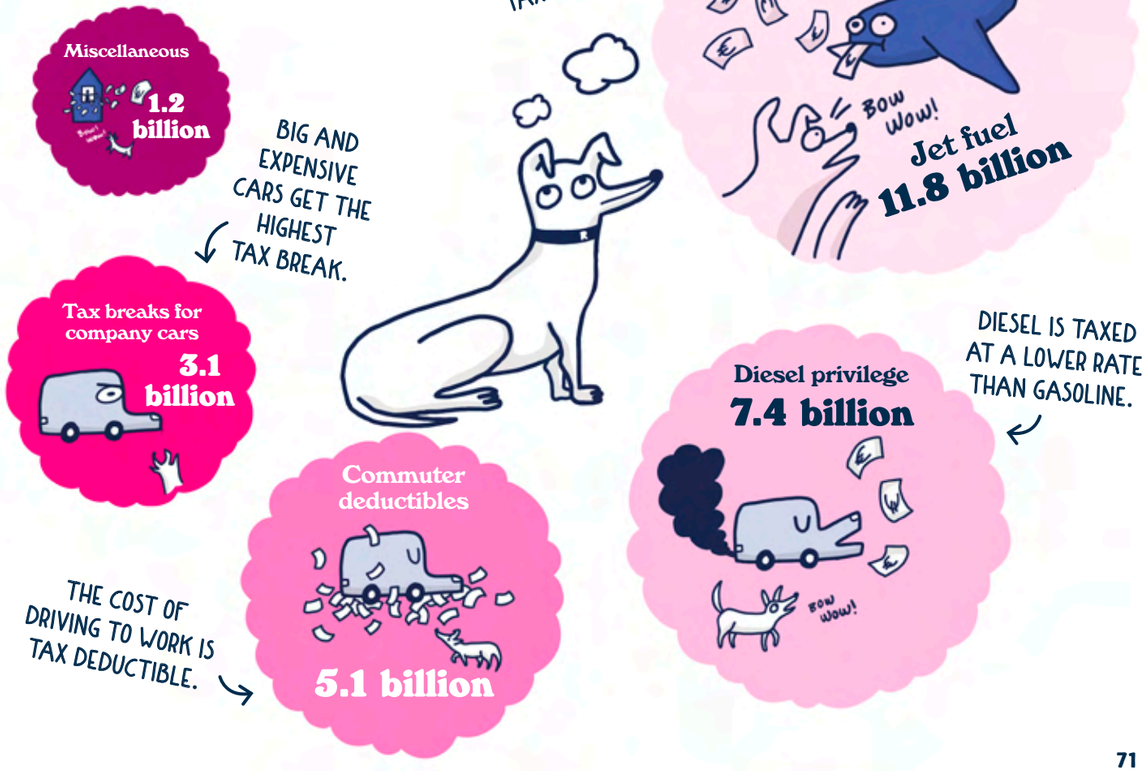
WE CAN AFFORD SUSTAINABLE TRANSPORT



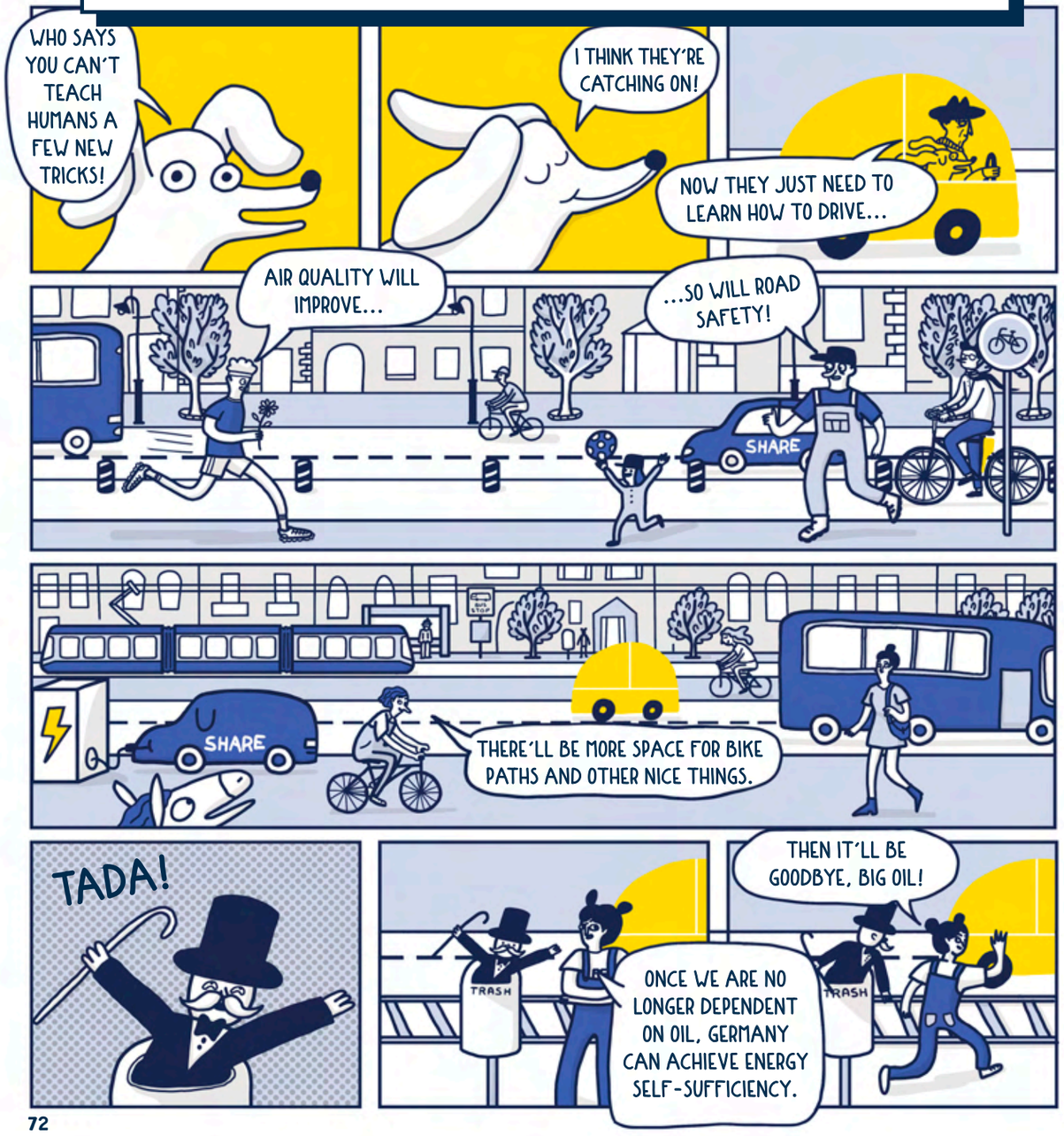


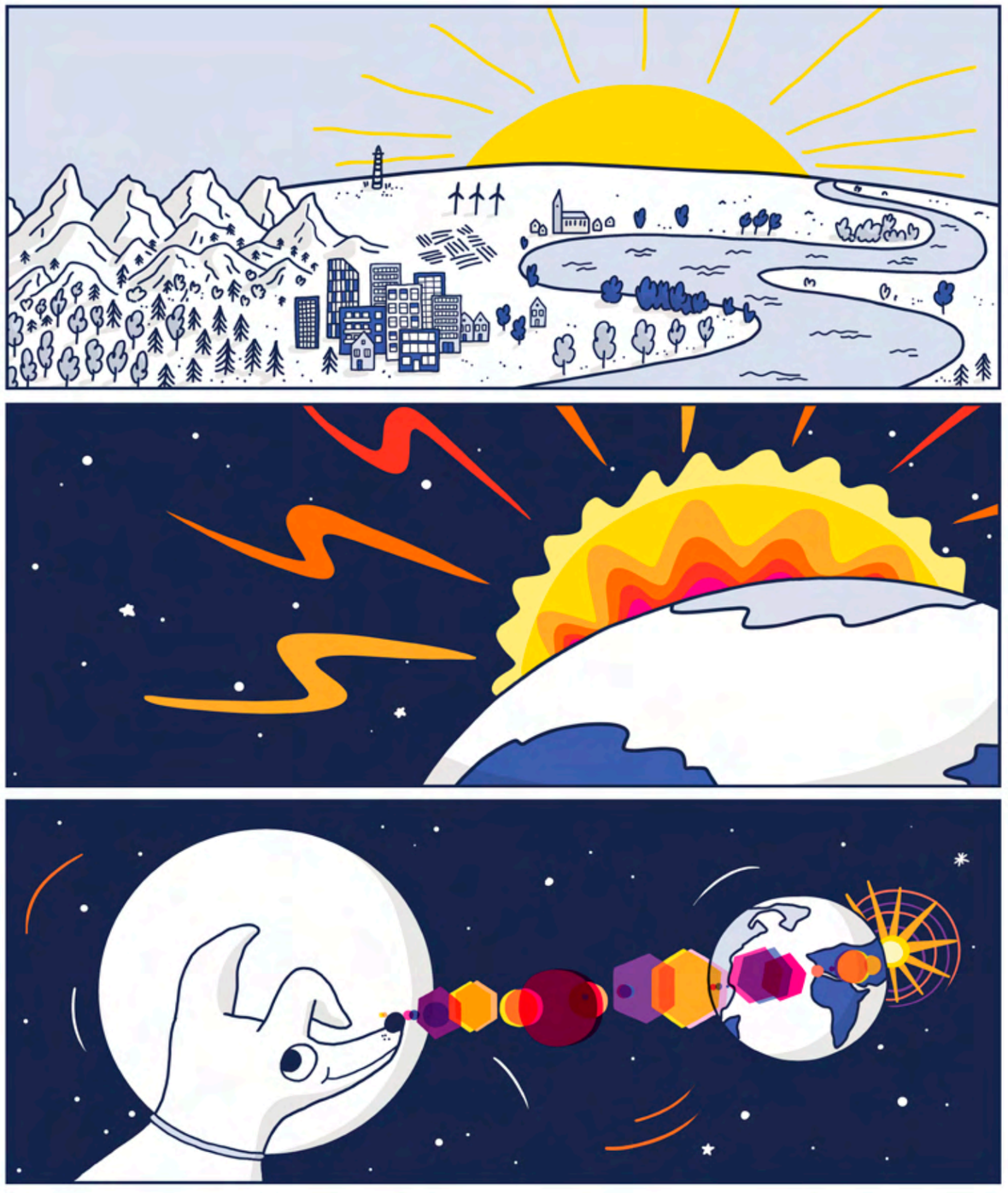
The German government awards environmentally harmful tax breaks in the transport sector amounting to 28.6 billion euros annually. In purely mathematical terms, the abolition of these tax breaks would be more than sufficient to fund the investment necessary to transform the sector.

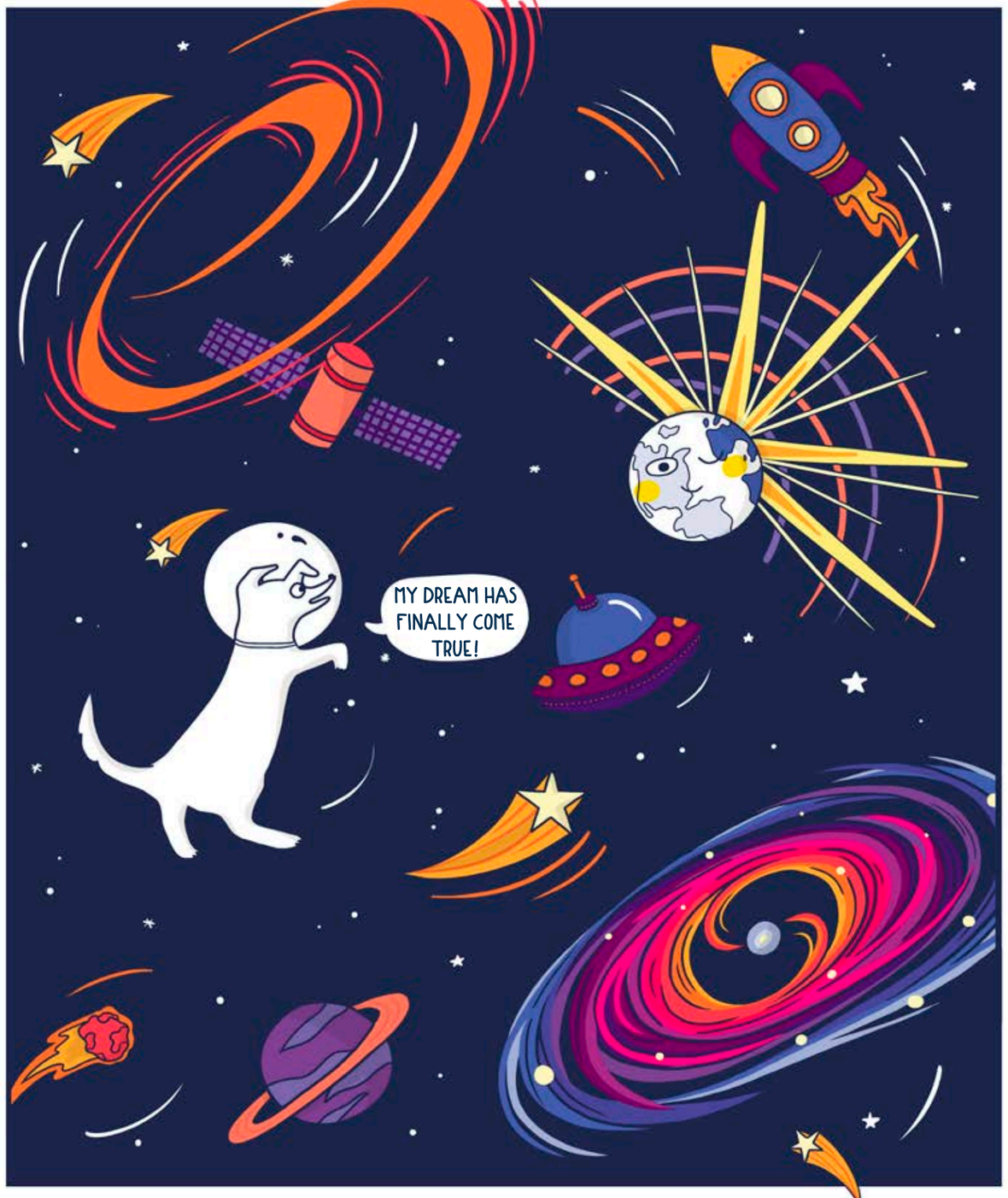
Value of environmentally harmful tax breaks, (2017), in euro billions



SUSTAINABLE TRANSPORT IS GOOD
NOT JUST FOR CLIMATE PROTECTION






MY DREAM HAS FINALLY COME TRUE!

GLOSSARY

Agora
Greek for "gathering place" or "marketplace"; the central public space in ancient Greek city-states where ideas were exchanged and debated.

CO_2 equivalents
A unit of measurement for standardizing the climate impact of different greenhouse gases. It refers to the magnitude of the greenhouse gas effect as expressed in CO_2.

Electric vehicles
This includes both battery-electric and fuel-cell vehicles.

Electric mobility
Discussion of electric vehicles in German and French usually falls under what is known as “electric mobility” (German: Elektromobilität; French: mobilité électrique). The term has been slow to catch on in English-speaking countries, most likely because “mobility” is already frequently used to refer to “mobile computing” and “social mobility.”

Intermodal transport
When different means of transport (car, bus, bicycle) are combined in a single journey.

MJ/P km
Refers to the amount of energy required to transport one person one kilometer in megajoules.

MJ/t km
Refers to the amount of energy required to transport one ton of goods one kilometer in megajoules.

Modal share (AKA modal split)
The percentage of travelers using a particular type of transportation.

Multimodal mix
When different means of transport (car, bus, bicycle) are combined in a single journey.

NIMBY
NIMBY (short for “not in my back yard”) describes the opposition of residents to a planned development – such as an airport, a low-incoming housing project, or, as in our case, a wind turbine – that they would otherwise support were it not being built so close to their homes.

Passenger transport
While the term “passenger” is normally used in English to refer to an individual transported in a vehicle that he or she does not operate, the OECD defines “passenger transport” as any form of transport of people by road, rail, water, or air.

Power-to-gas
Also abbreviated PtG, this refers to a process for producing gas from electricity, which can be stored and used to power vehicles.

Power-to-liquid
Refers to a process for producing liquid fuel from electricity. Hydrogen is first split from water via electrolysis, and then converted into synthetic fuel via Fischer-Tropsch synthesis.

GHG
Greenhouse gases are all gases that raise the temperature of the earth’s atmosphere. They include carbon dioxide (CO_2), methane (CH_4), and chlorofluorocarbons (CFCs).

Verkehrswende
A German neologism inspired by the term "Energiewende" (literally, "energy transition"), it is a compound of the German terms "Verkehr" (transport, traffic) and "Wende" (transition, turnaround). It refers to the transformation of the transport sector toward greater sustainability (pronunciation: Fair-cares-venn-duh).

BIBLIOGRAPHY

WHY WE NEED SUSTAINABLE TRANSPORT

Reason #1 for Sustainable Transport: to Protect the Planet

10 International Energy Agency (2018): CO_2 emissions from fuel combustion

10 NASA (2019): Global Climate Change: 2018 fourth warmest year in continued warming trend, 6.2.2019 www.climate.nasa.gov

11 Bundesministerium für Wirtschaft und Energie (2019): Abkommen von Paris, Artikel: Klimaschutz www.bmwi.de

11 | 12 Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (2018): Klimaschutz in Zahlen

14 European Environment Agency (2019): EEA greenhouse gas – data viewer www.eea.europa.eu

15 BMU (2018): Klimaschutz in Zahlen

15 Kraftfahrt-Bundesamt (2019): Bestand in den Jahren 1960 bis 2019 nach Fahrzeugklassen

15 Bundesministerium für Verkehr und digitale Infrastruktur (2018): Verkehr in Zahlen 2018/2019

15 Bundesministerium für Verkehr und digitale Infrastruktur (2000): Verkehr in Zahlen 2000

Reason #2 for Sustainable Transport: to Improve Quality of Life

16 Umweltbundesamt (2019): Umweltbelastung durch Verkehr www.umweltbundesamt.de

16 Umweltbundesamt (2019): Stickstoff-belastung geht 2018 insgesamt leicht zurück, Pressemitteilung 04/2019 www.umweltbundesamt.de

16 Statistisches Bundesamt (2019): Unfälle und Verunglückte im Straßenverkehr, 2018 www.destatis.de

17 Umweltbundesamt (2019): Indikator: Landschaftszerschneidung www.umweltbundesamt.de

17 Umweltbundesamt (2016): Schwerpunkte 2016, Jahrespublikation des Umweltbundesamtes, S. 36

17 Arbeitsgemeinschaft Energiebilanzen e.V. (2018): Auswertungstabellen zur Energiebilanz Deutschland 1990 bis 2017

18 | 19 Agora Verkehrswende (2017): Transforming Transport to Ensure Tomorrow’s Mobility: 12 Insights into the Verkehrswende

SUSTAINABLE MOBILITY

The Transition to Sustainable Mobility will Begin in Cities.

23 Umweltbundesamt (2017): Umweltbewusstsein in Deutschland 2016, Ergebnisse einer repräsentativen Bevölkerungsumfrage

24 Bundesministerium für Verkehr und digitale Infrastruktur (2019): Mobilität in Deutschland. Ergebnisbericht, p. 47

25 Umweltbundesamt (2019): Stickstoffdioxid. Gesundheitliche Bedeutung von Grenzwerten www.umweltbundesamt.de

25 Authors' calculations: Area required for bus based on EvoBus Citaro O530 with 70 seats; that of a car based on VW Golf. A bicycle is assumed to require 1.80 m x 0.65 m. Further assumptions: Average bus occupancy rate: 21%, car: 1.4 persons, as per Umweltbundesamt (2018): Vergleich der durchschnittlichen Emissionen im Personenverkehr – Bezugsjahr 2017 www.umweltbundesamt.de

26 Agora Verkehrswende (2019): Parkraummanagement lohnt sich! Leitfaden für Kommunikation und Verwaltungspraxis, S. 12

27 Authors' calculations: Cost per day for a street parking permit (approx. 10 m²): approx. 0.08 €. Rent without utilities for an apartment in Berlin constructed in 2003-2017): 10 euros per m² per month, according to Berlin rent index. This means that the rental prices for 10 m² are 40 times as high as the cost of a parking permit.

27 Agora Verkehrswende (2018): Supporting a U-Turn in Parking Policy, p. 4.

29 Agora Verkehrswende (2019): Neue Wege in die Verkehrswende. Impulse für Kommunikationskam-pagnen zum Behaviour Change, p. 9–11

30 | 31 Agora Verkehrswende (2017): Transforming Transport to Ensure Tomorrow's Mobility: 12 Insights into the Verkehrswende, p. 26–39

Goods Transport in Cities

32 Statistisches Bundesamt (2018): Verkehrsunfälle 2017. Fachserie 8, Reihe 7

32 | 33 Agora Verkehrswende (2019): Ausgeliefert – wie die Waren zu den Menschen kommen. Zahlen und Fakten zum städtischen Güterverkehr

34 Bundesregierung (2019): Projektionsbericht 2019 für Deutschland, p. 104

Automated sustainabile Mobility?

35 Twitter (2018): Anne Will, Nico Rosberg zum automatisierten Fahren (04.03.2018)

36 | 37 Agora Verkehrswende (2017): Transforming Transport to Ensure Tomorrow's Mobility.

36 | 37 OECD/ITF (2016): Shared Mobility: Innovation for Livable Cities, p. 8

In Rural Areas Sustainable Mobility Looks Different

38 Statistisches Bundesamt (2019): Bevölkerung nach dem Grad der Verstädterung und Staatsangehörigkeit www.destatis.de

38 Bundesagentur für Arbeit (2018): Pendleratlas (Datenstand Juni 2018) www.statistik.arbeitsagentur.de

39 Bundesministerium für Verkehr und digitale Infrastruktur (2019): Mobilität in Deutschland. Ergebnisbericht. Bonn 2019, p. 47

40 | 41 Agora Verkehrswende (2017): Transforming Transport to Ensure Tomorrow's Mobility

From Road to Rail

43 Umweltbundesamt (2018): Vergleich der durchschnittlichen Emissionen einzelner Verkehrsmittel im Personenverkehr – Bezugsjahr 2017 www.umweltbundesamt.de

43 Umweltbundesamt (2018): Vergleich der durchschnittlichen Emissionen einzelner Verkehrsmittel im Güterverkehr – Bezugsjahr 2017 www.umweltbundesamt.de

43 Umweltbundesamt (2019): Entwicklung des spezifischen Energieverbrauchs im Personenverkehr, Bezugsjahr 2017 www.umweltbundesamt.de

43 Umweltbundesamt (2019): Entwicklung des spezifischen Energieverbrauchs im Güterverkehr, Bezugsjahr 2017 www.umweltbundesamt.de

43 Umweltbundesamt (2019): Endenergieverbrauch und Energieeffizienz des Verkehrs. Bezugsjahr 2017 www.umweltbundesamt.de

44 | 45 KCW GmbH (2019): Railmap 2030 – Bahnpolitische Weichenstellungen für die Verkehrswende. Studie im Auftrag von Agora Verkehrswende

SUSTAINABLE ENERGY IN THE TRANSPORT SECTOR

We Need Alternatives to Gasoline and Diesel

48 Umweltbundesamt (2019): Energieverbrauch nach Energieträgern, Sektoren und Anwendungen 2017

Biofuels Are Not the Answer

49 Umweltbundesamt (2019): Bioenergie www.umweltbundesamt.de

Synfuels: A Viable Option, But Expensive

50 Agora Verkehrswende, Agora Energiewende and Frontier Economics (2018): The future cost of electricity-based synthetic fuels.

Direct Power Consumption is the Most Efficient

51 Agora Verkehrswende (2017): Transforming Transport to Ensure Tomorrow's Mobility.

52 Der Tagesspiegel (2007): Reserven und Ressourcen – Rechnen mit Rohstoffen (05.12.2007), www.tagesspiegel.de

52 | 53 Öko-Institut (2019): Gigafactories für Lithium-Ionen-Zellen – Rohstoffbedarfe für die globale Elektromobilität bis 2050 www.oeko.de

52 | 53 U.S. Geological Survey (2019): Mineral Commodity Summaries 2019

52 | 53 Agora Verkehrswende (2017): Strategies for Ensuring the Availability of Raw Materials to the Electric Vehicle Industry

54 | 55 Agora Verkehrswende (2019): Lifecycle Analysis of Electric Vehicles: Determining Factors and Improvement Potential

56 Die Bundesregierung (2018): Koalitionsvertrag zwischen CDU, CSU und SPD www.bundesregierung.de

56 Umweltbundesamt (2019): Erneuerbare Energien in Zahlen, www.umweltbundesamt.de

56 Agora Verkehrswende (2019): Lifecycle Analysis of Electric Vehicles: Determining Factors and Improvement Potential

57 Agora Energiewende & Agora Verkehrswende (2019): 15 Eckpunkte für das Klimaschutzgesetz

58 | 59 Navigant, Kompetenzzentrum Elektromobilität and RE-xpertise (2019): Distribution grid planning for a successful energy transition – focus on electromobility. Study on behalf of Agora Verkehrswende, Agora Energiewende and the Regulatory Assistance Project (RAP)

Heavy Trucks: Experts Are Still Debating How Best to Power Them

60 Agora Verkehrswende (2017): Transforming Transport to Ensure Tomorrow's Mobility.

Large Ships and Aircraft

61 Agora Verkehrswende (2017): Transforming Transport to Ensure Tomorrow's Mobility.

The Adventure Meme is not without Drawbacks

62 | 63 BMVI (2018): Verkehr in Zahlen 2018/2019, p. 178, 216, and 240.

62 | 63 Authors' calculations based on Umweltbundesamt (2018): Vergleich der durchschnittlichen Emissionen einzelner Verkehrsmittel im Personenverkehr – Bezugsjahr 2017 www.umweltbundesamt.de. Average CO_2 emissions per capita: Car: 0.139 g CO_2 equivalents/km (average occupancy rate: 1.5 people); train: 0.036 g CO_2 equivalents/km (average occupancy rate: 56%, German electricity mix)

62 | 63 Authors' calculations based on the Atmosfair emissions calculator (2019): Average emissions produced by a one-way economy class flight with an average occupancy rate of 74.1%, www.atmosfair.de.

63 European Environment Agency (2019): EEA greenhouse gas data viewer www.eea.europa.eu

63 PIK (2019): Reallabor „Klimaneutral leben in Berlin" zieht Bilanz www.pik-potsdam.de

USHERING IN THE AGE OF SUSTAINABLE TRANSPORT

Carbon Pricing is Essential for Sustainable Transport

66 | 67 Agora Energiewende & Agora Verkehrswende (2019): 15 Eckpunkte für das Klimaschutzgesetz

Change is Inevitable But Offers Tremendous Opportunity

68 | 69 Authors' calculations based on Fraunhofer IAO (2018): ELAB 2.0 Wirkungen der Fahrzeugelektrifizierung auf Beschäftigung am Standort Deutschland, Abschlussbericht 15. November 2018

68 | 69 Schäfer S., Schade W., Berthold D., Mader S., Scherf C., Wagner U. (2019): Transformation der Mobilität aus regionaler Sicht: Fortschreibung des Status quo von Wertschöpfung und Beschäftigung in der Mobilität auf Kreisebene. Arbeitspapier im Auftrag der Hans-Böckler-Stiftung

68 | 69 Bormann R., Fink P., Holzapfel H., Rammler S., Sauter-Servaes T., Tiemann H., Waschke T., Weirauch B. (2018): Die Zukunft der deutschen Automobilindustrie: Transformation by Design or by Desaster? WISO Diskurs 03/2018

We Can Afford Sustainable Transport

70 Boston Consulting Group (2019): Analyse Klimapfade Verkehr (2030)

70 Bundesministerium der Verteidigung (2019): Verteidigungshaushalt 2019 www.bmvg.de

71 Umweltbundesamt (2019): Umweltschädliche Subventionen www.umweltbundesamt.de

Sustainable Transport is Good Not Just for Climate Protection

72 | 73 Agora Verkehrswende (2017): Transforming Transport to Ensure Tomorrow's Mobility.

PUBLICATION DETAILS

PUBLISHER

AGORA Verkehrswende
www.agora-verkehrswende.de

Anna-Luisa-Karsch-Straße 2
10178 Berlin
Germany

Executive Director
Christian Hochfeld

Project Manager & Editorial Director
Marena Pützschler

Director, Strategic Communication
Dr. Fritz Vorholz

Editors
Sheree Domingo, Lisa Gradl,
Christian Hochfeld, Marena Pützschler,
David Ramirez Fernandez, Bernd Riedel,
Dr. Fritz Vorholz, Johannes Wirz

Scientific Content
Wolfgang Aichinger, Dr. Carl-Friedrich Elmer,
Christian Hochfeld, Dr. Günter Hörmandinger,
Alexander Jung, Anne Klein-Hitpaß,
Dr. Urs Maier, Kerstin Meyer,
Marena Pützschler, Fritz Richard Viertel,
Dr. Fritz Vorholz

Operations Director
Steffi Niemzok

Translation from the German
Lucais Sewell, Dominic Bonfiglio
WordSolid, Berlin

CONCEPTION & DESIGN

Ellery Studio
www.ellerystudio.com

Glogauer Straße 19
10999 Berlin
Germany

Concept
Bernd Riedel

Creative Directors
Eugen Litwinow, Bernd Riedel, Dodo Vögler

Art & Infographic Director
David Ramirez Fernandez

Story Director
Sheree Domingo

Editorial Design
Lisa Gradl

Illustrators
Qixuan Chen, Lucia Cordero,
Sheree Domingo, David Ramirez Fernandez

Infographics
Lisa Gradl, David Ramirez Fernandez,
Bernd Riedel

Design & Layout
Lisa Gradl, Nazare Picos, Simon Schabel,
Hannah Schrage, Shriya Shankar Seetharam,
Gaja Vičič

Cover Illustration
Brady Kuehl, Gaja Vičič

Fonts
Lulamb (Ellery Studio),
Windsor, Colby

Paper
140 g / m² Circleoffset
Premium White FSC® Recycled
and Blue Angel certified

Colors
Pantone 803, Pantone 806,
Pantone 2728, Pantone 7617

Publication date
First English edition, May 2021

Printing
Druckhaus Sportflieger
www.druckhaus-sportflieger.de

Please cite as
Agora Verkehrswende and Ellery Studio (2021): Future Ahoy!
An Infographic Novel about Sustainable Transport

9 783981 997835

GOLD
MALOFIEJ 28
INTERNATIONAL
INFOGRAPHIC
AWARDS

GOLD
INDIGO
AWARD 2021
BOOK DESIGN

Agora Verkehrswende is a Berlin-based think tank that conducts in-depth research on mitigating climate change in the transport sector. The arguments in favor of a Verkehrswende – a sweeping transformation of the transport sector toward sustainability – are numerous and compelling. Yet so far action has failed to materialize, persuading us to ask: What can we do to increase public awareness for this important issue?

You're holding the answer in your hands. This infographic novel shares our insights in a new format designed to reach a wider audience and engender broader public support for sustainable transport. The storyline follows a family of three generations, from the young and idealistic to the old and cantankerous, as they grapple with issues related to the climate and the future of mobility. They discover that sustainable transport is not just good for the climate, but also an opportunity to positively reshape how we live and work together.

Agora
Verkehrswende

ellery
studio

Agora Verkehrswendeis a joint initiative of Stiftung Mercator and the European Climate Foundation.

Ellery Studio drives transformation at the intersection of innovation, knowledge and design.