

The transport sector has a significant impact on climate change. Not only is it responsible for a quarter of emissions, but it is also a sector that, due to its strong growth, is not managing to lower its emissions.

In this book, Cathy Macharis demonstrates that emissions need to be reduced by a factor of 8. She presents a scheme of four actions and four conditions that we can use to facilitate a sustainable transition. A story of 8As that can lead to a transformation of our mobility: Awareness, Avoidance, Act and Shift, and Anticipation of New Technology to achieve a sustainable mobility system. But then we also need to Accelerate the transformation through Actor Involvement, Altering Behaviour and falling All in love! Yes, you read correctly: falling in love is the right state of being to achieve change.

This book is written for anyone who has already moved or is interested in moving to the future of mobility: that means you! Freight transport is also discussed, because haven't we all become more aware of the logistics behind our online purchases?

*Climate change is here to stay. Denying it is pointless. Just like when paralysed by fear or in a doomsday scenario, thinking is futile. The point now is to look for solutions; and they do exist. In this book, Cathy Macharis clearly explains how the transport sector can make the shift to a more sustainable form of mobility. But the book is about much more, it describes the principles that will enable us as a society to make the turnaround to climate neutrality. With a Factor 8 towards the Mobility System of the Future is a book that gives hope and confidence. Making the turnaround may not be easy, but it is entirely possible. And each of us can make a difference.*

Former Chancellor Caroline Pauwels, Vrije Universiteit Brussel.



Cathy Macharis is full professor at the Vrije Universiteit Brussel and coordinator of the research group MOBILISE. Her research focuses on the transition to a more sustainable mobility and logistics system. She is the chair of the Brussels Mobility Commission and part of the High Committee for a Just Transition in Belgium.



With a Factor 8 to the Mobility System of the Future



# With a Factor 8 to the Mobility System of the Future

Cathy Macharis

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With a  
**Factor 8**  
to the  
**Mobility  
System**  
of the **Future**

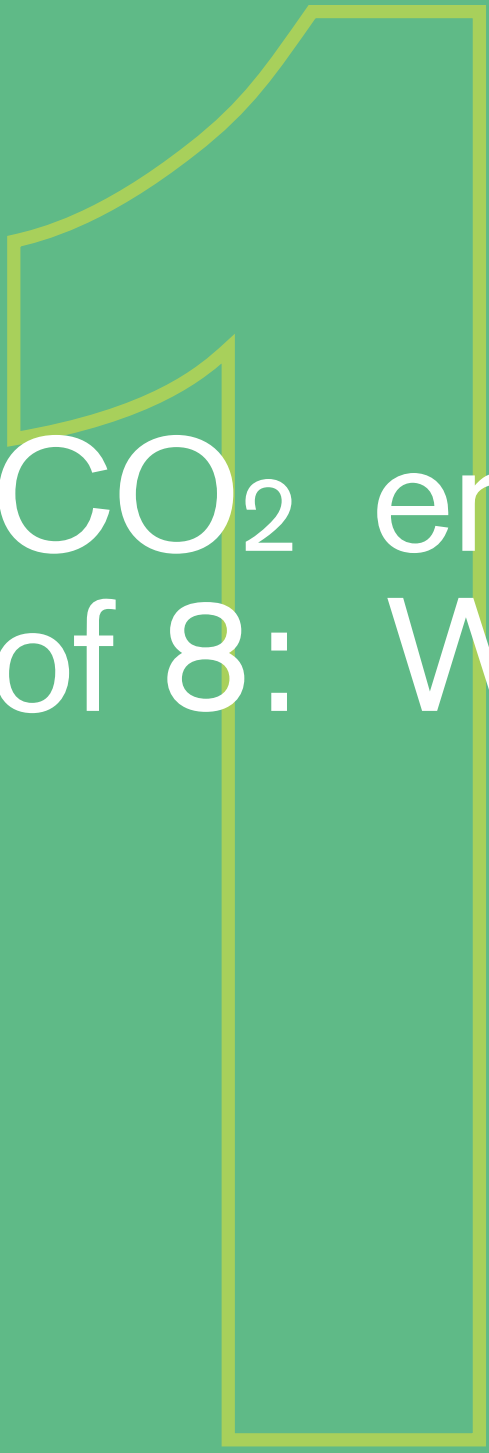
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Reducing CO<sub>2</sub> emissions by  
a factor of 8: Why?



**“We’re not going to make it to 2050”** was the alarming headline of a 2022 article by the British economist, Umair Haque. Although pessimistic, this headline is fast becoming our reality. Much of Europe experienced a massive wave of heat this 2022 summer, and this is simply a prelude to what is yet to come. Australia battled floods just after recovering from wildfires in previous years, and Southeast Asia experienced up to 16 floods and four landslides in just the first half of the year. Simply put, several parts of the world have experienced one natural disaster after the other, and they are bracing for more. But let me put it in a clearer context.

I was on holiday in the French Alps, by the beautiful Lake Allos. A lake that is fed by glaciers whose water runs off via waterfalls. Every year, one can see how this process accelerates, how the level of the lake goes down and how the vegetation around the lake changes.

What am I getting at? Climate change is already here. We do not need to think that it is something abstract for the future. We are already experiencing it.

How did it come to this? Since the Industrial Revolution, many greenhouse gases have been released into the air, mainly by burning fossil fuels. This disturbs the natural greenhouse effect and results in climate change. In fact, you can picture the atmosphere as a shell around the earth, which we are now filling with CO<sub>2</sub> and other greenhouse gases such as methane and nitrous oxide, thickening the shell and forming a thick insulating layer. As a result, the heat from the sun that is returned by the earth as thermal radiation can no longer escape. The greenhouse gases, such as CO<sub>2</sub>, methane, and nitrous oxide, absorb heat radiation in the atmosphere and subsequently radiate it in all directions, including back to the earth. This makes the earth warmer and causes climate change.

This greenhouse effect still had a positive effect until the Industrial Revolution. Without it, it would be freezing cold here. But since the Industrial Revolution, the volume of greenhouse gases that we pump into the atmosphere has increased enormously, so the insulation layer has become too thick. As a result, global temperature has already increased by 1.1

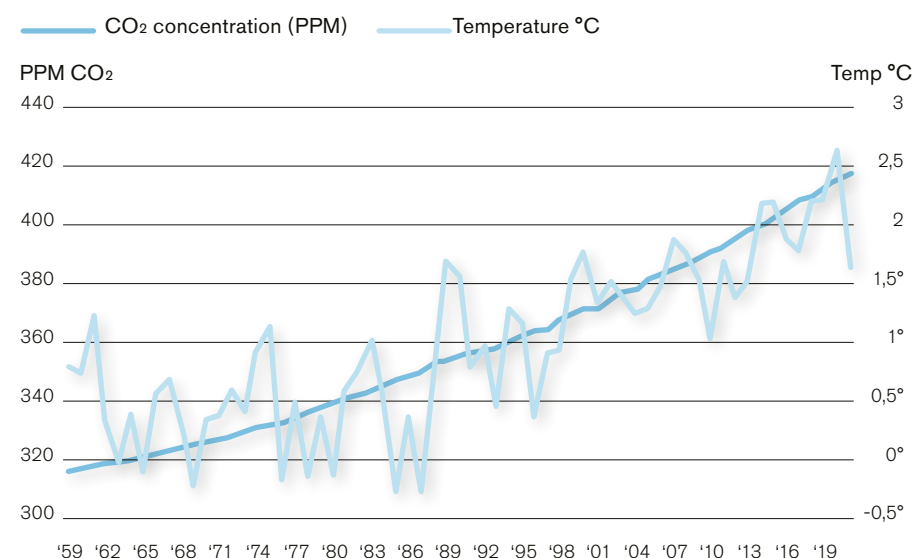
degrees<sup>1</sup>, and if we continue at this rate, the temperature on earth will increase by 8.5 degrees - with the measures that are now being taken, by 3 to 4 degrees - which is an absolute disaster<sup>2</sup>. In fact, there is now a 50-50 possibility of hitting 1.5 degrees by 2026<sup>3</sup>.

How does this happen? Trees and plants absorb CO<sub>2</sub> from the air as they grow. Since fossil fuels are created when tree and plant residues and other organic material are compressed into the earth's crust, the burning of fossil fuels such as gas, oil, and coal releases all the CO<sub>2</sub> that has been stored in them over the centuries. It is a process that happens under great pressure and takes millions of years. And that gas is released back into the atmosphere in large quantities during combustion. As for methane, it mainly comes from the decay process of plants.

The impact is clearly measurable: warming of the atmosphere and oceans, a change in the frequency and intensity of precipitation, a change in the activity of storms, a decrease in the amount of snow and ice, and an increase and acidification of the oceans.

This, in turn, has an impact on biodiversity, agriculture, health, the economy, and so on - in short, on the entire ecosystem. The figure below shows the relationship between the increasing level of CO<sub>2</sub> emissions in our atmosphere and temperature.

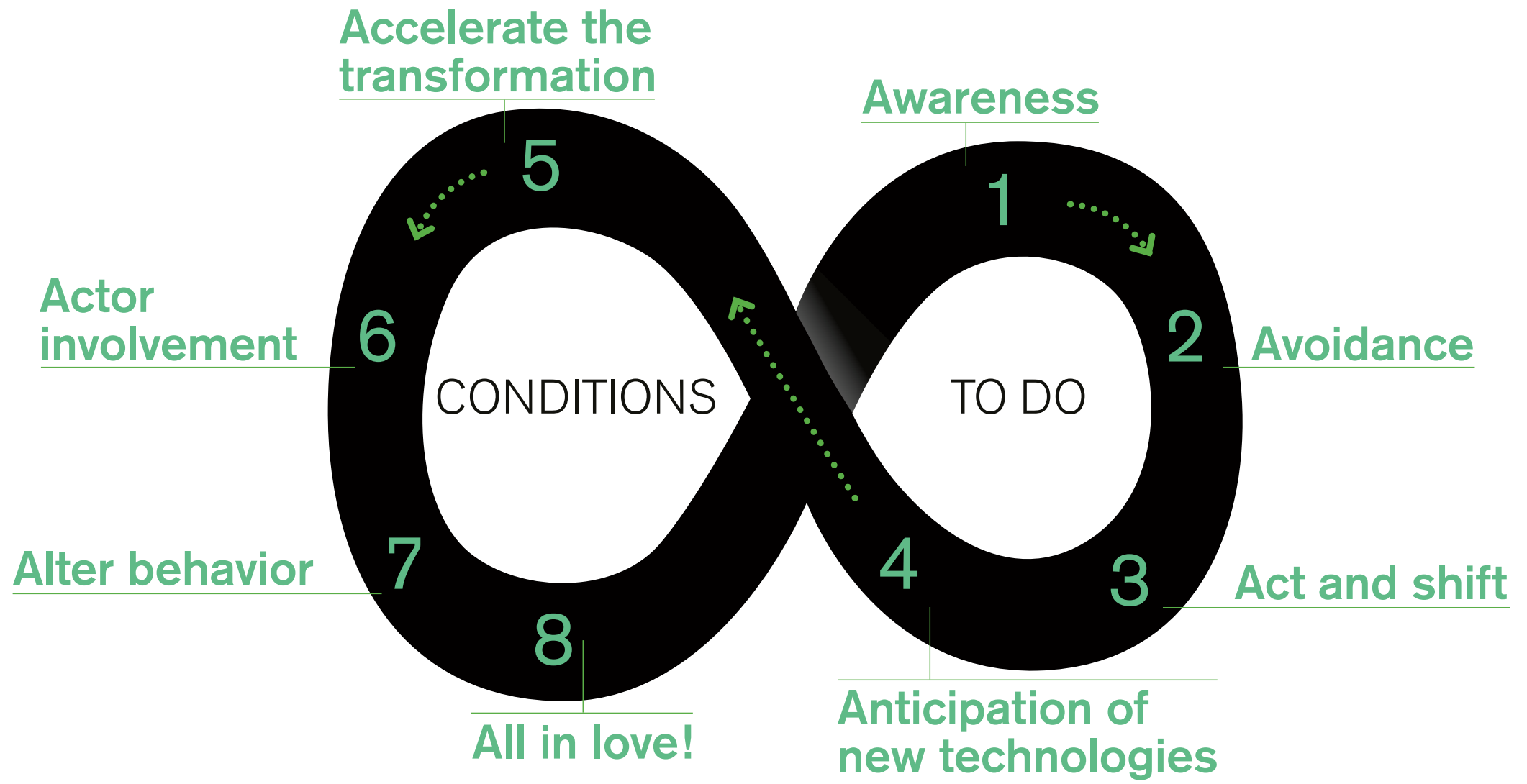
CO<sub>2</sub> is the main greenhouse gas that is emitted. It is responsible for two-thirds of global warming<sup>4</sup>. But there are also emissions of methane, nitrous oxide, and other greenhouse gases. The concentrations of these gases have been rising sharply over the last 150 years. Methane is one of the most vicious gases. It traps 80 times more heat than CO<sub>2</sub> and is responsible for 17% of the current warming. It does disappear from the atmosphere after nine years, but it then decomposes back into CO<sub>2</sub><sup>5</sup>. In the rest of the book, I will mainly talk about CO<sub>2</sub> emissions because they are the main contributor, but I will also mention other greenhouse gases when they are relevant<sup>6</sup>. Often, CO<sub>2</sub>-equivalent is used. In this way, all gases are expressed with CO<sub>2</sub> as standard. To make this conversion, both the amount of heat that is retained and how long the gas stays in the atmosphere are considered. For example, the emission of 1kg of methane is equal to 25 CO<sub>2</sub>-equivalents.



Annual global temperature and CO<sub>2</sub> levels between 1959 and 2019<sup>7</sup>.

The earth has already warmed up by over 1°C. Droughts, floods, forest fires, hurricanes... We see them on the news almost every day. But extremely cold periods are also part of climate change. These new weather conditions have a significant effect on the survival of some animal species, but also on our food supply. We may not be so aware of it anymore, but what we eat still has to be grown. In 2018, extreme weather conditions across Europe caused problems for agriculture<sup>8</sup>. Indeed, our food supply is at risk.

According to Al Gore, everyone has to have their aha-moment when it comes to climate. The moment when you suddenly realise, “damn, we really do have a problem”. For me, that moment came a few years ago when I was travelling with my family to Senegal. Until then, the climate had always been a topic in my research, along with the many other effects of transport. But at that moment, I felt how climate change would impact the lives of the people in Africa. In Europe, we often imagine that life will go on as before, or at least we hope so. By the time there is another heat wave, we will have installed air conditioning. And when the weather is bad, we just turn up the heat. We often live very much sheltered from the weather. But when you live with nature, as you do in





What can we do about it?





AWARENESS

## How can we create more awareness?

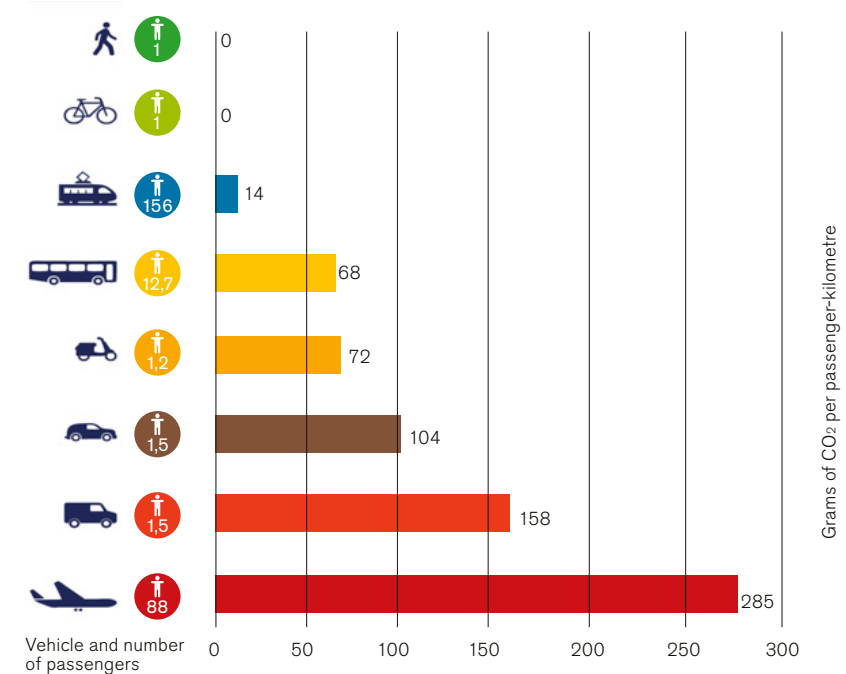
**The first A stands for Awareness: mentioning and knowing what the impact is.** Becoming aware of something is indeed a necessary first step towards change, and on the climate issue, awareness is growing. According to the 2021 Eurobarometer survey by the European Commission, 93% of European citizens now see climate change to be the single most serious problem facing the world. This is a huge rise from the 2019 survey, which saw only 23% of European citizens acknowledging this. This is not just a realisation for Europe but globally as the “Peoples’ Climate Vote” of the UNDP reports that 64% of the respondents (which covered half of the world’s population) saw climate change as a global emergency. Lots of information is being made available and the actions of climate youngsters (‘youth for climate’, ‘students for climate’), companies (‘sign for my future’) and scientists (‘scientists for climate’) further sharpen the awareness of the urgency of the climate problem and the necessity of sustainability.

Regarding our climate, there is no being “for” or “against” it, so any form polarisation in the social debate context must be avoided at all costs. Climate change and the influence of greenhouse gases on it is a scientifically established and substantiated objective fact. It has no political colour! It is therefore very important to report the facts objectively, about the impact of our travel behaviour but also about the alternative options that are more sustainable. Thankfully, different impact analysis methods exist for this.

### CO<sub>2</sub> emissions per means of transport

A very simple way to weigh alternatives is to indicate the amount of CO<sub>2</sub> emissions per transport mode. In the following figure, this is indicated per passenger kilometre, that is, how many grams of CO<sub>2</sub> are emitted by a person for one kilometre of travel. Walking and cycling are of course

the best, followed by public transport. And as clearly shown, air travel has large emissions per passenger, so even if you are in a plane with several people, it is still much worse than going by train. There is also a big difference depending on how far you fly. Planes emit a lot on take-off and landing, so, proportionally you have more emissions per kilometre for short flights than for longer flights, but it’s a little more complicated than that. When travelling by plane, the impact on climate change is not only through greenhouse gases but also through the formation of condensation trails (radiative formation). Therefore, the effect of the insulation blanket is even greater, and for the aviation sector you have to count on an impact that is 2 to 3 times higher than just the CO<sub>2</sub> emissions.



Carbon emission from passenger transport<sup>52</sup>

It may be possible to make it more concrete by indicating in what way, for example, the plane trips could be compensated. For instance, to compensate for the CO<sub>2</sub> emissions of a flight from Brussels to Auckland in New Zealand, you would have to eat no meat for 6 to 8 years or install 10 solar panels on a roof for about 2 years. However, this will not yet have removed the emitted CO<sub>2</sub> from the atmosphere. You will simply have

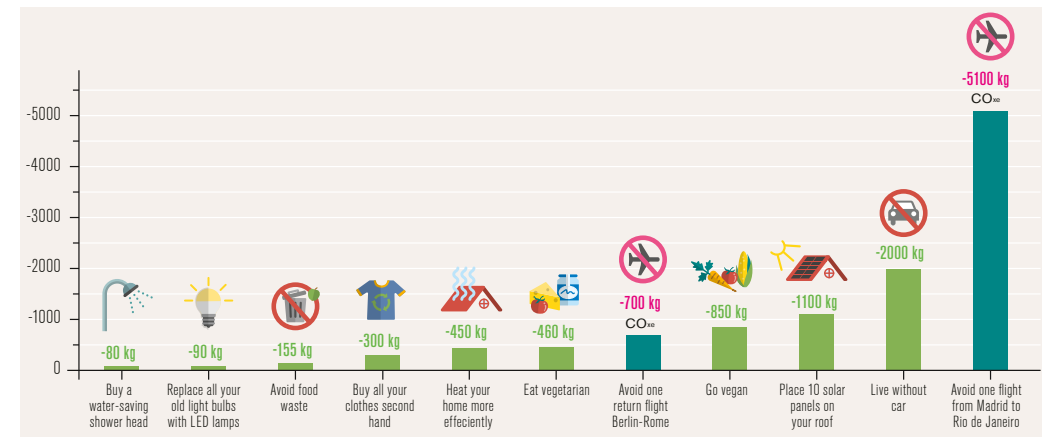
saved those emissions on your own CO<sub>2</sub> consumption.

How much CO<sub>2</sub> can we emit per person? Well, if we want to meet the 2°C target, every person on the planet should only emit an average of 2 to 2.3 tonnes of CO<sub>2</sub> per year. Unfortunately, this is not the case. Although in the entire African continent, the average per person is 0.99 tonnes, for high CO<sub>2</sub> emitting countries like Australia and United States it is 15.37 tonnes and 14.24 tonnes, respectively; and for the whole of Europe, it is 6.61 tonnes. Let's do a little comparison as there is an imbalance even within Europe. While countries like Moldova, Malta, Portugal have a per capita of 1.28 tonnes, 3.61 and 3.96 respectively, countries like Luxembourg and Czech Republic have a per capita of 13.06 and 8.21<sup>53</sup>. These figures are significantly greater than what is needed to achieve the 2°C target. However, it is interesting to note that some countries with high CO<sub>2</sub> emission per capita (emission per person) have a small population size and this factors into the calculation. Nevertheless, we can see that the figures are alarming.

In Flanders, the footprint is about 12 CO<sub>2</sub>-eq/t per inhabitant. If you also include the production of consumer goods abroad, then we are talking about 20 tonnes of CO<sub>2</sub>-eq per inhabitant per year, which is almost 8.6 times as much as the impact we are allowed to have. A factor of 8, so to speak!

If we look a bit deeper into this, we can see that passenger transport takes up about 2.9 tonnes, food 2.8 tonnes and accommodation 5.8 tonnes, and the rest comes from various sources such as clothing<sup>54</sup>. A roundtrip to Brussels-New Zealand already emits 6,6 tonnes<sup>55</sup>. And as earlier mentioned, for flight you have to multiply this with a factor two to three to get the impact on the climate change. Such figures put things into perspective.

In the following figure, you can see how aviation compares to other actions so you can choose to lower your CO<sub>2</sub> footprint accordingly.



#### Living sustainably by avoiding flying

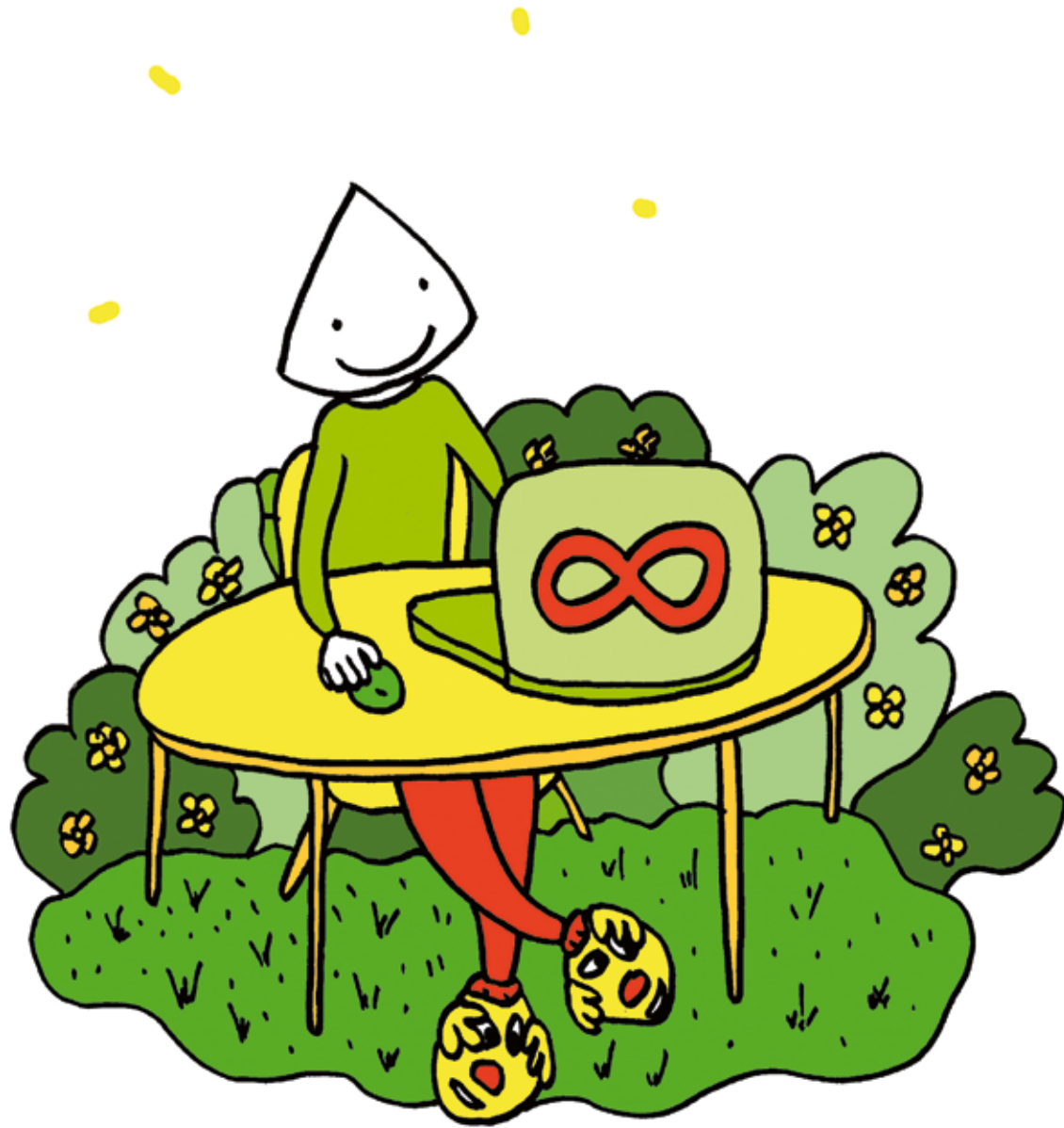
Greenhouse gas emission savings of different sustainable lifestyle changes, in kg CO<sub>2</sub>-equivalents/year, 2020

And the sad fact is that the wealthiest 1 percent of people emit double the combined climate pollution of the poorest 50 percent. This, of course, is not a reason to not think about your own footprint, but it is apparent that more awareness has to be brought to these people. Flights are certainly an aspect in their lifestyle that adds to this, but also the way they invest their money and the energy use in their houses and cars.

#### The ABC travel policy of the Free University of Brussels (Vrije Universiteit Brussel -VUB)

Academics are keen travellers. After all, their research work has to be tested against the work of other researchers. Conferences, study trips and teaching therefore involve a great deal of air travel and, consequently, also CO<sub>2</sub> emissions.

For the VUB, this amounted to some 34,869 tonnes of CO<sub>2</sub>-equivalents per year and the number is on the rise. To raise awareness about the impact of flying, the 'ABC policy' was introduced in the academic year 2019-2020. A stands for 'Avoid': do we really need to make the trip? Can't it be done via Skype? B stands for 'Book an alternative'. The train, for example. For all train journeys lasting less than 6 hours, it is recom-



AVOIDANCE

**Once we become aware of a problem, we can do something about it.** And the best first step towards more sustainable mobility is avoiding unnecessary kilometres. To achieve this, we need to examine spatial planning. After all, we move around because we have an activity, such as work, study, shopping, and so on, that does not take place where we live. The same principle applies to the transport of goods: the closer our point of consumption to the production site, the fewer kilometres we have to drive. Secondly, we can avoid travelling by working at home or organising meetings via video conferencing. Thirdly, we can also avoid kilometres and make better use of journeys by sharing them.

## Spatial planning: Reducing the need to travel

The distance between the locations of our activities such as living (our homes), working (offices, factories), studying (schools), shopping (shops and services), spending our free time (sports fields, restaurants, bars, cinemas) are one of the key determinants of how far we need to travel. If the locations of these activities are very scattered, more trips are needed to live our lives. Spatial density defines the distribution of these activities and the denser our urban areas are built, the higher the chances that you can find a shop, school or a job closer to where you live, hence avoiding long trips.

In Belgium, for example, activities are extremely fragmented. If you look at the area around Brussels (Figure 2, centre) compared to what we observe in the same area around the Randstad in the Netherlands or Paris, you can see that activities are sprawling across the metropolitan area and beyond.

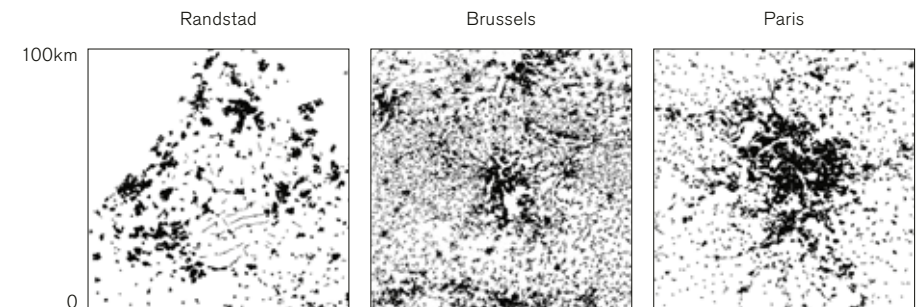


Figure 2: The built-up area around Brussels is much more fragmented than around Paris and in the Randstad<sup>72</sup>.

This fragmentation (also known as sprawl) has many consequences. First, it makes it very difficult to offer a high-performance public transport system. The public transport network therefore leaves much to be desired. And this also means that the car dependence of people who do not live in the core city is much greater<sup>73</sup>. If you look at the large densely built cities with a good public transport network, the modal share of the car can be as low as 15%<sup>74</sup> with a high percentage of trips made by public transport, walking and cycling. In areas with fragmentation and sprawl, like the metropolitan areas around Manchester and Birmingham

in the UK, the car accounts for 65-70% of trips.

Secondly, because of the fragmentation, people tend to live further away from their work. In Belgium, for example, people drive 6% more kilometres to work than the Dutch and 9% more than the French. For people with a company car, that distance is even significantly greater, namely 32 km compared to 19 km<sup>75</sup>.

These two elements together mean that the social and environmental impact of mobility in an area with low density are twice as high as in the city centre<sup>76</sup>.

Spatial planning, that is, the long-term planning of activity locations is thus a crucial element to influence mobility and its consequences at the source. The most important fundamental layer of a sustainable mobility policy is therefore spatial planning. Here, we not only need to make our metropolitan areas, cities and even communes denser, but we also need to do this in a smarter way, namely by working with mixed functions. If living, working, shopping and relaxing can all be done in the same place, why move around? In practice, there are already fine examples of such mixed-use developments, such as at King's Cross in London, where one of the largest mixed-use development projects in Europe has been implemented, combining office, retail, service and residential spaces with excellent public transport connections.

Urban sprawl has many other effects as well. Admittedly, just like many other people, I find a house in the greenery quite a nice dream. But for society, it gives rise to too many additional costs. It means that people are more car dependent, but also that more infrastructure works are necessary, that the house needs more heating, and so on.

If the costs of infrastructure (maintenance of roads, utilities such as water, gas, electricity, sewerage and lighting), the loss of open space and ecosystem services are also calculated, then you get large differences between that house in the green countryside and an apartment in the city. All in all, by choosing a scenario in which open space is given back to nature, it was calculated, that for Flanders, 25.6 billion

euros can be saved by 2050<sup>77</sup>.

Interestingly, if we leave the countryside and go back to the city, improve the limited public space within the urban area by reducing the number of parked cars, add more greenery, build bike and walk infrastructures, we can actually have the living environment that we are searching for outside the city.

## Teleworking and teleconferencing

Many commuting trips can be avoided by allowing people to work at home or at a satellite office nearby. Thanks to teleworking, a lot of external transport costs can be avoided. For a day worked at home per week, we are talking about a 20% reduction in external costs<sup>78</sup>. It is often said that people who work at home will still travel that day, but this does not outweigh the home-work trip. Our research shows that only a very small proportion (5.4%) of teleworkers use their car for extra journeys while working at home. In addition to the benefits of reducing external costs, working from home can contribute to the wellbeing of employees by reducing time spent in traffic jams during peak hours and provide increased productivity and financial savings for both the employer (less office space required) and the employee (reduced commuting)<sup>79</sup>.

Working in satellite offices, that is, an office location of a company separate from its headquarters, can also have a positive effect. However, if one does not consider whether the employees can also travel to the satellite office with the same train pass, it can cause unexpected impact on travel behaviour. For instance, our research showed that people who normally commuted to work by train to the company headquarters, changed to car when commuting to the satellite office. This was not so much due to the poor accessibility of the satellite offices by public transport, as satellite offices are often very well connected, but more because the travel was not included in their public transport season ticket, and they therefore chose to go by car. Coworking spaces can also be interesting for digital nomads who have the freedom to work anywhere, but also like to do so with people around them.

Many meetings or appointments can also be done via videoconferencing, using Teams or Zooms. During the corona crisis, we all learned to work with these apps, which means a lot of – often long-distance – meetings can be avoided. At the university, we encourage people to use it more. For example, evaluation commissions for PhDs and some conferences are now organised virtually. Of course, we remain people and real (eye) contact is important for networking, but some of our activities can certainly be done just as well without travel. Furthermore, lessons, doctor visits, but also hobbies such as dancing, meditating... just about everything has been tried out digitally during the corona crisis. As of now, many employees and employers voiced they want to keep a certain amount of telework and teleconferencing, even after corona. Tuesdays and Thursdays are popular days to go to work while the other are often used for teleworking. The public transport operators also notice this in their capacity use and are adapting their passes to make them more flexible.

### Sharing trips: avoidance through more optimal use of capacity

Look around when you are in a traffic jam, there is often only one person in the cars next to you. And you are also probably alone in your car, even though there is much more room in the car. Car occupancy is an indicator of the number of people travelling in a car. Average occupancy rates in Europe range between 1.1 and 1.2 for commuting to work and 1.4 to 1.7 for family trips<sup>80</sup>, while the capacity of passenger cars is typically 4 to 5 persons. We can avoid a lot of journeys just by driving together<sup>81</sup>. While a few years ago we had to stick our thumb in the air to ride with others, or use a company organised carpool system, thanks to new technology and smartphone apps, there are now many other possibilities.

However, carpooling for home-work trips still hovers at 3% of trips<sup>82</sup>. Applications like BlaBlaCar are becoming more and more popular in Europe. They make it possible to find people who have a seat free for the destination you want to go. So, the platform connects people who were going to travel anyway. The people who offer a ride do not do this as a professional activity and only the cost of the ride is shared.

Uber or Lyft work based on a different business model as these are taxi-like services where drivers and passengers are linked in real-time via a mobile application based on a specific demand for trips and supply of vehicles and drivers (it is often called ride-hailing). The impact of these services on other modes of transport is still unclear. A study in the San Francisco region shows that 31% of the trips made by ride-hailing replaced trips by public transport<sup>83</sup>.

In itself, a concept like Uber can help reduce car ownership in the city<sup>84</sup>. However, we have to watch out for the long-term effects. In the US, for example, certain public transport services are replaced by Uber services. Another example from the US is the construction of parking spaces at a train station. These are no longer needed because Uber can take care of the trip to the station. In the short term, you do save money that can be used to subsidise the train passengers' Uber services, but what if Uber raises its prices substantially after a while? They will already have a monopoly and the money to build the car park will no longer be there.

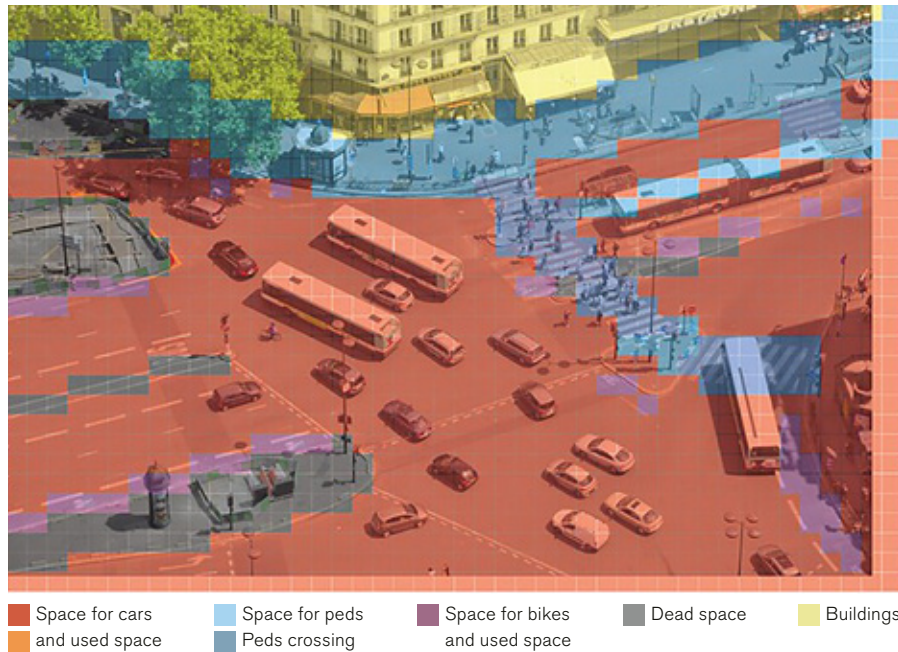
Illustrative of what is to come is the evolution in New York. There too, Uber and Lyft made their appearance with fine promises about the positive effects on mobility: more shared mobility instead of solo use of cars and more efficient services than the existing taxi industry. In 2015, it was mainly about attracting the customers of the yellow taxis, but gradually it was noticed that there was more and more congestion in New York. As it turned out, people who used to take the bus and underground were also increasingly starting to use Uber services. These trips were not so much shared services, but solo and this led to many more rides in an increasingly congested city<sup>85</sup>. The idea that Uber is especially useful where public transport is temporarily not possible because of too little demand is nice in theory, but in practice the Uber drivers also work where there is the most demand, usually in the centre of the city and not in the inaccessible zones. Such services must therefore be closely monitored in order to ascertain whether or not they contribute to the city's sustainable mobility objectives.



ACT AND SHIFT



In part one, we already saw that car use still dominates our journeys. It still remains a very easy, comfortable way of getting around. What would it take to get people to travel in a more environmentally friendly way and to put freight on more environmentally friendly modes?



The arrogance of space<sup>89</sup>

## A historical perspective: a story of space

A documentary about how Leuven evolved from a city that, like many others, became saturated with cars and then pursued a policy to make the city car-free again is an eye-opener<sup>90</sup>. It shows how streets that used to be meeting places for neighbours and friends, and where children could play carefree in the street, have been completely taken over by parking and cars driving around with unhealthy exhaust fumes. The installation of the first shopping street, Diestsestraat, caused a lot of protest, most of all from the shopkeepers themselves. This is the evolution we have seen in many cities. From the 1960s onwards, cities were completely built to accommodate as many cars as possible. One of the reports also clearly indicates that the tram had to make way for the car. Then the focus of cities shifted from cars to sustainable mobility. A next step in urban development is to see the city as space and to give that space back to the people<sup>91</sup>.

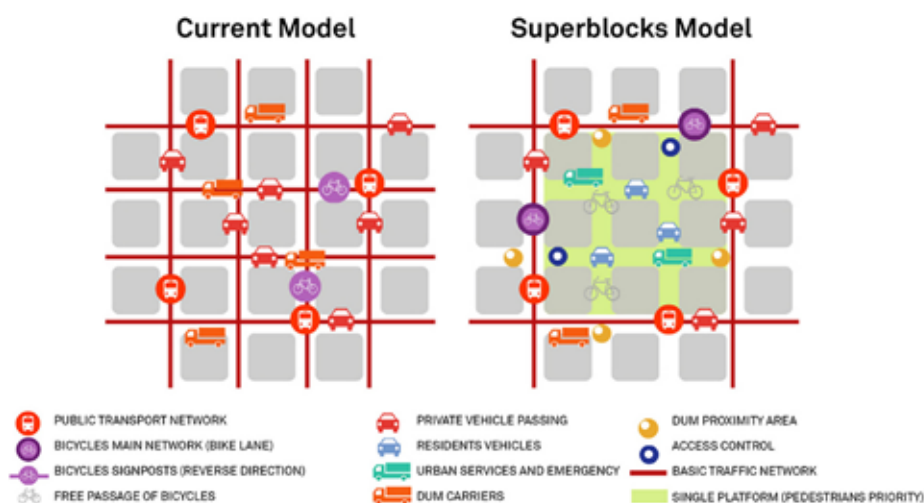
That is quite a difficult task, because in the meantime the car has taken such a prominent place that it is hard to change it again.

Urban planner Mikael Colville-Andersen uses colour in photographs of urban streets to show how the road surface is divided between cars, cyclists and pedestrians. He calls it the 'arrogance of space' and argues for a redistribution of urban space in favour of cyclists and pedestrians. In cities, often 50-70% of the space is occupied by the car<sup>92</sup>!

Why am I telling you all this? First, to show that car dominance has not always been there. And second, that we are in a negative spiral, because who wants to ride a bike in a city that is completely geared towards cars, so you have to be slightly suicidal to jump on a bike. If public transport is also poor and you get stuck in car traffic jams, you are not really motivated to jump on the bus. And do you want to walk in a city where the pavements are small, and you have to walk amidst the emissions and the crowds of cars? No! And so, we have even more people in the car. And there are people who flee the city to live in a greener environment with better air and then commute by car to work in the city. If we want to get out of this negative spiral, we have to make an effort to give that space back.

This can be done in a very clear way by installing pedestrian zones. In Brussels, one of the largest pedestrian zones in Europe was installed thanks to the citizens' movement 'Picnic the Streets'. Not only does the zone itself give way to pedestrians and cyclists, but it has also given rise to the shift we are talking about here. Now, 14.5% of the people coming to the pedestrian zone no longer come by car but rather by public transport, and there were 2.5 times more pedestrians in the pedestrian zone. Among employees working in the zone, 9% also indicated that they had shifted from driving a car to other sustainable modes<sup>93</sup>. Similar stories can be found in cities and other countries. The initial resistance of residents and shopkeepers quickly turns into a positive assessment of the introduced changes. And the expected traffic chaos does not materialise, because the traffic evaporates<sup>94</sup>. People no longer come or come with other means of transport.

So, it is about giving space back. In Barcelona, they work with the 'superblocks concept'. In such a superblock, which often consists of nine blocks of houses (see figure), priority is given to cyclists and pedestrians. Brussels, too, is already working on such a district level, so that it can become a car-free district. In fact, you restore the liveability in such a district. School streets and bicycle streets also give the street back to the active modes.<sup>95</sup>

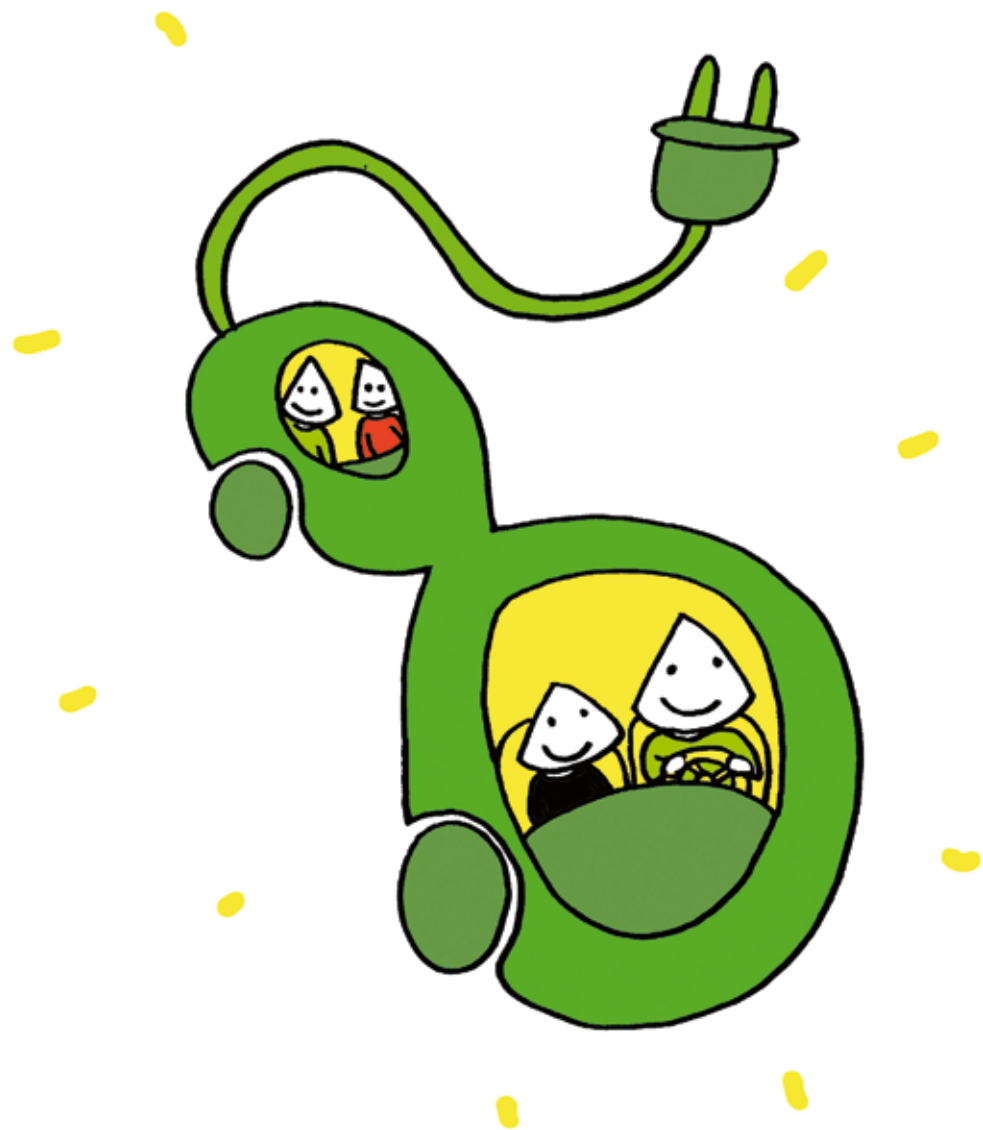


To enable a shift to cycling, the only option is to invest in infrastructure. By the way, that cost far less than road infrastructure, and it yields so much more. Copenhagen, the example of a city that has made the shift happen, did only three things: and that is invest in infrastructure, and again and again. Parking lanes were taken away to build free-flowing, metre-wide cycle paths. But also, all kinds of other infrastructure interventions, from tunnels to smart traffic lights, ensure that there is as little friction as possible between cars, public transport, cyclists and pedestrians. Bicycles are also allowed on trains and subways which makes the combination easier. This transformation into bicycle cities can also be seen in many other European cities.

Cities such as Copenhagen and Amsterdam, which cannot immediately be labelled as the sunniest compared to our region, still appear to get many people on their bikes thanks to stimulating measures. Once the tipping point is there, thanks to sufficient infrastructure and sufficient attention and space for active modes, cycling and walking become an automatic reflex. And as the Danes say: there is no such thing as bad weather, only bad clothes. So, investments in safe cycling infrastructure pay off. Our research into why people do not cycle in Brussels also revealed that, in addition to the infrastructure, individual and social factors also play a major role in whether or not people cycle. For instance, cyclists receive more social support from partners, colleagues, friends and/or children in their decision to cycle. They also had a higher score for self-reliance, which means that cyclists are not discouraged from cycling even when it rains during the journey to work, for instance<sup>96</sup>. It is, as it were, part of the culture and a way of life.

With electric bikes and speed pedelecs, cycling is now also becoming interesting for longer distances. In 2018, 503,119 new bicycles were sold, of which 50% were e-bikes<sup>97</sup>. With the corona crisis, the bicycle revival has really taken off. After all, it is both healthy and safe and additional cycling infrastructure was provided.

In addition, you must ensure that there is a quality supply of public transport<sup>98</sup>. And therein lies one of the biggest problems. Public transport requires major investments, but instead of investing in it, it has just been



## ANTICIPATION OF NEW TECHNOLOGIES

**The fourth A stands for Anticipation, primarily regarding new vehicle technologies.** If we cannot avoid travel, or shift to more environmentally friendly modes of transport, can we at least “change” the cars we use? Here, indeed, many new options have emerged in addition to the classic petrol or diesel cars. As indicated in the ‘Awareness’ section, electric cars are the most appropriate in terms of CO<sub>2</sub> emissions. They are also a good alternative in terms of local emissions, since there are no more emissions while driving. As with other cars, there is particulate matter from brake disc wear, but this is less with electric cars because they are automatically braked by the motor, so the brake discs wear less than with other types of cars.

If we want to achieve the climate objectives, the electrification of the entire vehicle fleet is necessary. However, we absolutely must also focus on the two previous As, Avoidance and Acting and shifting, otherwise we will not achieve the climate objectives and we will continue to be stuck in traffic jams. Hence, we must aim for less driving and the sharing of cars so that less has to be produced. This is once again confirmed by a 2019 study by VITO and the Circular Economy Support Centre which showed that if we continue to have the same size car fleet, we will not be able to meet the climate objective in 2030<sup>115</sup>.

Some countries have already indicated that they will no longer sell cars that are not emission-free. In the Netherlands that is in 2030, and in Norway already in 2025. Cities are also starting to indicate that diesel cars, and later petrol cars, will no longer be welcome; in Brussels this will be in 2030 and 2035 respectively. Such measures are important because a car is used for an average of 15 years and will therefore continue to pollute for a long time once it is bought. If we want to have a completely climate-neutral transport system by 2050, then this is only possible through such clear measures. And to me, the only clear measure is moving towards electric cars. The car lobby has long insisted on keeping such decisions and measures technology neutral. The technology of electric cars could not be chosen decisively. However, none of the other technologies can achieve the climate objectives. Running cars on natural gas is not the solution because it still involves a lot of CO<sub>2</sub> emissions since it is also a fossil gas. Biofuels are not sustainable enough to mix in large quantities. What’s more, it will mean that even more forests will have to make way for farmland, taking even less CO<sub>2</sub> out of the air. And hybrid cars are not the long-term solution either. They only run on electricity for a limited amount of time and from experience I can say that the need to switch them on after use feels just a little less urgent than with a full battery electric vehicle which means even less driving on electricity.

However, there are still some barriers to the full market introduction of electric cars. These are mainly the purchase cost, the limited driving range of the cars and the charging infrastructure that is not yet available everywhere. We will see that these barriers are also fading.

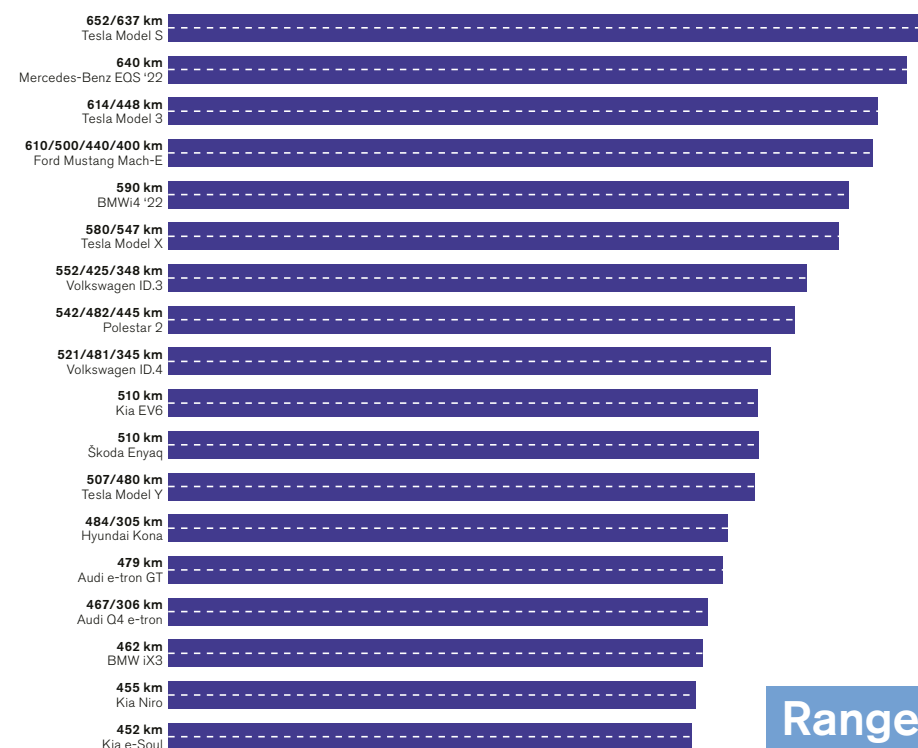
First, let's look at the cost of the car. It is best to look at it over the entire life cycle of the car in a so-called Total Cost of Ownership (TCO) analysis. In such a TCO, all costs are included - the purchase cost, but also insurance, fuel costs, and so on. For smaller city cars, electric vehicles are currently more expensive than petrol cars. This is also a very competitive segment where you can buy a petrol car for as little as 10,000 euros. But even in the middle class, electric cars are not yet competitive with traditional cars. It only becomes more compelling in the premium segment, for example Tesla<sup>116</sup>.

We expect this cost comparison to change soon. This is because the cost of the battery, an important element in this comparison, is rapidly becoming cheaper. Between 2010 and 2018, the cost has already dropped by 80% and is further decreasing due to increased battery production capacity. In 2022, the cost has already dropped by 89% and there is forecast of a further 92.5% in the 2030s<sup>117</sup>.

This is accompanied by increased capacity for the batteries. They are becoming more efficient and are also increasing the driving range of the cars. Electric cars can now easily cover 350 to 400 km with some models going above 600 km, whereas the first models had to do with 100 km. See the figure on page 81.

According to a study by Bloomberg<sup>118</sup>, 2026 will be the tipping point for the purchase price of electric vehicles. At that point electric models will be more interesting than cars with a fuel engine. Other studies speak of 2022 as the tipping point. As indicated above, there are already segments in which it is more interesting. A fiscal policy aimed at stimulating electric vehicles can also help a lot. In Norway, for example, 1 in 2 cars are already electric, partly due to a tax policy that makes electric cars cheaper than diesel or petrol cars.

Moreover, there will be many new models on the market by 2022<sup>119</sup>. So, for those who think "all well and good, but those electric cars look so ugly". Well, according to an IEA report, the number of electric vehicle models was 370 as at 2020 and many more models are in production. So, you have several options but if you still can't find your choice in



these, I don't know where else you would. Even Harley Davidson now has an electric model. The salespeople still hope that there will be an appropriate sound but what is disappointing in this whole transition is that the car manufacturers give priority to their big SUV-type cars to bring on the market. This means that more and more big cars are driving around, a trend that was already going on before with the petrol and diesel cars. Now, 45% of global car sales are SUV's<sup>120</sup>.

I used to have an electric car at home, which I used from time to time. The car, a BMWi3 was still an 'old' model with a range of 100 km. It had a generator that would create some extra electricity anytime the battery ran out. They call it a range extender. That has helped me a lot because with a range of 100 km, I can only make the journey from Brussels to Antwerp and back, if there are not many detours. But the car drives wonderfully. It is very nimble too, which gives me a safe feeling, because