BETWEEN DARK SCENARIOS AND A BRIGHT FUTURE

Aiming for a 2050 Sustainable and Competitive European Transport Industry

2030 and 2050 Scenarios Narrative

RACE2050 – Responsible innovation Agenda for Competitive European transport industries up to 2050

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**RACE2050 goals**

RACE2050 foresight study aims to identify key success factors for a sustainable growth of the European transport industry and for policies which can increase its strength in a long perspective up to 2050. By integrating the tremendous available foresight intelligence into a comparative synopsis, we will be able to compare and assess various visions and especially different policies to reach these goals. The results of this analysis will be discussed with experts from the transport industry, research, policy, and the foresight field. By this, we will come up with weighted explanations and long duree core concepts for a sustainable strength of the transport industry.

By studying the actual impacts of past foresight studies we will learn how to present our own integrative foresight synopsis and what to expect from transport industry and policy. Important drivers of change will be extracted by analyzing current policies, emerging technologies, energy and environment aspects, demand forces, geopolitical trends and other relevant domains. General Morphological Analysis (GMA) will then be used to integrate and assess a multitude of driving forces for alternative scenarios. Wild Cards analysis will provide additional important input to the final outcomes: novel scenarios for 2030 and 2050 on the competitiveness of the European transport industry. The scenario construction will be supported by a web-based interactive foresight synopsis tool, envisioned to create a long-term legacy for stakeholders, lasting beyond the duration of the project.
Introduction

This report contains the six scenarios of the project RACE 2050 on the future of the European transportation industry. Developed by the project team and written by the futurist Karlheinz Steinmüller, these scenarios depict different, rather extreme futures for the time horizons 2030 and 2050. For 2030, the project team decided to develop predominantly pessimistic and cautionary visions, based on an extrapolation of existing negative trends ("Dark scenarios") and on the historical conviction that negative or horror scenarios successfully triggered adaptation and development processes within the European transportation industries.

On the contrary, the 2050 visions combine positive answers to existing challenges with optimistic assumptions about a deep transformation of the industry based in particular on cultural changes ("Bright scenarios"). For both time horizons, a main scenario is accompanied by two less comprehensive "side-scenarios" that highlight specific developments and that can be understood as more extreme alternatives to the main scenario.
Advice to Readers

Scenarios are a wonderful tool to inspire discussions about the future, about advantages and disadvantages of present developments and about strategies. But, in using scenarios, one should keep certain facts in mind:
Scenarios are scenarios, stories about the future, not forecasts. Their aim is to provide insights about potential futures; they do not and cannot depict “the future” as it will be. As consistent and plausible images of possible futures, they say: “This is the way it could happen.” But even if you have a set of alternative scenarios to a certain topic, the future will never look exactly like one of the scenarios. No one, no scenario writer, no futurist or other expert, can foresee all emerging developments, all possible innovations or wild cards. And there are always unknown unknowns.
This limitation, however, does not diminish the value of scenarios. Scenarios transport specific messages about the future, and one can learn from the narratives of the scenarios. They inspire thinking about the future, they encourage mental experiments, and they can contribute to debates about the future, and, hopefully, lead to better decisions.

Most scenarios exaggerate present developments for the sake of clearer, more distinct images, a sharper perception of present trends, innovations or policies. Smooth and conventional images of the future are of no help, anyway. On the contrary, scenarios may be regarded as mental experiments that draw conclusions from a set of premises: “What if…?” “What if this goes on?” “What if a certain disruption happens?” Counter-factual premises or assumptions that run against commonly shared convictions inspire open “out of the box” thinking. Scenario studies should make conventional convictions transparent – and perhaps show how shaky they are.

Usually, scenarios describe actions from quite different actors: citizens and politicians, managers and activists for some cause... Very often, in a scenario these actors engage in strategies or measures that are contrary to their present behaviour. Such actions are part of the premises, part of the mental experiment, and in no case a recommendation! And, of course, no scenario writer can guarantee that the actions described in a scenario give rise to exactly the results indicated in the scenario. The impacts are based on the experience and the knowledge of the team that generated the scenario. This experience, this knowledge, however, is necessarily limited.

Even “negative” scenarios that describe a very unpleasant future that looks plainly horrific may lead to important conclusions. Usually, even scenarios of this type combine desirable and undesirable aspects. Debating the “pros and cons” of a scenario provides not only insights into options the actors have. It also makes the diverging future expectations, preferences and values of people engaged in the debate transparent. Individual, professional and political perspectives of a participant determine whether he or she regards a scenario as fearful or desirable, as highly plausible or rather unrealistic.

No scenario can give a comprehensive description of “the whole future”. Scenarios are always constructed around their main topic and emphasize mostly the aspects related to this topic. Many interesting side-ideas have to be briefly touched or left out. Usually, scenario readers have their own ideas of what could be added and what makes the picture more complete. A scenario writer, however, has to be rather selective, just because the human attention span is limited.
Scenarios may be used in quite different ways: to stimulate thinking about the future, to initiate a debate, to test the robustness of strategies, or to support decision-making. For a first encounter with scenarios, the reader may ask:

• What is intriguing about the scenario?

• What makes the scenario plausible, realistic? Which elements of the scenario are implausible or utopian?

• Does the scenario extrapolate present trends and developments – or deviate from them? And if this is the case: in which points?

• How do the main actors in the scenario act? According to their present strategies? Or do they implement alternative strategies?

• Who are the winners and the losers in the scenario?

• Which aspects of the scenario are desirable from my point of view? Which ones are not?

Scenarios do not provide answers about the future. But they can help us to pose better questions.
Dark SCENARIO: A Cautionary Vision

The Scenario in a Nutshell

In 2030 Europe has fully hit rock bottom of the "end of mobility", defining a continent completely surprised by the overwhelming economic success of competitive emerging markets, facing rising energy constraints as well as substantial internal shifts in mobility concepts and behaviour patterns. Having missed the opportunity to adapt business models and technological solutions to new energy supply impediments and new mobility patterns, the European transport industry in 2030, also due to massive decline of public investment, consequently has lost the technological pole position, which for the industry had been traditionally based on the presence of strong domestic demand and on an effective continental market providing a “critical mass”.

In 2030, as a result of public financial constraints, the EU will experience deteriorating quality of infrastructural systems, and a consequently shrinking (and eventually collapsing) transport industry. 2030 will experience dramatically lower mobility due to dramatically lower incomes, reflected in a wide-spread public consensus to reduce (or even avoid) mobility. Beyond that, the transport industry faces a “demographic shock” of having acknowledged the ageing society too late, and therefore lacking an adequate workforce.

On the political side, the long-lasting tensions since the financial crisis and the mismanagement of coordinated political solutions lead to reinforced nationalism, polarization and infrastructural "corridorization", causing a disintegration of peripheral areas and therefore of major parts of European transport systems.

Prior to 2030, reliance on technology has been the overestimated key factor for (sustainable) change: but 2030, however, marks the point of ultimate disillusion, caused by the amount of unfulfilled technological expectations. Instead, the emerging economies appear to be better prepared to cope with the changeover into a post-fossil era, while the European transport industry, despite ambitious high-tech aspirations, basically followed business-as-usual implementations and inadequate business models. Ever rising R&D spending and a technocratic perception of European progress have on the one hand lowered the ability to finance more conducive approaches, like low-tech and low-cost implementations. On the other hand, the plenitude of existing technical solutions is lacking political implementation and remains unused.
Main Dark Scenario: The Spiral of Decline

More stop than go

By 2030, transportation is in a terrible mess throughout Europe. You can observe it nearly everywhere: In Northern Italy, commuter trains are more than simply crowded, they are overcrowded; sometimes people are travelling on the roof, “like once in India”. The Paris RER is in really bad shape with 30 year old carriages struggling along – but it is still in much better condition than regional trains in Southern France or North/Pas de Calais. Londoners complain about the tube, Madrilenians about the Cercanias (local trains), Berliners about the permanent crisis of the S-Bahn. They all carry the hardship of cancelled trains, long delays, carriages so full that you cannot enter them. Some Spanish cities have already employed “pushers” who help people to get on to trains. Nobody knows how public transportation could cope with the daily rush without the persistently high unemployment rate! Many people have adjusted their working hours to the traffic situation and either start extremely early or leave the office very late in the evening.

Taking the car is not a good alternative either. Just listen to the daily traffic reports: Stop and go on Le Périph1, total congestion in greater London (despite a horrendous city toll), recently even a cycle path congestion was reported! Accidents block motorways M1 and M3 in direction to Budapest, particulate dust pollution levels in Athens exceed the European limits already for the 10th day in a row, but the municipality does not dare impose restrictions for the majority of 15 to 25 year old cars…

In the countryside it’s even worse. Roads are bumpy – if not completely closed! Trips that once took one hour may require half a day. In Scandinavia, road repair is already, as the local population says, three to five winters “behind” and will never catch up. Some Polish farmers have switched to horses and take a ride to the next town as their ancestors did. Some factories have been relocated from rural regions with deteriorated transportation infrastructure to congested agglomerations simply due to logistic reasons.

Business people, at least, are much better off than the general population. They live – and travel! – in a world of their own without any contact to the poverty stricken masses. The long distance high-speed train network operates very well throughout most of Western Europe and connects e.g. London with Milano, Stockholm via Malmö (on a refurbished X2000 route) with central Europe, Lisbon via Madrid and Barcelona with Lyon. Well, it is advisable to not take a taxi in these cities, and in fact it is not necessary, since hotels, conference centres and most company head offices are situated close to the stations or they are part of the airport. No need to go into the messy, noisy, over-crowded, and perhaps unsafe districts.

Travelling by air is for those who can afford it the first option, despite delays and some cancellations: One European Sky is still not completely realized and some airspaces lack capacity, the region of Baden-Württemberg, Northern Switzerland, and Alsace is tight with air traffic causing many delays. Budget airlines have left the EuroAirport Basel because of a tremendous rise in airport taxes there. Heathrow works at maximum capacity, there is no room left for extensions; the same applies to Frankfurt and Paris-CDG. By contrast, the capital city airports of Sofia and Bucharest are working at best at half capacity. Some smaller airports have been abandoned, and most budget airlines are struggling to survive. Flying is something for the global business class, not for average European citizens. The same infrastructure deficiencies that cause daily suffering for the commuter are a serious challenge for the logistics industry. Most roads are in a bad state of repair and crowded with cars, LDV and heavy trucks. Others have been closed completely, and you never can be sure that an important highway bridge will not suddenly be closed too. Cities are stuck with delivery vehicles.

1 Le Boulevard Périphérique: the circular motorway round Paris.
Rail infrastructure on most relations is in terrible need for overhaul, with dramatic speed or load restrictions. A lot of local and regional relations have been completely abandoned. Certain small rail service operators try to find their niche in this situation, mostly without sustainable success.

Waterways are in a slightly better shape and have attracted slightly more freight traffic than before. Port operators, however, are complaining about decreasing revenues. Hopes that the new “northbound” ice-free Arctic routes would give a boost to maritime transportation have been disappointed – at least for most northern European ports.

A divided continent

One should think that congestions and crowded public transportation is a sign of frantic economic growth and an increasing population, but the opposite is true. European GDP has been stagnating for a decade; the share in global GDP – in 2010 slightly over 20% – is down to less than 15%\(^2\). China, once the workbench of the world, has finally experienced the end of its economic miracle, but South America, South Asia and Africa with their dynamic economies and flourishing middle classes have replaced it as engines of the world economy. Near-shoring instead of off-shoring to the Far East did not really make it easier for the manufacturing industries in Europe.

The real causes of European economic marginalization and social polarization, however, have to be found within Europe itself. And they are rather complex. Some blame a shrinking and ageing European population for the decline, but the obvious inability of European societies to adequately respond to that challenge is at best one of factors. It is combined with a deflationary vortex exacerbating European economic downturn that led to higher unemployment, the distresses imposed by armed conflicts in neighbouring countries, the harmful impact of tax evasion, transnational fraud and aggressive tax planning on the world economy, higher energy prices (against competing economic regions) and an established reluctance against reform and innovations, in general. Alas, even this is only half of the story.

More important is the growing division in European societies, a division into a globalized class of business people, experts, high ranking professionals and rich heirs on the one hand and “losers of globalization” (as they see it) on the other, a threatened middle class on the way down, a growing “precariat” of badly paid service employees or self-employed people, and a growing number of “drop-outs” of the welfare system. The income gap is increasing every year; wages are at the very best stagnant (in nominal figures!), whereas capital yields never stop growing – as is public debt.

As a result of increasing poverty, consumption is divided into a still strongly going premium sector and low cost and discount offers with extremely narrow margins.

All spheres of consumption are affected: FMCG, clothing and furniture, real estate – and last but not least transportation. Take as an example car makers. Large European OEMs still sell premium cars to European customers and the global upper middle class that cherishes shining traditional brands. European middle class cars, however, find only a small domestic market – and cannot compete on the Chinese, Indian, South American markets where new car makers (often with political support) produce cars with European quality standards but at much lower costs – despite tremendous pressure on wages in the European car industry. The average active life of middle class cars in Europe is up to twenty years – approaching the lifespan of rail running stock.

The situation gets even worse since European OEMs seem to have lost their edge in innovation. In the past, they set the standards in applying the most advanced technologies. It should have been a warning sign that they did not get the first plug-in hybrids on the market, and that they were generally a little late in embracing electrical vehicles. They developed excellent assistance systems; nevertheless, they were bypassed in automated driving by what they arrogantly called “non-cars”, developed by ICT companies. In the end, they were surprised by large sales of South

product/, forecast estimated based upon study “Global Europe 2050” (2012), scenario “Europe Under Threat” and
Korean “two litre cars” (with low energy consumption) everywhere in Europe. And they reacted with an even stronger focus on premium models and by supporting “Buy European” campaigns. As a result, France lost its automobile industry almost completely, trucks, busses and commercial vehicles are no longer manufactured in Italy or Spain, and Germany experienced, politely expressed, a massive consolidation.

The road into decline

It is difficult to trace back the reasons for decline, since there are so many. One might argue that after the financial crisis of 2008, Europe never again enjoyed its past economic vigour. Short-sighted macroeconomic measures dictated by creditor interests - obsessed with budget deficits, paranoia over inflation and an erosive sense of “economic justice” - lead to too much fiscal austerity and too little monetary stimulus to the economies, so that depression, like a virus, could spread from Europe’s southern economies throughout the continent. One might also stress the point that infrastructure investment was insufficient at least since the second decade of the century. One might indicate that this combined with outdated or inadequate business models within the transport industry (not of all sub-sectors, not of all companies of course) and with misguided innovations that resulted in over-engineering and a lack of export-oriented “frugal innovation” that could have addressed also the lower stratum of the domestic market. Some object that the White Book on Transportation of 2011 and its 2021 update in principle gave the right directions and that implementation only (!) failed due to insufficient political will and the economic slump. Others (mainly from outside Europe) blame the European citizens for “la malaise européen”: their nostalgic sentiments of times past, their fear of change, of disruptive innovations, their reluctance to take risks, their unwillingness to play the game according to global rules... As a point in case they mention the rather complete absence of venture capital, the lack of entrepreneurial spirit - and last but not least the ease with which local populations can be mobilized against nearly any infrastructure project. Even benevolent critics from outside regard Europe as the NIMBY continent, where the public sentiment is: “Not in my backyard” (or in case of fracking “Not under my backyard”). And one might add other unfriendly characterizations: Europe is a “Not invented here” and “No experiments, please” continent that follows a “Never change a running system” principle, even if the system is no longer running at all (as was the case with monetary policies). Reforms are understood as “the replacement of a situation with known disadvantages against a situation with unknown ones.”

In the dusk world of 2030, blame game is a common political sport in Europe, popular with left wing and right wing, centrist and extremist, pro-European and anti-European parties. Obviously, passing the buck to someone else is part of the problem. Anyway, Europe slipped in the last one or two decades into a kind of downward spiral with some grave vicious cycles, political and economic feedback-loops – and the transportation sector provided one or two additional loops. To give a sketchy outline of the main factors in these loops: less dynamic economy and more global competition – shrinking domestic markets – inadequate business models – less exports – worse trade balance – dwindling public budgets – less spending in infrastructure – higher transportation costs – less profits, diminished competitiveness – less expendable income, increasing income gap – loss of attractiveness for foreign capital – less GDP. It should be added that a climate of decline does not foster innovation. Reforms are needed, but societal consensus for reform is lost. The crisis provides a fertile ground for extremist movements and parties, decision making is hampered by clashes on goals, aims, principles, and strategies, sometimes by outright obstruction. Transportation is a telling example for clashes and obstruction. In some countries, “protest parties” – often with a distinct anti-Brussels, anti-establishment
or even anti-Western stance – have gained influence and taken hold of regional bodies. Some of them put a clear emphasis on local and regional transportation, which of course is not bad at all: More investments in public transportation, in trains, trams, buses, cycle paths and local roads. This, however, does not align with national policies. Most national governments still see their main task in maintaining infrastructure on the national level – to foster global competitiveness. In consequence, authorities on different levels fight for shrinking budgets and thus prevent spending even less of the money available. Central governments are blamed for acting in favour of “upper class mobility”; local authorities for parish-pump policies.

Awkward times for the transportation sector

Stagnating or shrinking transportation markets, declining public budgets, public hostility against large infrastructure investments, and a general reluctance with respect to innovations provide a grim business environment for the transportation sector.

First example: rail equipment. Looking at the sad state of the running stock, there is a real massive need in new engines and carriages, and in refurbishment of existing ones. But orders do not catch up with the situation; and frequently public authorities have to postpone their orders several times, which amounts to an additional risk for manufacturers. Naturally, they try to compensate for the lack of domestic purchases by expanding exportation. European markets, however, have shrunk below a certain critical volume, so that no room is left for testing new products there. Take as an example the EST, the “European smart train”. A consortium of European train makers developed, supported by the EU, a blueprint for a highly flexible, energy efficient commuter train with the most recent ICT – and the ability to run even on degraded tracks. However, EST never left the prototype stage. Without a sufficient number of orders, the consortium could not benefit from an economy of scales. In the end, a similar Brazilian train with a much lower price tag became a global success story – and is now procured by European rail operators. The former rail equipment companies, if they still exist, now focus on business in MRO (maintenance, repair, and overhaul) as was already the case by the end of last century in several countries, such as Portugal.

Second example: electrical vehicles. By 2015 nearly all European OEMs had e-cars on the market. As the rule, they used their traditional middle and premium class models as a platform, and – to put it simply – replaced the engine by an electrical motor and the tank by a battery. Battery prices, however, did not drop sufficiently and prevented average citizens to buy an e-car. Car makers sold enough cars to comply with European CO2 regulation (which was their primary aim), but the huge market explosion, some had predicted and hoped for, did not take place. At least not before 2020. After that date, a whole armada of different electrical vehicles invaded Europe: small and cheap e-Tatas from India, small high-tech three-wheelers from California, e-bikes and e-cycles of different origins and quite different designs, and – last but not least – battery or fuel-cell powered buses from Latin America. European car makers had put too much emphasis on their traditional models and neglected the diversity of the electrical vehicles ecosystem. Contrary to the general trend, European premium brands defended their territory, and customized e-bikes produced by small workshops found their niche – also in delivery services. But the backbone of middle-class car manufacturing with its broad scope of suppliers was broken. A wave of consolidation swept through the whole industry. Several supplies merged into small-scale monopolies, others reoriented towards 3D printing of household goods or other spheres of business, some left Central Europe for India.

Third example: air transportation. As in other industries, social polarization had a tremendous impact on airlines. Due to shrinking transcontinental outbound tourism, most airlines offered less long distance flights. In a way, they adapted to the market change by cuts and new
business models. Bitter jokes about the “wooden class” abounded: “With the standard tariff, you only get a standing ticket. Like luggage or a meal, the seat is an extra.” The large traditional airlines (the national flag carriers of long ago) focussed on business and economy flex classes – with high competition by airlines operating from outside Europe like Emirates, Qantas, Air China. Most of the European airlines reduced their networks to the most (i.e. only) profitable destinations from hub to hub.

Aircraft manufacturers are less hurt by the European economic decline. Airbus takes benefit from global growth and sells mostly to outside Europe, but competition e.g. by COMAC is getting more harsh from year to year. Suppliers are in a slightly better position. But throughout the industry, fears are rising, that the next round of global climate protection agreements will finally hit the air transportation sector. On other continents, companies are adjusting to the upcoming regulation. A US start-up has already announced the maiden flight of an all-electric wide-bodied aircraft, and a Chinese-Brazilian consortium is working on HIL – a “hydrogen intercontinental liner”. The European aircraft industry has nothing to counter. Radical, disruptive innovations are not in its portfolio, and it seems therefore questionable whether European aircraft manufacturers will survive. One may regard it as emblematic that Europeans only shook their heads when Virgin Galactic offered the first one-hour suborbital flights from the US to India.

**Hopes for change**

Even in the darkest situation, there is always a silver lining on the horizon. People react to hard times, they help each other, they invent, they find their way. In many regions, self-help, barter and exchange networks are flourishing. As a rule they rely on the web, on social media, on “deals for a deal” platforms. There is a vast variety of regional, or complementary, currencies. “Sharing economy”, crowd funding and open innovation are very popular in the younger urban population, urban gardening has become a large success and some dream already of a subsistence economy. Throughout the agglomerations, car sharing is on the way of becoming the standard model of car use.

The impact of all these small changes on the macroeconomic level, however, is negligible. They help to survive, and they are signs of a change of mentality, and that’s it. From a purely economic point of view, the devaluation of the Euro (and other European currencies) is much more important, since it increases global competitiveness. Premium car makers, again, are the first to benefit from it, followed by the tourist industry that can attract more Asian and Latin American travellers to old and – in the best case – romantically rotten Europe. In contrast, Europe does not (yet?) succeed in attracting many foreign investments. Political barriers against the alleged “sale of European assets” are high, and a deteriorated transportation infrastructure with many bottlenecks is not the best precondition for doing business.

**Conclusion: An Avoidable Crisis**

The European mobility crisis of 2030 has not come as a surprise. It is a result of well-established long-term trends, which could be observed for about two decades. Impacts of globalization combined with poor macroeconomic policies, and demographic change led to a slow decline of European competitiveness. But in the end, it is first of all a home grown crisis, due to myopic behaviour of political and economic actors based on a wait and see attitude and the reluctance to reform.

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3 COMAC – Commercial Aircraft Corporation of China Ltd.
**Side-Scenario “Dark” 2: Fractal Europe**

In 2030, experts in spatial planning and practitioners of logistics speak of a “fractal Europe”, implying that the old continent is not just divided or fragmented but has obtained a “fractal” structure in the mathematical sense with respect to accessibility and mobility. Just take a look with a satellite camera of nocturnal Europe. There are bright, maybe even brilliant spots, areas, and filaments: The hubs of commerce and transportation like Rotterdam, Hamburg, or, of secondary order, Genoa, San Sebastian, Barcelona, Rome, Copenhagen/Malmö, and on a smaller scale Constantia. There are large dense agglomerations like Greater London, Paris/Île de France, Bruxelles-agglo, parts of Baden-Württemberg, Bavaria and Switzerland. They are connected by corridors of activity along the Rhine and partly the Danube rivers, along some coastal lines, with some luminous “tributaries” (not necessarily rivers) and barely discernible ones of second and third order. Around them, there is an ocean of darkness with only some small spots of light – towns of some regional importance scattered as a sparse archipelago.

If you compare maps from 2000 or 2010 with the present view, the difference is quite striking: darkness has eaten into former bright areas, even into the so-called “Pentagon”, the area inside London – Hamburg – Munich – Milan – Paris. Only a thin skeleton is left of some places like Northern Italy or central Spain and most of the Balkans. Some call these thin lines of higher activity with reference to the former “Blue Banana” the “blue spaghettis”. Large parts of Eastern Europe and the Iberian Peninsula are entirely dark. As if they have fallen back into the Middle Ages…

Territorial planners describe the phenomenon as “corridorization” – with a strong juxta-position of well-connected centres vs. a vast, left-behind periphery. Due to the deterioration of transport infrastructures, differences in accessibility have increased throughout Europe: peripheral regions seem much further away than in former times. And they are in reality, if you measure distance not in kilometres but in travel times – resulting in a “Europe of two speeds” as many complain, and in a loss of mobility capital. You get from Lisbon to Paris, from Warsaw to Athens in two hours. It takes another two hours from the airport to a village close by, and a whole day to a town that happens to be “in the middle of nowhere”. Some expert notice that accessibility in terms of population has not worsened. You may still reach about two thirds of the European population within less than a day as at the turn of the century. But this is due to the fact that the population is much more concentrated in large cities and agglomerations than in the past. It does not matter whether a place where nobody lives is several hours or several days away.

Again, a vicious circle contributed to rural and regional exodus: ageing and shrinking population – contracting regional economy – fewer jobs, fewer opportunities in general – shrinking municipal and regional budgets – decline of health care – less investments in transportation infrastructure, smaller budgets for public transportation – increasing deficits for traffic operators, deterioration of services – yet more reasons to leave the region. In particular, well trained and more flexible younger people left villages and small towns. In consequence, local companies had more problems to find an adequate workforce, and local trade suffered from the exodus of purchasing power. The worst, however, was the impact on the mood: “We live – literally – in a dying region.”

There have always been tremendous socio-demographic and economic differences between regions. In former times, national governments and later the EU had tried to close these gaps. Since the late 1980s, the EU had put a strong emphasis on not just social but “territorial cohesion”. Huge investments in trans-European networks (TEN in the EU jargon) were aimed to support the Single Market and to guarantee the free movement within it of persons and goods and to foster economic growth and employment in an

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4 “Blue Banana” – another term for the European hothouse of productivity and commerce from Greater London via Paris, Benelux and the Rhine valley, via Switzerland to Milano.

5 Understood as the ability of citizens to travel according to their needs without restrictions.

enlarged Europe. TEN and subsequent similar investment schemes succeeded in better interconnecting national hubs and important regional nodes. With tighter budgets as well as on the national and on the European levels, the question whether there is sufficient return on investment became more pressing. Administrations still paid lip service to geographical coherence, but the need for the most efficient allocation of public funds led to focused spending on regions with a relatively well developed economy that could take most benefit from improved interconnectivity. Sometimes this was called the principle of “strengthening the strong”.

Critics of this policy soon objected that large trans-European networks amounted to “building pyramids” that drained resources from other fields. In their perspective, this policy was based on a misconception of territorial cohesion and forgot about inclusion and small-scale infrastructure. Not to speak of EU subsidies for motorways into nowhere or for regional airports that never had real air traffic…

In the long run, the large projects contributed to the “corridorization” of Europe, and one may even argue that it impeded economic development since it pushed people in the periphery out of the market.

In fact, people in the periphery have been increasingly “immobilized”: Public transportation is expensive and unreliable (if it is still offered at all) with time-tables full of gaps. Roads are in a really bad state of repair – you need not just a SUV, but a car with sufficient space between road and chassis! And even gasoline is more expensive here than within the urban centres. But without a job you need not go to work; living only on benefits, there is not much money left for shopping tours or holiday travels. You stay at home, you perhaps surf the web, try to find a “tele job”, and you are happy if you can cultivate a small garden… Isn’t this even better than to live in a city with all the expensive attractions around and without your own vegetables?

Thus, the fractal structure of accessibility maps into a fractal structure of individual mobility. One can easily distinguish different layers of mobility: rather “sessile” villagers and impoverished urbanites forced to self-organized slow mobility or even immobility, a population of commuters at the fringes of agglomerations with forced mobility who spend sometimes half a day in slow, congested trains and buses, professionals rushing from one client to the next, and a class of uprooted “global nomads”, managers and politicians that feel at home in a certain hotel chain and in the business lounge at airports.

In general, the fractal structure of transportation has two opposing impacts on the industry: On the one hand, there is more concentration within the corridors and in the equipment subsector. Most corridors are run by one service provider, which usually operates multimodal and combines road and rail services, in some cases also water transportation. On the other hand, there are highly specialized small companies which provide service to a municipality or a small region. As a rule, they are protected against take overs either by local (public) owners, by specific requirements issued by the local authority and/or insufficient profitability.
Side-Scenario “Dark” 3: Retreat of the State

As in the 1990’s, privatization becomes a catch-phrase in the transportation sector in the 2020’s. The reason is simple: The European economy stagnates; most national governments follow more or less strict austerity policies. National budgets are shrinking, and cuts affect almost all spheres. In most European countries, public authorities lack the money for maintenance and extension of transportation infrastructures. Economists calculate that hundreds of billions had to be spent solely to counteract the decay of bridges… The only way out seems to be to invite private money.

In 2025, the Federal Government of Germany sold – against opposition of the Berlin Senate – the Berlin Autobahn Ring to a private company. EuroRoads, a start-up from Sweden, acquired 196 km of highway in pressing need of repair for one symbolic Euro. By contract, the company promised not only to refurbish the road but to bring it to a “higher service level” and to restrict road user charges to less than 0,15 €/km.

EuroRoads invested a lot, not only in concrete but also in ICT, allowing C2I communication. Vehicles with a C2I interface obtained a 20% charge reduction. With this offer, EuroRoads aimed to increase road capacity and to reduce the number of accidents. Due to the large share of ten to twenty year old, not connected cars, EuroRoads could, how-ever, not guarantee “no accidents anymore”, as promised in some ads. After all, drivers who paid for the route depending on insurance premiums got a respectable reduction from their insurers. Carmakers hoped that these bargains would give a boost to their new models. They ran advertising campaigns to convince car owners that money spent in C2I and other devices for semiautonomous driving would pay off in terms of TCO. These campaigns had some effect for the upper middle class, but not for the average car owner.

In the meantime, EuroRoads extended its sphere of operations and bought at bargain prices some motorways in Germany, some in Slovakia, some connecting Greece and Bulgaria and finally several hundreds of km in Poland. The basic idea, however, to connect all these pieces into a EuroRoads network from the Baltic to the Mediterranean did not pan out. Other private motorway operators rushed in and seized the best pieces. For a short period, governmental auctions of highways – like 25 years ago of cell phone frequencies – became a kind of fashion, especially in regions with high population density and high commercial activity. The periphery had to live with degraded public infrastructures as before. ICT companies like Google also displayed growing interest in European traffic systems. They already offered traffic information and road traffic management systems based upon big data from connected vehicles. These systems – some of them rather traditional mobile apps – became more important with more frequent congestions, roadblocks, de-lays and cancellations. ICT companies also tried to engage as service providers in operations. The first Google Buses, however, were rejected by citizens. It was the beginning of campaigns against an alleged “sell-out of Europe” led by some NGOs and left- and right-wing parties. Companies with a European image – not necessarily owned by European shareholders! – had more success. Ryanbus got a certain hold in medium distance and local services, followed by easyBus. It was not by chance that airlines tried to get into the “ground business”: They intended to compensate for stagnant passenger numbers and dwindling profits. Ironically, in some cases, Ryanair and Ryanbus competed on the same relation for the same passengers!

Other companies combined different modes of transportation. Flextram developed an urban tram system for rail and road use. MLCS, Metrolink Corridor Solutions, operated with buses and trains. In many places, municipal authorities tried to get rid of local infrastructure and local service providers with high running deficits. Few succeeded. Some met strong opposition from the local population. Some cities first invested and then sold.

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7 C2I – car to infrastructure, in difference to C2C (car to car communication).
8 TCO – total cost of ownership.

The chosen model of infrastructure market design leads to more competition but has nothing to offer for the periphery.

Private investors engage in innovation and high tech services.

New entrants come from outside the transportation sector and from outside Europe.

After the hype, privatization gets stuck.
Others never found an “investor”. All these new public transport companies were supervised by network agencies at the European and national levels. They had the task to prevent monopolies and to regulate tariff levels like in the case of mobile communications. It was their responsibility that even after the wave of privatization, competition never was as free as most investors had dreamt. Consequently, shortly after the hype, investments started to fall. In the end, privatization increased polarization. In agglomerations and important transportation corridors, private companies invested in infrastructure and in services with a good to high standard at well calculated prices for their clients. In the province, authorities maintained public services of very low quality and mostly moderate prices – and public infrastructure in rack and ruins. For a certain period, rail equipment and car manufacturers had hoped for larger domestic sales. One or two years of a small “privatization boom” were followed by depression. In 2030, Tata bought the remainders of Fiat “to keep the brand alive”. Chinese state and pension funds looked for opportunities in Europe. As in the case of “land grabbing” in agricultural regions, they engaged in “infrastructure grabbing”, no matter if it was water, energy or transportation. It was “privatization with a Chinese face” as some blogs wrote. Finally, an Indian fund purchased Citroen after it had been “prettified” with governmental money. Employees, who first protested, adapted to the situation: “Better to work for the Asians than not at all.” Contrary to promises, profits were not reinvested in France. After years of fast expansion, EuroRoads ran into trouble, too. Its network was never really integrated, neither technically nor organizationally. On many relations, traffic volume continued to shrink. EuroRoads first sold its “Habsburg” part, connecting Slovenia with Slovakia. A short time later, it was taken over by a Latin-American hedge fund. In the end, the European transport industry is no longer European.
Bright SCENARIO: An Optimistic Vision

The Scenario in a Nutshell

In 2050 the European transport industry has successfully learnt the lesson from the “End of Mobility” by having established a functioning paradigm of (socially and environmentally) sustainable mobility, represented in the term of the “New Normal”. The consolidation of 2030 mobility attitudes as well as political decision-making not only reflect a full awareness of facing the dusk of the fossil fuel era, but, broadly, they reflect the arrival at a new sense of mobility. Due to long-lasting political and energy constraints, Europe has finally conceived how to cope with problematic frame conditions through cutting-edge policies and highly adaptive business models as well as with better fitting technological devices.

While around the same time the previously booming emerging countries are starting to face similar constraints as experienced by Europe in 2030, the European transport sector appears to have gained a competitive advantage in having dealt longer than others with the problems of resource scarcity, declining public investment, or ageing population. The European transport industries, having successfully found innovative and service-driven business models, sensibly addresses the dominating framework conditions such as shared economy or decreasing mobility, are able to provide well-proven equipment and service solutions to other parts of the world. This long-lasting experience of finding the right business models (e.g. selling services not only products, overcrossing transport modes, carefully listening to the customers), which turned out to be more important than high-tech solutions, in 2050 becomes Europe’s precondition for showing the best position to fill the expectations of the emerging world’s adjusting sustainable mobility paradigm. Therefore, intelligent ICT networks will not become an end in itself, but will unleash, support and simplify Europe’s transport solutions. Hence, Europe is again able to position itself as the world leader, combining a creative and innovative mind-set with tailored technological solutions and adaptive business awareness balanced by appropriate supra-national EU intervention.

Consequently, Europe in 2050, having learnt how to deal with the previous depression and having created a strong service-oriented transport landscape, has become the world’s new benchmark for sustainable transport.
Main Bright Scenario: Towards Pragmatic Mobility

Mobility without much ado

In the middle of the century, mobility has been deeply transformed. But its most striking quality cannot be seen: It is the absence of noise. In former times, traffic meant the droning sound of internal combustion engines, the screeching of brakes and tires, the thundering of passing trains. In 2050, European cities are not exactly silent, human activities always are accompanied by a lot of sounds, but cities are much quieter than one or two decades ago. Vehicles – cars of most different designs, bikes and other two- or three-wheelers, buses, just everything – run on electricity. The loudest noises are produced by tires and by the airstream. For the Europeans of 2050, noise is a sign of inefficiency: useful energy is transformed into vibrations of the air.

Earlier in the century, people dwelling close to an airport suffered from unbearable noise. Since planes are now powered by electricity or hydrogen, they take off and touch down much quieter. Trains are running softer too – with improved anti-loudness under-carriages and tracks in perfect condition. Except, of course, high speed trains. These descendants of the Spanish AVE, the French TGV, and the German ICE can be heard from the distance when they hurry from Athens to Stockholm or from Lisbon to Riga.

Despite traffic volume – as well in person-km and ton-km – having grown again after stagnation in the late 2020’s and 2030’s, congestions have been decisively reduced, even in Greater London or the Vienna-Bratislava agglomeration. This is partly due to a massive change in the modal split: About half of road freight transportation has been shifted to rail and waterways. Traffic management has improved with C2C and C2I communication. In public transportation, efficiency has also grown because of increased attractiveness – trains, buses or trams are not overcrowded but have on average very good occupancy rates. ICT also enables traffic management on an individual level: You can, e. g., call a bus, but it is put on the line only if predicted occupancy surpasses a certain threshold. Otherwise you are served with a taxi. And in freight traffic, empty trips are largely avoided and delivery services, wherever possible, bundled. Last but not least, deadly traffic accidents have become – thanks to ICT and artificial intelligence, assistance systems and semiautonomous vehicles – almost one of the horrors of the past.

A Chinese or Indian tourist travelling Europe may wonder about many aspects of traffic. One surely is that there are much less restrictions, limits and prohibitions than in the megalopolis he or she comes from. China, most prominently, has restricted individual transportation for almost all large cities. Signs like “no cars allowed” or “no fossils” are absent in Europe. Astonishingly, old vehicles seem to be extinct, and no avenue, no highway is stuck with individual cars. As in former times, Germany has a few speed limits on its motorways. But traffic runs smoothly, without congestions, without much lane hopping and – nearly – without any “hot rodder”. Perhaps someone explains to the Chinese or Indian tourist that the average velocity is therefore even slightly higher than twenty or thirty years ago. Speed is no longer an obsession, neither for the individual nor for the logistic company. To be first is no longer the most important thing, but to be at the right time at the right place.

A very sharp Indian or Chinese observer might perhaps notice that there is much more courtesy on the road and in trains. You give way when lanes merge. And if a suburban train is crowded, which rarely happens, young people tend to offer their seats to the elderly. Social researchers interpret this in psychological terms. Traffic has lost some of its “stressors”, it has become almost a relaxing activity: No need to hurry up, no fight for parking or a seat, no bumpy roads and bottlenecks, no fear of delays and cancellations, less

Environmental impacts of traffic have been decisively reduced.

Anticipatory policy making, regulation for the benefit of sustainability and farsighted planning have fostered innovation in the transportation sector.

Traffic stress has subjective reasons.

9 Changing the modal split of freight transportation and zero traffic accidents belong to the goals formulated for 2050 in the White Book on Transportation of 2011. In general, this scenario is partly inspired by the White Book.
The Chinese or Indian tourist who visits Europe surely sometimes wonders why Europeans do not really appreciate how smoothly and quietly they travel every day. Obviously, this has become the new normal condition, nothing worth considering. Mobility is something ordinary, a simple, unfailling, reliable and therefore pleasurable commodity for everybody. You need not make much ado about it.

**The road from 2030 to 2050**

Looking two or three decades back, traffic was really in a terrible mess. Rail and road infrastructure was in a deplorable state, it had for many years lacked sufficient investments in maintenance and repair. Trains and buses were overcrowded and frequently in delay, if not cancelled. The gap between regions well connected with the global economy, e.g. within the “Blue Banana”, and peripheral regions like Macedonia or Sicily increased from year to year. Car making was in decline, with the exception of premium vehicles; rail equipment manufacturing seemed already an industry of the past. In most countries, voters strongly pressed for more and better jobs, better opportunities for elderly citizens – and a better quality of public transportation.

External factors contributed to the general awareness of crisis: Climate change had become a dire reality for a large part of humankind with dramatic floodings and extreme weather conditions. Europe suffered from long droughts and series of severe tornados. Decisive measures were needed, adaptation as well as mitigation. Phasing out of fossil fuels and energy efficiency climbed to the top of the global political agenda. China was experiencing the end of its economic miracle; the centres of growth were shifting again around the globe, to Latin America and to Africa. The picture would not be complete without technology. ICT passed the baton on to nano- and biotechnologies. New materials combined with artificial intelligence – some already called it “smart matter”. Eco-efficiency became a generally accepted principle of design. Additive manufacturing replaced in many cases processes that went back as far as to the second industrial age. Whole industries were transformed again.

Throughout Europe the awareness increased that change was imminent, that radical reforms were needed in many fields, and that muddling through as in former crises would not help anymore. Too often, politicians had only reacted when a situation turned into urgency – and this meant: too late. Public opinion now required that politics should pro-actively direct the development, i.e. act with foresight. The term “anticipatory governance”\(^\text{10}\), albeit already twenty years old, was applied to this new approach of policy making (that in fact was not completely new). Anticipatory governance included structures and facilities that allowed politicians and public servants to learn from past crises and present predicaments, to quickly adapt to new trends and demands, and to assess long-term impacts of policies in advance.

Such a deep reorientation of policy making implied – and was based upon – a profound cultural change, a real turn of the tide in moods and in political philosophy. Policy makers had to move beyond thinking (and acting) in isolated issues – energy, transportation, environment, competition – towards a new sense of integrated anticipatory planning. The old “silos” in the minds and in organisational structures had to be torn down. Naturally, broad participation of citizens was a central piece of this process. Only the support from the population allowed shifting the allocation of public funds from consumption to investment: in education, innovation and infrastructure. The deplorable – if not disastrous! – state of rail and road infrastructures also presented an opportunity: the prospect to overhaul it with the most advanced and most suitable technologies, which meant a case-dependent balancing between high-tech and low-tech implementations. As well as on the European and the national levels, emphasis was put not on “lighthouse” projects but on down to Earth projects with perhaps less visibility but more effectiveness, e.g. in less...

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favoured cities and regions. Cooperation of all kinds was encouraged. A minor, but telling example is that freight and delivery services into cities were frequently bundled across competing service providers according to the principle of “one LDV for one street”.

Of course, the new policies met many setbacks and roadblocks, in particular from parts of the finance sector that was forced to invest more in the real, productive industry than in innovative financial products. Departmental interests survived the first round of reforms; they were overcome only by joint pressure from the population and from the top political personnel. In contrast to earlier reforms that had also promised to dismantle bureaucracy, the regulation density was this time really cut back.

**Transformation of the transportation sector**

During the 2030’s and 2040’s, the European transport sector was deeply restructured. It had, in fact, to reinvent itself for the sake of its very survival. Business models dating back to the 20th century – higher volume of sales, more clients, more power, more speed – no longer worked for the entire transport industry. New diverse business models had to address the needs of the European population, the demands of the economy, the state of the infrastructure, and the requirements of climate change and resource depletion.

Rail equipment manufactures may serve as an instance. They suffered on the one hand from the collapse of the train and carriages market throughout Europe in the early 2030’s due to lack of orders from near-insolvent operators and tight public budgets and on the other hand from increasing global competition. After a period of “market consolidations” with a huge loss of jobs, the surviving companies reacted with two different, often combined strategies. Some specialised in MRO – maintenance, repair, and overhaul – and after some years of struggling became champions in upgrading tracks and carriages in Europe and on other continents. Others companies still manufactured trains, but they did no longer sell them and instead offered them to lease. These companies guaranteed their clients a constant high quality of the train fleet with regular exchange of existing running stock by new models or completely overhauled and refurbished trains. They put their claim into a nostalgic slogan: “Replacing wheels – for an engine running at full steam.”

Higher customer satisfaction was one important effect; the other a constant improvement of energy efficiency (or, more comprehensively eco-efficiency) as required by the European authorities. High innovation dynamics of European companies also increased their competitiveness on the global market. It was therefore no surprise when in 2038 a European manufacturer was the first one to sell 1LT regional trains to Latin America. The limitations of the European domestic market that only two decades ago had posed a serious disadvantage had been overcome.

In 2030, carmakers were in a slightly better situation than the rail equipment manufacturers since premium cars – of established European brands! – had a still expanding global market. It could, however, already be seen, that the global “car peak” would be reached at some time in the middle of the century, even in countries like China, Indonesia or Angola. Besides that, an ageing population and the transition of the energy system required a deep change in the philosophy of the OEMs: in the design of vehicles, in business models and even advertising. These challenges also had their upsides. The phasing out of fossil fuels allowed putting one new generation of electrical vehicles after the other on the market. Ageing populations – almost everywhere in the world! – could be addressed in particular with assistance systems. Following the dynamics of ICT and nanotechnologies, these systems were constantly improved at diminishing prices. In 2050, even low cost LDV and trucks are equipped with high grade safety and efficiency systems.

Already since some time, car ownership as such has become an out-dated role model. Mobility is the aim, not the possession of vehicles. The behavioural shift began decades ago when younger people no longer regarded it as a

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11 1LT is an abbreviation of “one litre train”, meaning that the train needs in average only the equivalent of 1 litre of Diesel for 100 person-km (by occupation rate of 70% and on a reference relation). Ironically, the 1LT trains (as all trains in Europe) run on electricity...
necessity to obtain a driver’s license – except for “fun and experience driving”… Because most people and institutions preferred leasing or renting vehicles to owning them, OEMs engaged in car leasing, renting, in supporting car pools and sharing networks, and in mobility services of all kinds. Sharing has in the meantime become so commonplace that real individualists are returning to the old concept of car ownership, but of course with very special vehicles, either true vintage cars or pimped-up high-tech vehicles that express their individuality. The shift from manufacturing transport equipment to mobility services had, however, an adverse macroeconomic effect: equipment can be exported, services in general not. Job losses in manufacturing were partly compensated by the creation of jobs in other industries (in particular around energy efficiency and “vehicle intelligence”). Moreover, some services – and business models for services – proved to be major export generators. Several European companies now offer training in various mobility services to the rest of the world; other companies provide ICT-based remote services like software updates for autonomous vehicles, remote monitoring and maintenance… European MRO companies operate from Bagdad to Shanghai and from Cairo to Cape Town. As a final example, air transportation changed tremendously during this period. After a long period of rather constant growth, global markets showed the first signs of stagnation in the 2030’s. With rising oil prices, kerosene prices went up. Governments were less willing to give subsidies to an air transportation industry based on fossil fuels. As rail services improved throughout Europe, more and more airlines stopped serving short haul trips up to 400… 500 km. Several airports of only regional importance were abandoned – some transformed into business parks or logistics centres. The most disruptive change, however, was the transition to electricity and hydrogen and partly to biologically produced synfuel. During the 2030’s, Airbus went through a very difficult time of restructuring that left its mark also on its suppliers. (Its competitors Boing and COMAC were not much better off.) Startups in the US and China announced to manufacture completely new types of aircrafts. Fears run high that – worse than in the case of electrical vehicles – the traditional large manufacturers would be overtaken by small innovative companies, “the Teslas of the Air”. Airlines started to cancel orders of fossil fuel driven aircrafts, the big ABC12 slipped deeply into the red. As in former crises, innovation was the way out, and the climate for innovations was favorable in Europe. The diversity of the European air industry, multiple clusters of highly competitive suppliers, helped a lot, especially in competition with China. Additionally, European regulations forced airlines to quickly modernize their fleets. A whole new generation of planes was needed. High innovation dynamics in many fields contributed to the transition: ICT, energy technologies, material sciences ...13

Conclusion: Mobil, but not in a hurry

When change is rapid, you can lose territory in a moment – but you also can regain territory in a rush if you are agile and inventive, if you follow the right concepts, and if you have the best fitting policies and business models. In the long run, harsh challenges may turn into opportunities. Europe was among the first global region that had to cope with an ageing and shrinking population. Contrary to expectations, ageing and shrinking provided a stimulus for better involving all parts of the population. Europe was among the first who experienced the depletion of fossil fuels and who engaged against climate change. Contrary to fears, risk awareness and precautionary measures did not stifle innovation, but instead encouraged it and helped to restructure whole industries for the 21st century. Perhaps most importantly, Europe was the first continent that reinvented itself on a supranational level and reached a new stage of cooperation. In the middle of the century, Europe has – again – managed to offer beneficial conditions for a vibrant transport industry such as skilled labor, good infrastructure and political stability. Instead of competing only

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12 Airbus, Boeing, COMAC – Commercial Aircraft Corporation of China Ltd.
13 E.g. intelligent coatings and adhesives with self-repair mechanisms, carbon nano-tubes for improved electrical, mechanical and thermal properties, metal-ceramic nano-structured bulk composites and many others.
technologically, Europe in 2050 has developed a genuine “social competitiveness”, including a change of the whole framework in which mobility takes place from efficient planning and intelligent policy making to more pragmatic, more “mature” mobility behaviors. In the late 2020’s and the 2030’s, social coherence was nearly forgotten. But now, Europe has found a new social consensus. Energy and resource efficiency is at the top of the agenda. Sustainability, once thought to be a constraint (or an empty political catch-phrase), has become an opportunity for the European industry – far beyond the transportation sector. It induces cost advantages as well as huge environmental improvements. “Invented in Europe” is a good selling proposition. Focusing on providing services instead of selling products, Europe has – again – become a prime mover and pioneering driver of innovation and growth in the global transport sector. For the Chinese or Indian tourist, it is an interesting and reliable place in a messy world – contrary to many Europeans who regard it perhaps as a little boring.
Traditionally, the transportation sector is characterized by high innovation dynamics. In the middle of the 21st century, new technologies—and improved existing ones—nurture the transition to a highly efficient pragmatic mobility. The scope of these developments is large. It starts with ICT for C2C and C2I communication and nanotechnologies for sensors and actuators (integrated in assistance systems), and with new composites for lightweight construction; it includes surface technologies (partly with nano-structures) for reduced friction of vehicle exteriors and new lighting technologies (like OLEDs) that bring more comfort and security to vehicle interiors. New energy technologies form the center piece of the evolution of traffic systems: smaller and more powerful batteries with longer life cycles, improved fuel cells and new ways to store hydrogen, better and smaller motors and generators, more efficient ways to produce biofuels. Seen from 2050, the 2040’s were a decade of experimentation: Inexpensive and robust photovoltaic foils allowed the installation of “solar highways”. In some places, where a refurbishment of road infrastructure was necessary anyway, old noise barriers were fitted with PV. AirDelivery, a daughter of several CEP companies, inaugurated—in rural areas of Poland and Spain—the first drone delivery services—and inspired jokes: “They went a little bit late into the air business: Exactly, when there was no longer any risk that they get orders from these (depopulated) regions.” A European consortium of research institutes developed artificial muscles that work under “real world” conditions. Thought to revolutionize robotics, citizen scientists invented wheelchairs and rollators with “artificial feet” for rough and difficult terrain. Artificial muscles also found their way into cars, trains and airplanes: not as engines providing the thrust but as actuators that make the whole body of a vehicle flexible.

Different regions engaged in different directions. Whereas in Europe efficiency and safety counted as the most important principles, and even “slowness” had become a lucrative niche for some companies, developers in the US still followed a high-speed paradigm. Here, the 2040’s produced yet another wave of flying cars, quite different models, some of them designed according to the principle of gyroplanes. They were supposed to alleviate traffic problems of cities. Ironically, the decisive show stopper was the lack of parking or landing space, especially where flying cars were most needed: in large cities. Virgin Galactic offered regular one hour intercontinental suborbital flights from the US to destinations to Australia, South Africa, India and China. The price for a ticket, however, was prohibitive even for most business travellers—which provoked some media to draw parallels to the limited economic success of the supersonic passenger airliner Concorde in the late 1970’s.... Elon Musk finally inaugurated his Hyperloop tube transport line in California. Commercially, the Europeans usually took the safe side; Americans engaged in risky business and hoped for a “killer app”.

After a long period of gestation, artificial intelligence of the second and third generation invaded and transformed vehicles as well as infrastructures. Big data allowed a far more efficient traffic management, but problems related to security and privacy had to be solved before it realized its full potential. In about 2040, autonomous driving became something normal. Logistic service providers reduced costs by running trucks without drivers. Of course, there were difficulties at the beginning. Truckers protested and blocked highways in France and Germany. For a period, “remote truck-jacking” seemed to undermine the whole philosophy of the driverless truck, since some logistic companies hired “accompanying personnel” or invited travellers with the same destination to sit in the empty cabin and guard the truck for a small while. Different regions engaged in different directions. Whereas in Europe efficiency and safety counted as the most important principles, and even “slowness” had become a lucrative niche for some companies, developers in the US still followed a high-speed paradigm. Here, the 2040’s produced yet another wave of flying cars, quite different models, some of them designed according to the principle of gyroplanes. They were supposed to alleviate traffic problems of cities. Ironically, the decisive show stopper was the lack of parking or landing space, especially where flying cars were most needed: in large cities. Virgin Galactic offered regular one hour intercontinental suborbital flights from the US to destinations to Australia, South Africa, India and China. The price for a ticket, however, was prohibitive even for most business travellers—which provoked some media to draw parallels to the limited economic success of the supersonic passenger airliner Concorde in the late 1970’s.... Elon Musk finally inaugurated his Hyperloop tube transport line in California. Commercially, the Europeans usually took the safe side; Americans engaged in risky business and hoped for a “killer app”.

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14 After decades of disappointments, biofuels from algae have finally reached competitiveness.
15 Courier, Express, Parcel.
16 Abduction of vehicles by taking remotely control of their systems.
remuneration! After these initial problems were overcome, insurance premiums decreased and service quality – measured in timeliness and safety – increased. As a next step, buses, taxis and shared cars without drivers showed up in some European cities and regions. Other cities lagged behind, since many people still feared that “robot-cars” could run wild or that terrorists could use them as weapons. However, especially in rural areas car owners frequently abstained from driving “by hand” after an evening in a restaurant. Soon a big car maker built an advertisement campaign on the slogan “My car takes me safely home.” Driverless cars, however, were not the perfect selling proposition. The younger generation understood that if you do not need to drive, you also do not need to get a license, and in the end you do not need to own a car anymore. You just call one and tell it where you want to go. That’s it. No need to take the burden of ownership on your shoulders. For European carmakers this change of attitude was an additional reason to reorient their business models towards mobility services. Driving, again, becomes something for the sporting person, a kind of pastime or extravagant hobby. Owning a traditional car – with all these insurances and taxes! – is a kind of luxury like keeping a horse decades ago. Once a year car owners from all over Europe assemble for a large “Moto Festival” at Caen or at the renovated Nürburgring or at Milano and display their vintage vehicles; even “fossils”, “stinkers” or “Benzinkutschen” are allowed to the festival. Their owners are proud eccentrics, not necessarily rich, and they feel like the first motorists 150 years ago. Efficiency based on best available new and best suitable “old” technologies, the huge investments in smart infrastructures, and high quality of transportation have its price. Of course, no one expects that average citizens can afford a trip on a Virgin Cosmo Liner to Australia. But travelling with one of the new electrical or hydrogen airplanes is expensive, too – about as expensive as in the last stage of “fossil flights”; when prices doubled and tripled within a year. Only well-off tourists travel to other continents. European airlines had to adapt to the split market with a reduced number of (mostly business class) intercontinental flights, a reduced number of domestic flights and a constant high volume of flights to destinations within Europe or neighboring regions. Regional differences within Europe are still important. It is technically no problem to call a driverless cab or minibus in peripheral regions like Pomerania or Transylvania where no public transportation is available anymore, since several ITPs (individual transport providers) claim 100% coverage of Europe. – But you have to pay perhaps five times the average city rate. Well, if you are happy they may send you an American fly car without surplus charge, simply to meet their PR claim: “Any place, any time – in a moment at your service…”

17 Special terms for non-autonomous vehicles emerged: „hand-driven car“, „person-driven car“, or – in official parlance – „manually operated vehicle“ (MOV).
Side-Scenario Bright 3: Mobility Redefined – by the Triumph of Patience

For almost four centuries, acceleration was the shibboleth of progress. Life was a race, and, as the Red Queen told Alice: “It takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!” Companies aimed to be first on a new market or to get the first mover advantage with a new technology, whole countries tried to outpace their competitors (as in the “space race” of the 1960’s), individuals strived to get on a fast track career.

Gradually, during the first decades of the 21st century, the perception of time changed. With each new generation, with increasing work intensity and pervasive online media, work life balancing gained more and more relevance. People wanted to have more “quality time” not just more efficient time management. Sabbaticals and pilgrimages became a fashion – quite contrary to the obligation to be always within reach and contactable. Most people understood in a rather intuitive way that fragmentation of time, shorter time horizons and, consequently, myopic planning horizons were contrary to an abundant and meaningful life for the individual and to sustainability on the societal level.

The mobility crisis of the 2030’s gave a lot of backing to the tide change. With each new generation, with increasing work intensity and pervasive online media, work life balancing gained more and more relevance. People wanted to have more “quality time” not just more efficient time management. Sabbaticals and pilgrimages became a fashion – quite contrary to the obligation to be always within reach and contactable. Most people understood in a rather intuitive way that fragmentation of time, shorter time horizons and, consequently, myopic planning horizons were contrary to an abundant and meaningful life for the individual and to sustainability on the societal level.

The end of the “acceleration paradigm”: Time appeared (like territory) at the top of the political agenda.

Mobility had to recombine with individual freedom.

Not so much the individual, the social perception of time has changed.

Time has become a dimension of territorial (regional and urban) planning.

For the average citizen, it is the transition – as a slogan puts it – “From stop-and-go life to easy going life”. You need not hurry to get to your goal. People now are as aware of their time budgets as of their money budgets, but they consider also the energy costs and the impact on the environment. In total, they travel less and they travel slower. They prefer a walk, or the bike, or public transportation. Of course, there are still some frantic people “who chase their own tails”. The majority is inclined to attest them a minor psychological disturbance – something like in former times ADHS.

Travelling time, mostly, is seen as a time of relaxation, where you talk to your companions or read something. You may also engage in some piece of work; comfortable means of public transportation facilitate this too. Since the shift has come from the population, European governments could abstain to implement regulations going beyond already existing emission laws or zoning rules. Urban and territorial planning puts the emphasis not on new expensive high-speed infrastructure (except for some inter-urban core arterials), but the improvement of existing systems and in general on a good mixture of living, working and leisure and on high quality public spaces. Sharing is widespread, of cars and other goods but also of time. You give a helping hand to your neighbor. Priority is put on community, not on money. For people
from other continents some of the new rules may sound rather paradoxical: Sharing companies pay you a bonus if you park your car closer to the inner city, closer to possible demand, but most people regard it as natural to meet the next user halfway. In long distance trains, there are no longer any reimbursements for delays – perhaps sometime a company will even start to collect a voluntary premium for the extended use of the amenities of the train?

On the whole, public transportation has absorbed huge investments. Rail equipment manufacturers and service operators have benefited from the complete overhaul of the systems since the 2030’s. Of course, logistic companies still follow the principle of “just in time”, but timeliness does not imply the need to move as fast as you can. Quite on the contrary: Freight transportation proceeds much smoother and with less hustle and bustle. It is more efficient, consumes less energy, and it is much more reliable – making it more valuable for the clients.

A perfect case in point is the Euro-Asian rail freight transport corridors. Since the 2040’s, rail freight between Western Europe and China’s East coast has taken large shares from previously dominating air and sea transport. Because of their extraordinary length and rather low velocity, the media like to call the trains running on the “Iron Silk Road” “snake trains” (or in Chinese: “long dragon trains”). Due to their moderate speed, energy consumption is much lower than even in ocean freight which gives them a decisive cost advantage. Not being subject to weather conditions, they are as well absolutely reliable.

Car makers belong to the losers of the changed mobility behavior. Almost nobody in Europe is willing to pay a premium on powerful engines that allow driving at 200 km/h. Assistance systems and first models of driverless cars, however, are welcome – every-thing that makes travelling easier and simpler. Airlines and plane manufacturers are the biggest losers of this development. Most people book a flight only in case of emergency; even business people prefer either going by train (which is much more comfortable anyway) or teleconferencing. Perhaps the most striking aspect is that thin order books impede innovation. Airplane makers have repeatedly postponed the inauguration of the new “post-fossil” generation of electrical and hydrogen planes and by doing so manoeuvred even deeper into the dead-end.

Since other continents are lagging behind in terms of the behavioral shift and still follow the acceleration paradigm, European premium car makers and airplane manufacturers have either left Europe and shifted headquarters and assembly lines to Asia or Latin America or Africa – or they have been completely wiped out from the market by their competitors. The loss of jobs in these sectors is more than compensated by a surge in other sectors of the transportation industry. European rail equipment, bus and tram manufacturers and OEMs of micro-vehicles (e-bikes etc.) are in a dominant position on the global market. European mobility services are copied in many countries, giving European companies an opportunity to establish training centers, to export vehicles and other equipment. Europe is providing a new, more sustainable and more pleasant model of mobility to the world.
### RACE2050: General Information

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<td>Responsible innovation Agenda for Competitive European transport industries up to 2050</td>
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### RACE2050 consortium partners are:

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The Transport Synopsis Tool: an outlook to 2050 key factors for competitiveness

One of RACE2050’s key ideas was not just to add another foresight study to an already extensive library of future studies in the transport field, but to integrate and visualize the tremendous foresight intelligence in a comparative synopsis with the aim of identifying and comparing the many different assessments and estimations about the key factors that are assumed to shape the future competitiveness of the transport industry.

Therefore, RACE2050 developed the Transport Synopsis Tool, a free online platform that for the first time enables industry stakeholders, policy makers and the wider public to access a comparative analysis of a magnitude of almost 100 future studies concerning the European transport industry. Based on an extensive review of these studies, the RACE2050 project team evaluated the study’s assessments regarding their assumed relative importance of a range of 15 predefined competitiveness parameters. The review of such pertinent transport future studies and future industry scenarios comprised the investigation of seven primary and eight secondary parameters that could be evaluated on a scale from 1 (“Extremely relevant” issue for the industry and/or the market, positively or negatively”) to 4 (“Competitiveness factor was not mentioned at all”). These parameters are not chosen randomly, but are based on RACE2050’s enduring substruction of the most crucial competitiveness parameters out of dozens of future studies as well as on the World Economic Forum’s (WEF) global competitiveness reports. These assessments fed a database that finally formed the core of the Transport Synopsis Tool and enables serious, informative and playful interaction.

With the aid of clear visualizations and individual search options, dozens of otherwise isolated future studies and scenarios from 11 industry segments are integrated into a comparative tool, facilitating the identification of key success factors for a sustainable growth of the European transport industries, which can increase its strength in a long perspective up to 2050. Visualizations of reviews are offered either in a “Radar” or a “Bar Chart” modus.
As this tool is not only intended to illustrate (contradictory) paths for future growth of the sector, the Transport Synopsis Tool is also developed to grow itself. Designed with the idea of an open network character, the tool strongly encourages the possibility to add new reviews of fresh future studies or scenarios to the platform in order to let it grow gradually.

The Transport Synopsis Tool aims at both informing the transport industry community by highlighting key factors for competitiveness as well as to facilitate the discussion among experts from transport industry, research, policy and foresight experts. In this vein, this tool, which was for the first time presented to the public at the InnoTrans trade fair Berlin in September 2014, will persist as a legacy well after the end of this project, and, beyond that, is developed to implement continuous extensions and amendments to let it become one of the leading European future platforms in the transport realm.

http://www.transport-synopsis.eu
Deliverables list

- D2.1 - Report on transport foresights since the 1960s: strategic warnings, visions and outlines, edited by Robin Kellermann
- D3.1 - Report: European transport related policies, edited by Johanna Ludvigsen
- D3.2 - Input for the EU-transport policies up to 2030 and 2050, edited by Johanna Ludvigsen
- D4.2 - Report on Equipment and Services until 2030 and beyond, edited by Massimo Moraglio
- D5.1 - Report on current transportation demand and global trade outlook, edited by Miguel Sena e Silva
- D5.2 - Report on current and possible trends on Global demand for means and services, edited by Miguel Sena e Silva
- D5.3 - Report on the predicted development of transport demand, edited by Miguel Sena e Silva
- D6.1 - Report on the synopsis on the current framework conditions, edited by Merja Hoppe
- D6.2 - Report on Wild Cards and Weak Signals in the transport field, edited by Aharon Hauptman
- D6.3 - Report on Sustainable transport and the role of energy issues: expected challenges, edited by Merja Hoppe
- D7.1 - Report: Synopsis of the current scenarios on the EU transport industry, edited by Tom Ritchey
- D7.2 - Report: European transport industry, competitiveness scenario for 2030 and 2050 (forthcoming), edited by Tom Ritchey

All the deliverables are available at www.race2050.org
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Dr. Massimo Moraglio (Project coordinator)

Suggestion for reference:
Between dark scenarios and a bright future. Aiming for a 2050 Sustainable and Competitive European Transport Industry, RACE2050 project funded by EC, TUB, Berlin, 2015
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