Reinventing Mobility

14 Theses on Mobility Policy

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We are at the end of mobility as we know it. Fossil fuel based travel and transport constitute an historical epoch that is now coming to an end. Moreover, the cultural model combining mass car ownership and suburban lifestyle are at an impasse.
No alternative technology – not even the electrical automobile – will be able to provide a fully functionally equivalent replacement for fossil-fuel automobility as it is known today without violating main requirements of sustainability or producing new resource shortages. Nevertheless, it is necessary to develop the technology of the electric automobile at a fast pace in all of its variations, be it of the electrical hybrid, electrical fuel cell, or electrical battery kind. There will continue to be a need for individual motor vehicles in the future for tasks related to exercising sovereignty, maintaining social order, and performing administrative and regulatory functions in order to provide state and private services to the public.
The European transport sector is almost completely based on the use of petroleum. It makes quick shipment of large quantities of goods over long distances possible and thus is the foundation upon which the global division of labor rests. Worldwide agricultural production and thereby global food security is also almost completely based on the use of fossil resources for the manufacture of chemical fertilizers and the operation of agricultural production and transport equipment. From this perspective, a shortage of petroleum constitutes an enormous stability and security risk.
The finite nature of fossil resources should therefore be the major theme in the contemporary discussion of mobility. This focus gives rise to other political exigencies compared to those that would arise, for instance, from an emission reduction policy geared toward climate protection only. Climate change directs our attention to what we should do in order to avoid future dangers. It is well possible, however, that “peak oil” will very quickly and directly force us to make changes in our culture of mobility and therewith at the very core of the modus operandi of our society. We should prepare ourselves well in advance.
The rapid reorganization of our transportation systems not only seeks to protect the environment for the future but above all aims to avert enormous economic and social dangers. It is especially the danger of massive transformation-induced unemployment in production and services in the mobility sector associated with motorized road traffic and ensuing second order unemployment in the economic sectors dependent on high mobility costs that together underline the necessity of developing transformation strategies in a timely manner.
Mobility design is essentially transformation policy. If the reorganization of this core area of modern society is successful, then it will be successful for all needs and functional spheres of society. Today, the design of mobility is more important than research on mobility. We know enough in order to be able to act with confidence.
Key strategies of this mobility policy are intelligently coordinated product, usage, and system innovations in the field of mobility. Usage innovations can be begun immediately. Concepts of mobility that in many different ways and to varying extents rely on “sharing schemes” represent the ideal type of usage innovation. The systematic electrification of all modes of transport must have as its goal the complete reorganization of transportation on the basis of renewable energy and its comprehensive integration into the economy of energy.
A modernization campaign for collective modes of transportation (public mass transit, long distance and regional trains, rail transport of goods) is the lynchpin of a sustainable mobility policy after petroleum. Linking micromobility (bicycles, e-bikes, light electric vehicles, Segways, etc.) and public transport will be the pillar of modern urban mobility.
Product, usage, and system innovations in logistics and changed consumption patterns (for example regionalism, seasonalism, and vegetarian nourishment) in combination with a return to regionally concentrated economic cycles can lead to a massive reduction in the distances commodity transport is required to cover in the future.
Worldwide merchant shipping is the backbone of the international economy. It will continue to be of tremendous importance in the future. Inland and coastal water transportation have a great deal of growth potential. The combined use of alternative forms of power (second generation renewable resources, hydrogen fuel cells, and wind power), improved engine technology, aerodynamically efficient designs, and, finally, efficient logistics planning can place ocean transport and inland water transportation on a fully renewable fuel basis in the foreseeable future.
In the long-term, fossil-fuel powered air transportation may possibly only be available in special sectors and will have to be reserved for tasks related to exercising sovereignty, maintaining social order, and performing administrative and regulatory functions to provide state and private services to the public. In the future, personal transport will be guaranteed by a combination of revived passenger shipping and railroad traffic.
The issue of providing alternative energy sources for agricultural production equipment and for hauling the heavy loads of the raw materials and construction industry has not been taken seriously enough. For the foreseeable future, it will be necessary to use second generation renewable fuels in these areas, which are to be reserved only for this market segment and shipping.
Mobility begins in the mind. The power of our imagination precedes any mobility policy. Today’s economy of waste and acceleration is a phenomenon associated with the affluence of the fossil fuel era. Ironically enough, it will only be possible to master the transition to a post-fossil culture if we start thinking today as if the transition were already well underway: as a temporary phase of shortage that combines and focuses our creative potential to immediately begin designing a sustainable society.
In the final analysis, only mobility that is avoided is a truly sustainable form of mobility in the long-term. Thus, issues concerning our lifestyles, levels of needs, and ultimately our idea of prosperity are at the heart of the matter.
Reinventing Mobility
Designing our World with Mobility Policy

Stephan Rammler

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Introduction

“The philosophers have only interpreted the world, in various ways. The point, however, is to change it.” This was the view of Marx in his eleventh thesis on Feuerbach. This viewpoint was no longer fashionable during my studies. Though completely unknown to my students, it gives rise to fascinating discussions that lead into the realm of social theory. This article too is intended as an introduction. I want to introduce the reader to social science discourse on spatial mobility in order to illustrate that shaping mobility is not only important and possible but also constitutes – by its very nature – social policy (in the sense of Gesellschaftspolitik). This returns us to Marx and my opening theme: Enough with interpretation! We already know enough about mobility. Yet this knowledge has not been put to use. We lack a vision of the future that we want to create and the belief that the task can be accomplished. Mobility is not everything, but there cannot be anything without mobility – if I may once again draw from my storehouse of quotations. It is for this reason that the reinvention of mobility is at the very center of public policies for a sustainable society. This could be the theme for an entire book – and a controversial one at that. However, my space is limited. I will therefore come to the point. This may result in some trenchant statements that call for disagreement and discussion. I hope that this will encourage further reflection.

2

Mobility in Modern Society

We already know enough about mobility! I am tempted to refrain from further comment on this statement and proceed directly to the main point, which is how mobility can be influenced and shaped. However, it serves our purpose to begin by reviewing some of the insights that research in the area of transportation sociology has provided – in order to keep our urge to reshape things from starting us out on the wrong foot. The following thoughts represent the quintessence of current research.

- Mobility and modernity are mutually constitutive – like two sides of the same coin. One cannot imagine one without the other. This relationship can be described as “an elective affinity between the development of modern society and an increase in mobility.” I hereby refer to the phenomena of interpenetration and cross-catalysis in the development and expansion of modern society, on the one hand, and the steady increase in mobility opportunities and requirements, which become manifest in a dynamic increase in traffic, on the other. The progressive social differentiation and economic division of labor engender traffic as a means of enabling the spatiotemporal integration of the differentiated spheres of action and economic activity. Conversely, it is transport and the mobility opportunities it grants that makes further differentiation and thereby social modernization and the division of labor possible in the first place. This applies both for the transportation of persons and goods. To put the matter more pointedly, transportation is a force that holds the modern world together while driving it apart (cf. Rammler 2001, 2003).

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1 The German term Gesellschaftspolitik refers to political measures that seek to systematically influence and shape a social order based on a certain values.
The automobile plays a special role as a spatiotemporal integration machine for the continually advancing processes of individualization, flexibilization, and pluralization. The more that paths of time and space are individualized, separated, and no longer follow simultaneous patterns, the more will the degree of autonomy and flexibility associated with the means of transport become a key criterion in making choices. In other words, the more “autonomous mobility” that a means of transport makes possible, the more attractive it will be for users. Along with growing prosperity, increased availability of leisure, and the symbolic-expressive aspects of identity formation, social distinction and social integration, this is an important reason for the success of the automobile. The interplay of modernization and motorization gave rise to spatiotemporal structures geared toward the automobile, in which the realization of the promise of liberty and prosperity in modern societies was more and more closely linked to use of the automobile as well as its infrastructural and institutional preconditions. It is not only a question of expanding the freedoms of (auto-)mobility but primarily one of all-encompassing forms of cultural dependence on the automobile, to the point of automobility representing a social model for society. In a society in which the structures of time and space, variety in lifestyles, and sense of purpose have been developing for decades on the basis of automotive functionality, this device has become a constituent part of the system. The socio-cultural system of automobility is now continually being passed on over time: structuring the material and institutional framework of action as well as forming and shielding automobile-related subjective concepts of action, guiding visions, lifestyles, and habits. This linking of the dimensions of the structure and action dimensions of mobility behavior explains the enormous stability of automobility (cf. Rammler 2003).

One could say that we live in a “made” world. In contending with his inner and with outer nature, man has formed and firmly established his environment. Every stone used in building, every meter of asphalt, every ton of railroad track, every harbor, airport, train station, every production facility and settlement has thereby become a fact for future development. The transport economist Voigt (1953: 199ff) coined the term “antediluvian effect” for the formative effects of the means of transportation, which have been caused by decisions “that may well have been justified at the time but since then – while they possibly or actually have improved the utility of the transportation system – have the effect of a hindering or opposing the tendency underlying the development of the basic structure.” Once a transportation system exists, we cannot easily get rid of it again. The same applies to modern man’s frame of mind. Every action, every thought, every recurring emotional stimulation serves to form mental patterns, and such patterns become more stable and resistant to efforts of change the more frequently they are acted upon, thought, and experienced, as well as the more a generation has been socialized into the mindset. Actions become habits and habits evolve into institutions – which can prove more stubbornly resistant than steel infrastructures. Beginnings therefore exercise great influence over the future. This applies always and everywhere, also to changes in transport culture. Transport sciences have generally dealt with visible structures: engineers in terms of shaping them, economists in terms of economic calculations, and transport policy researchers have made them an object of regulatory considerations. With the concepts of structure, habitus, and routine in their theoretical toolbox, the social sciences have been the first to include mental impressions and dispositions in their explanation of modern mobility culture (cf. Franke 2001). Whoever now wants to pursue transport policy must acknowledge the fact that we not only live encaged in our material infrastructures but also in our social institutions and subjective habits.

As a preliminary result, it may be noted that, after years of research in the transportation and social sciences, the question as to the sources of traffic generation appears to have been satisfactorily answered. The next logical step would then be to concentrate on designing the development toward sustainable mobility. Yet the question is still posed as to whether we know enough to be able to shape mobility. For, while we can
historically trace mobility and explain why its development under ceteris paribus conditions took a stable course, we nonetheless have problems envisioning the future. The future has never been less transparent. This is in part due to fundamental limits in analyzing it but also because the future we are entering into presents a high level of contingency. This future is more difficult to grasp than the future that stood before us only one or two decades ago. Under these circumstances, concepts previously used to explain mobility may quickly prove inadequate for the precise reason that the social frame of reference that shapes mobility, in an interactive process, and that serves as the counterpart in that relationship of “elective affinity” has been exhausted and has outlived itself. The likelihood that this will occur grows from day to day. Subsequently, the most important developments that will determine the future role of mobility will be described.

3

The End of Mobility as We Know It

To the sociologist Claessens (1959: 23 – translation from German) “Transport is a mirror of society.” It will be determined by the multi-faceted interaction of ecological, economic, and social processes that advance a cultural transformation process that is nowhere near to being understood. There is most certainly a need for interpretation in this regard. Certain aspects can nonetheless be identified:

• The need for mobility is growing. The number of automobiles worldwide will have almost doubled by 2030. This could lead to a more than doubling of fuel consumption and emissions by 2050 (IEA 2007). Researchers predict that, should we continue with this trend, we will be confronted with the worst possible scenario of climate change. However, in the face of this problem, a sense for the urgency of a far more dangerous development could be overlooked. The finite nature of fossil fuel resources should be the main theme in contemporary discussions of mobility, because, for the short and the middle term, it holds a much greater potential for crisis than climate change. Although both are closely associated, energy supply is the vital question of the 21st century. Tackling this problem is the key to a solution for many others and to maintaining the ability to act in the first place – not least in regard to climate change. In 2007, the transport sector accounted for 58 percent of world oil demand. This sector – especially road haulage – is a driving force in the intense competition for petroleum. Today, wars are waged to maintain the transport sector as a lifeline in our societies. Fossil-fuel based mobility – with its ecological and geopolitical consequences – increases the risk of global instability of gigantic proportions. Designing mobility with emphasis on saving resources therefore also plays a key role in fending off the political dangers to security posed by dependence on petroleum.

• The greater part of the world’s population lives in urban regions. Moreover, future growth in population will also be concentrated in these areas. Cities are the laboratories of modernization. They are the forums and means for the modern way of life, gigantic wheelworks of interlocking systems for regulating housing, work, consumption, and mobility. This means that the future of mobility will be decided in the city of the future (cf. Schöller-Schwedes and Rammler 2008). The dilapidated condition of urban supply infrastructures is not to be underestimated. They must be modernized. Fresh capital will also be needed to develop new infrastructures for renewable energy. In addition, the population is growing older. User-specific solutions are to be found in the area of “universal design,” i.e. the design of systems of mobility to accommodate all age groups. Demographic change also brings changes in settlement

2 In allusion to the book by Leggewie and Welzel (2009) “Das Ende der Welt wie wir sie kannten.”

3 A conservative estimate would be that between 1991 and 2003 the USA spent 600 billion dollars to maintain its presence in the Gulf region.
patterns, which give greater urgency to the issue of how public transportation infrastructures might be financed.

The preliminary result can be reduced to a simple formula: more and more people who are growing older on the average have increasingly less space to live in and consume more raw materials, thereby generating an ever increasing amount of emissions. While the overstraining of ecological systems is pushing the earth to the verge of irreversible damage, the limits to geopolitical and cultural capacity will be reached through competition for resources and the creation of new social inequalities as a result of the unequal allocation of wealth and life risks. This can be expected to give rise to such a fast-paced dynamic of transformation that the world in the foreseeable future, simply viewed empirically, will no longer be the one we now are familiar with. In other words, we find ourselves on the way to a “world survivor society.” According to Ulrich Beck, the world risk society is defined by risks that this society itself produces. I would go beyond this definition to define the global society of survivors as the effect of the final culmination of consequences of reflexive modernization on the question of human survival. The transition will take place when the risks transform into actual dangers, as is now the case. In this situation, we must radically question the system in many respects and immediately direct all of our actions toward the apriority of sustainability (Rammler 2010). The supposition is that it is possible to make the change to a sustainable form of society and that each further development must be subordinated to this primary goal. This is based on the assumption of social learning ability, concentrated action, timely availability of technology, and the condition that we are not yet beyond the point of no return toward irreversible ecological impact. This self-chosen and deliberate cultural transformation is the opposite of the potentially chaotic transformation dynamic that would set in in the absence of action. Its goal is the creation of a desirable condition. According to Herbert Simmon, this is exactly the comprehensive definition of design: it concerns the design of a new global culture of survival, a design that overcomes modernity, a world design for survival leading to a postmodern era or however else this epoch is to be named.

4

Designing our world with mobility policy

Faced with this situation, our political concepts are more like undertaking maintenance on the Titanic than an effort to change the course to avoid the iceberg. This applies to our mobility policy as well. The mobility industry is technologically brilliant but conceptually barren and lacking in imagination. It is faced with the challenge of developing fully new conceptions of mobility but appears to be as trapped in the path dependency of our mobility culture as both transport policy and the transport sciences. We should do away with the grand delusion entertained by critical discourse on mobility, because as long as we remain on the current path of development we will not arrive at any substantial changes. All schemes aimed at optimization and management of traffic, improvement of traffic flow, and shifts toward alternative modes of transportation cannot avoid facing the fact that we are heading in the completely wrong direction as long as we hold onto the current model of society geared toward growth. Here are some of the key ideas that should be guiding mobility policy:

- **Mobility policy is social policy.** Design of mobility has always been implicit social policy and has sometimes been explicitly regarded as such. Current transport policy lacks this perspective. Just as mobility research might be conceived as dropping a plumb line into the depths of modern society’s structural foundations to fathom the constitution of modernity, so can mobility policy be viewed as an instrument for changing its constitution. Mobility policy today can therefore also be understood as a paradigmatic vantage point for an all-encompassing cultural transformation. If restructuring needs in this intermediate area proves successful, then it can be accomplished in all other areas too.
• **Mobility policy is a lynchpin for the cultural transformation to a sustainable society.** From a theoretical standpoint, its importance is due to the linkage of modernity and mobility and the reciprocal influence that they exercise upon one another. Empirically, it is due to the factors mobility is based on. Because of mobility’s dependence on petroleum, it is the primary driving force of geopolitical dislocations and thereby represents one of the most important vantage points for the complete reorganization of our fossil energy culture.

• **Reinventing mobility is faced with our world’s resistance to change.** For a long time we have wanted to make mobility sustainable by making minor alterations when the real task is that of completely rebuilding the entire mobility machine. The incremental logic of previous transport and business policy is understandable when one takes into account that the challenges of a mobility policy for the future encounter resistance from its roots in the past – i.e. the cultural model of the mobility machine upon which it rests. Political measures to expand the range of opportunities are, in principle, simpler to legitimize and implement than those that come up against established levels of expectations and structures of dependency on the part of those affected. In this situation, “naïve” appeals to individual conduct are out of the question. The decisive question is how one can counter the story surrounding modern mobility – which promises freedom and independence – with a new and hopeful narrative that can be made the basis of an appealing and coherent vision for sustainable mobility in planning and policy.

• **The power of our imagination precedes any mobility policy.** For designing mobility, we have a much greater need for impulses that stimulate the power of our imagination than for incremental and unsystematic power politics. We lack the images, positive visions, and narratives supporting a new culture of mobility. We lack the internal map of a continent that we feel drawn to because its promises are so much more appealing than our present experience. This can be likened to the inner vision that animated the “America voyagers in the mind” (Burckhart 1997: 158) before they departed to find a better life in the New World. The pull of such images and stories of the functioning reality of a better world that lead the way, combine energies, and provide motivation are indispensable to help give rise to a “sense of possibility” (Robert Musil) – i.e., an overarching consensus and a disposition to innovate prevailing society – as a necessary prerequisite for any willingness to engage in profound changes and to support the respective policies accordingly. The difficulties involved with change begin with the limits of the imaginable. They begin with the need to conceive the new and to first free ourselves from habits mentally. Changed conduct can only occur as a consequence of this step. Such a “narrative mobility policy” is not the task of solitary visionaries but must arise from a collective, decentralized, and networked logic of innovation that must be organized and, through new channels, fed into the political process and public debate.

• **Sustainable mobility policy must set priorities.** Upon regarding the future of mobility, one gains a sense for the primary areas to focus on and the strategies to be employed in shaping mobility. Judgment criteria are the speed and the degree of beneficial environmental and social effects to be expected, the innovation power of the entire system, the extent and depth of impact, and, finally, the formative influence on cultural development and therefore the contribution to reinventing our modern civilization. This does not render obsolete the classical systemization of areas of action, strategies, and measures in transport policy but instead evaluates them in the light of a new logic of innovation. The incremental logic of innovation from the subsystem perspective – focusing on the technical systems of transportation and the organizational regulation and optimization of processes – that has hitherto defined mobility policy is countered by the ideal of an ambitious mobility policy that targets society as a whole. In accordance with the paradigmatic character of mobility, the
matter must be approached systematically and with a readiness to cut across disciplinary boundaries in order to determine which changes in other areas must be effected in order to bring about changes in the exercise of mobility. On the other hand, we must also ask which changes in our exercise of mobility might plant the seeds of change in other social systems.

5

Key strategies for sustainable mobility policy

The three classic concepts in ecological transport policy are improving (fuel consumption, traffic flow etc.), shifting (toward alternative means of transportation), and avoiding (traffic). This triad remains valid. Yet, here I would like to introduce the notions of product, usage, and system innovation in mobility as key strategies for sustainable mobility design in terms of the logic of innovation called for above. They make possible a differentiated argument that is linked to a broad range of other issues with a view to synergetically developing and implementing concrete measures and strategies of action. One could say that the three basic concepts offer an abstract matrix of goals for sustainable mobility design. The innovation triad of an ideally closely coordinated design of products, processes, and systems allows realizing this matrix with a view to specific levels of action, actors, and target parameters, such as being user-friendly, universal design, lowering energy and resource consumption, and compatibility with environmental, health, and social needs, etc.

5.1 Product innovation and mobility

Product innovation begins with the modes and individual means of transport. It does not alter the functionality of the devices or systems employed in managing transport processes but rather modifies the specifications of the product as such in order to realize one or more of the aforementioned goals. Product innovations should begin during the planning and production process, for instance, by employing a design based on recyclable components. Such innovations serve to optimize the consumption process and should take into account sensible subsequent uses from the very beginning (e.g. second and third uses). The incremental increase in the efficiency of the combustion engine belongs to this strategy just as does the development of new designs for powering all means of transportation (electric or fuel cell vehicles, magnetic levitation train) or completely new transportation technologies (Segway, rail cab). Product innovations are usually based on technical inventions. On the other hand, one can also achieve innovation by combining existing technologies or by introducing a new standard (size, weight) or type of use. The aim of product innovation should always be an increase in product efficiency, that is, the performance of the same function using fewer resources or the addition of a new product function based on use of the same or, ideally, a reduced amount of resources. Such innovations can make completely new functions possible that either create new needs or satisfy existing ones in a new way.

5.2 Usage innovation and mobility

Usage innovations begin with the operation of the means of transport. Here the question is how to satisfy existing mobility needs without employing new products or how satisfaction can be reached through using existing products in new ways or reconfiguring the context of product use. The impetus to innovation in this case is, at the least, focused on the (re-)organization of courses of action based on existing products in a given environment. This can take place with or without corresponding product innovations. The great significance of usage innovations in terms of pragmatic policy results from the situation described above where we noted that the world has developed as a rigid socio-technical system. The world of objects is just as firmly poured in steel and concrete as that of mankind is locked into change-resistant routines of usage and behavior. Any change toward the goal of sustainability must come to terms with this basic condition. Most often neither the money nor the political will is available that would be necessary
to undertake a large-scale product or system conversion. To the contrary, the solution is often to be found by making much more efficient use of products and infrastructures. This strategy is characterized by a low level of technological intervention. It is a strategy that involves proceeding wisely in how we as a society deal with the world we are currently faced with, a world whose potential has certainly not been exhausted in all areas of need. A classic form of usage innovation is “sharing schemes” of various kinds and extents. Generally speaking, sharing the means of transportation aims at providing the greatest possible satisfaction of needs with the least possible expenditure of resources. Examples include improving the utilization of privately owned vehicles through intelligent sharing schemes (car-pooling, “electronic hitchhiking”) or increasing the operation time of motor vehicles through fleet schemes (car sharing, car rental, call-a-bike), which theoretically reduce the number of vehicles operated (or being held for operation) by departing from private ownership of vehicles and operating them in a more economical fashion, thereby increasing resource efficiency.

Let me draw your attention to a current example that will clarify the interaction between product innovation and usage innovation. The concept of electro-mobility, as it is generally discussed today — that is, merely as a simple conversion design of established product variations of automobility — is in part based on classic product innovation but already borders on usage innovation since electric automobiles (apart from other modifications in their mode of functioning, for example, concerning fueling arrangements and driving) will continue to offer only limited range in the future (thereby departing from the usual product image), which must be regarded as the starting point of a new manner of use. This means that a usage innovation is already built into the product innovation of the electric automobile, as the potential user is confronted with the challenge of adapting to the limited reach of the vehicle. In this case, demands for certain lines of action incorporated in the product design are part of the design process, and appropriate solutions for the problem of limited range are provided along with the product. Such solutions could be, for example, mixed car-pooling schemes, in which — based on membership — an e-car driver has the opportunity to exchange his car for a combustion engine vehicle with a greater reach in the case of long distances. Another example would be an integrated mobility service scheme incorporating all modes of transportation. In this instance, the user of an e-car would be able to use the rail system for long trips. Booking, billing, and disposition would in this case be included as a package. Truly innovative kinds of uses for urban electro-mobility could be based on these intermodal mobility services, which enable autonomous mobility by more closely linking individual and collective means of transportation. The rapid leaps in the development of information and communications technologies make possible completely new linkages, thus opening the door to a range of scenarios for comprehensive system innovations in the field of mobility.

5.3. System innovation and mobility
The system innovation strategy of mobility links products and usage innovations and in this regard calls for extensive restructuring measures and investments in the urban environments and infrastructures that provide the context for mobility. System innovations are aimed at a new overall architecture integrating the infrastructures for post-fossil energy supply, information, and transport. Based on our list of criteria for sustainable mobility design, it is the strategy with the most beneficial environmental and social effects, the greatest power of innovation at the overall system level, the greatest range, depth, and the strongest formative influence at the cultural level. However, it is also the strategy with the longest expected implementation time.
Key sectors for sustainable mobility policy

If one links the analysis of the past and future of mobility, then three key sectors of sustainable mobility policy can be identified in which new design principles, combining product, usage, and system innovations, should hold sway. In dealing with them, all important environmental, climate, and energy policy challenges will be addressed at the same time in a prompt and sufficient manner – thus tackling the right problems at the right place in order to produce important synergies, which can also be expected to contribute to the transformation of society as a whole. This is an analytical and ideal-type systemization. In reality, the key sectors overlap to the same extent as the strategies to be employed in shaping them.

6.1. Energy conversion in mobility

The key strategic starting point is to shift the energy base for mobility from the prevailing fossil fuel mode of operation to a post-fossil, renewable one. Energy conversion for mobility is the most important of the key sectors because, based on the central role of fossil-based energy, it is here that the greatest ecological and geopolitical benefits are to be expected. In addition, one must take into account that, because of the aforementioned antediluvian effects of mobility, substituting the energy base of transport can be expected to involve considerably lower levels of conflict than restructuring crucial parameters of modern mobility, such as the built environment and infrastructure, organization and business operations, and mental dispositions, which will nonetheless be inevitable in the medium and long-term. In the past, various paths of innovation have been discussed for various modes of transportation. Ultimately, they all boil down to employing renewable primary energy sources that are converted into secondary mobile energy sources, such as electricity, hydrogen, or second-generation bio-fuels, for powering motor vehicles. It is my view that, in the future, we will use a mix of these energy sources in the various types of transport and areas of mobility. The use of electricity seems particularly suitable for the transport of persons and goods in the area of urban and suburban mobility. Here, one could make use of existing supply infrastructure and established forms of use, such as the electrical operation of public transport. In contrast, electricity is neither a suitable form of energy for transporting goods in rural areas or by non-railbound means of transportation, such as by road, air, or water, nor for the often underestimated transportation needs in agricultural production. Here, the use of second-generation biofuels or hydrogen is to be established as a source of energy for the remaining transport needs that can neither be avoided nor shifted to other means of transportation after a fundamental restructuring of commodity logistics.

6.2. Electro-mobility as system innovation: the linkage of micromobility and public transportation as pillars of urban mobility

The automobile is at the center of our mobile way of life. If one takes into consideration the extent to which automobile accounts for resource consumption and global warming, on the one hand, and the economic and social significance of the automobile and petroleum sectors, on the other, then the modernization of automobility and the energy systems, transportation infrastructures, and social environment it relies on is one of the lynchpins of an ecological industrial policy in modern society today. If the transformation meets with success here, then it will also meet with success in all other areas of needs and in all other economic sectors. Viewed against this background, I assume that the classic automobility known to us today in two senses is at an end: both as a classic model of mass motorization and as a path of technical development. Indeed, it must come to an end if we apply the criteria of sustainability. The automobility that we are so familiar with, that is, private ownership of a motor vehicle with a combustible engine, sufficient storage and transport capacity, great range, operated at moderate costs can impossibly be generalized worldwide, even if we at some point could reach an efficiency level of 1l per 100 km. The same holds true for the electric automobile if it is modeled
after the combustible energy automobile in terms of functional equivalency as the conversion design approach would have it. If we really take matters seriously, then the only way to reach permanently sustainable mobility is through the de-individualization of private mobility and commodity logistics on the basis of a completely renewable energy base in the medium-term, a dramatic increase in the significance of collective transport, as well as the reorganization of our economic and settlement structures. Automobility is simply another word for autonomous mobility. For modern man, this autonomous mobility has meant the mass-produced availability of the private automobile that runs on fossil fuels and has been deeply inscribed into our settlement, economic, and production infrastructures. However, the function of autonomous mobility could also be achieved in other ways: not by an individual technological artifact but as the product of a smooth interplay between the components of a system. Instead of moving in an artifact from point A to point B, according to this design philosophy I would be moved from point A to point B by means of a system. In this sense, the automobility of the future would actually largely be an “auto-free future.” Automobility instead would mean the autonomous mobility of people and goods through de-individualization of urban transport on the basis of modern, highly-developed collective transport in combination with innovative usage strategies for what one could call micromobility, that is, individual transport below the level of today’s conception of a vehicle (Pumas, Segways, light electric vehicles, e-bikes, e-mobiles, bicycles, etc.). Especially in the metropolitan areas of Southeast Asia, a sustainable economic and social development will only be possible based on the firm foundation of a highly efficient and effective mass transportation system. It is precisely here that it appears to be neither wise nor desirable to establish a culture solely based on the automobile – even with zero-emission electric vehicles – because of the intense competition for space. Instead, the combination of individual and collective transport seems to pose a much more appropriate solution. This problem of space is a crucial one in most regions of the world undergoing a process of catch-up modernization. Entry into the development of an integrated system of mobility that provides for a linkage of electric individual and collective transportation in a coordinated system of product, service, and system innovations, could, for example, be of great importance for the European mobility industry when one takes into account the enormous markets being opened up in global metropolitan regions. In light of the aforementioned trends and conditions for the further development of their mobility, the urban agglomerations of Asia can be expected to emerge as nuclei of a system innovation based on electro-mobility. In summary, upon sober reflection, the future of urban mobility will be determined through a few rather simple developmental requirements:

- the return or the extension of collective transportation as individualized mass transport;
- electrification of all means of transport on the basis of renewable energy production;
- micromobility: the continued existence of autonomous and flexible means of transport on the basis of electro-mobility together with service and usage innovations.

Just as the automobile with combustion engine today is the uncontested symbol of fossil-fuel based industrial modernity, in the future electro-mobility could come to stand for a paradigm shift in the history of civilization and a long-overdue structural change in the automotive, petroleum, and energy sectors. From this perspective, we can the view electrification in the field of mobility needs as a sort of Trojan horse for the post-fossil recultivation of the earth, for the switch from a fossil-fuel based to a solar culture, and for the decarbonization of the energy flow in the social organism.

6.3. System innovation and commodity transport
Have you ever considered what kind of logistical machine you set into operation when you order a book or other consumer goods over the Internet? Have you ever thought about the transportation history that lies behind a grocery item that you purchase in a supermarket? The world of goods and consumption is like a Windows interface on our home computer: the icons conceal quick and highly efficient – but also enormously energy and resource-intensive – processes, the functioning of which is unknown and of-
ten enough not interesting to us. At the same time, the modern world would not function at all without commodity logistics. What draws our attention the most is how we arrive at the places and facilities where we have errands to run. Less interesting to us is the transport-intensive way things are produced and sent to us or to the places where we pick them up to take them or have them delivered “the last mile” to our homes. Discussions of transportation policy generally revolve around the often emotionally charged issue of personal transportation. By contrast, commodity transport is a neglected topic in discussions about mobility policy, though unjustly so. In other words, commodity transport – that is the worldwide transport of raw materials, intermediate products, and finished goods ready for consumption – eats up resources, produces greenhouse gases, and contributes to diminishing the quality of urban life through an ever more fragmented and ever increasing transport volume. If we agree on the principle that mobility policy must comply with the standards of sustainability, commodity transport is one of the key sectors because it already today not only in no way meets the requirements of sustainable development but also displays extremely dynamic growth. This is emphasized by the conclusions reached by the Federal Environment Agency of Germany in May 2010. The report draws attention to the fact that the current trend could well become stronger by 2025. The German Federal Ministry of Transport projects that the volume of commodity transport could increase by 43 percent by 2025 compared to 2008. The courier, express, and parcel services (CEP) sector, which has the greatest impact on urban quality of life, has been earmarked for especially dynamic growth.

While diminished economic growth is expected, e-commerce will remain a major growth factor. The goods structure effect – the trend toward the small-sized shipment of high-quality and urgent goods – seems to be continuing unabated. Mobility policy can respond to this challenge on three levels, each with a decreasing depth of intervention. First and foremost, we must inquire into the factors generating commodity traffic. This raises the issue of the transportation requirements arising from our eating habits as well as from demands for immediate gratification (this relates, for example, to CEP services). Ultimately, the issue of traffic generation is directly linked to economic and production structures that involve a high level of division of labor and that search worldwide for comparative cost advantages in natural resource and labor markets – it is therefore at the heart of our growth model. The fact that the economics of the transportation industry fails to reflect the true costs of transportation also plays a major role. Low fuel prices have made the emergence of a worldwide system of division of labor possible to begin with. Without the dumping prices for energy that have defined the fossil fuel era, the globalization processes that we are experiencing today would not have been possible. The same applies to the development of the production and circulation sectors that are essentially not sustainable for the future and that link production and consumption locations in – from an ecological viewpoint – completely ridiculous ways that would never have taken place without the availability of cheap fossil fuel resources. In light of the apriority of sustainability, the issue of traffic generation in the final analysis turns into the question of avoiding the need for transport and thus the traffic it gives rise to. It is closely and causally tied up with the issue of our lifestyle and consumption patterns, which means that a solution is only to be found outside the genuine sphere of mobility policy but must nonetheless be addressed from this perspective. Answers will therefore only be found in the greater context of the political debate that we need to engage in regarding the scope and limits of our model of economy and consumption. Regionally oriented patterns of supply and demand, seasonal commensurability of consumer habits, foresight, planning, and consumer decisions based on greater patience, as well as product characteristics marked by longevity and durability are some of the answers that would also directly result in a decreased volume of transport and total traffic, and would ultimately have an effect on the structure of transportation in the direction of commodity transport schemes that involve slower, more systemic operations consuming less energy and less land.

This brings us to the second course of action, one which belongs to mobility policy in the stricter sense of the word. It involves a shift of transport modes away from roads and
airplanes to rail carriers and water transportation. Particularly the potential for transport on internal waterways has hardly been tapped so far. A shift in the modal split presupposes radical improvements in combining the various modes of transport. Combined transport is an idea that has long and often been discussed but which has nonetheless never been seriously implemented and tested in the real world. The reasons lie in the aforementioned cost relationships and the stability of consumption patterns that require a functionally equivalent quality of service as rapid and as flexible as commodity transport by road. Even the fact that key transport policy decisions and infrastructure investments to the benefit of combined transport have not been made cannot conceal the fact that, for reasons that lie in the very nature of the change required, we will most likely not be able to achieve functional equivalence to today's transport model with respect to speed, flexibility, etc. Even if one does not share this view, it would at least be worth considering that the attempt at handling the same level of transportation needs within the parameters of a newly designed transportation system, which might emerge as the product of comprehensive system innovation, would still involve an enormous expenditure of resources that would be clearly minimized compared to the status quo but would nevertheless continue to be in no way sustainable.

The third mobility policy option lies in increasing the efficiency of the current transportation systems by improving logistical arrangements, by using renewable fuels, and finally by increasing the energy efficiency of the engines employed in powering the vehicles used. In this regard, the spectrum of discussions we need to engage in ranges from the use of light electrically powered transport for the "last mile" in urban conurbations, through the option of using second generation biofuel in trucking, to visionary concepts such as "sky sails" in order to reduce energy use in overseas transport by means of wind power. In summary, the solution to the challenges of a sustainable design of commodity transport, just as in personal and passenger transport, lie in diversity, synergy, the suitable adaptation to the context of use, and the intelligent combination of organizational and technological options.

7

Inversion of the innovation pyramid

If one were to ask me to summarize and evaluate what has been said up to now, I would emphasize the following thoughts:

- **We are at the end of the cultural model of mass mobilization.** No further explanation is necessary in the case of fossil-based technology. However, it also applies to electro-mobility. If electro-mobility is to become the model for mass motorization, this innovation can only lead to a dead end. Electrification of mobility on the basis of renewable energy production will only be sustainable in the future as part of a system innovation, as a synergy of electrically operated collective and individual means of transportation, one that will replace mass possession of motor vehicles with mass access to mobility services operated by businesses providing them.

- **We need to invert the mobility policy innovation pyramid.** This will require new ways of thinking and acting in the field of mobility policy. Environmental transport policy has long been conducted primarily as product innovation. Yet, it is a question of thinking in terms of innovation of the entire system. Once innovative usage and business models have been devised, we can then turn to the question of product innovation as the final link in the chain.
• **As a middle-range strategy the idea of usage innovation makes it possible to start immediately and to seize existing opportunities, initially without directly making fundamental changes, radically abandoning the amenities of contemporary automobility, complex product innovations, or any highly controversial restructuring of systems and infrastructures. Usage innovations are oriented to the goal of satisfying existing mobility needs while using fewer products to do so and reducing the amount of materials and resources employed through more efficient use. The thrust of innovation will therefore initially only aim at (re)designing courses of action and organizational procedures for specific products in a given environment. Ideal-type usage innovations are forms of mobility based on “sharing schemes” of different kinds and to varying extents.**

• **We need a modernization campaign for collective modes of transportation.** The backbone of global mobility will be high performance and robust collective modes of transportation. In a design scenario, such as the one previously described, they will serve as the basis for a modern system of innovative and yet thoroughly individualizable forms of use and business models for mobility. Under the pressure of circumstances forcing change, which – due to the trends described above – are not unlikely to occur, they would serve to ensure that society’s basic mobility needs were met. We could easily find ourselves in times where things threaten to come to a halt and there is no other option than collective modes of transport to keep them going – whether it concerns the transportation of persons or goods. That would in many ways be a completely different world faced with completely different difficulties. However, mobility will still be necessary. In terms of precaution and risk protection, transport policy today would be well justified in deciding to undertake a massive shift in investment policy in favor of collective transportation and at the cost of the motorized transport of persons and goods. To state things more pointedly: the German Association of the Automotive Industry (Verband der Automobilindustrie – VDA) advertises with the slogan that it represents every seventh job in Germany. The time may well come in which every second job in Germany finds its guarantee in a functioning collective transportation system.

• **The only truly sustainable mobility is mobility that is avoided.** The application of the triad of innovations developed in this article is a contribution to the renewal of mobility policy. However, I am not certain whether their effect will be sufficient in order to achieve a truly sustainable mobility. The decisive answers will have to be given to the question of traffic generation, which – as shown in the case of commodity transport – is essentially a question that genuinely touches upon our lifestyle and therefore lies outside of the narrow scope of mobility policy. To once again emphasize, all schemes geared toward optimization and management of traffic, improvement of traffic flow, and shifts toward alternative modes of transportation cannot avoid facing the fact that we may be moving in the completely wrong direction as long as we do so within the framework of the current model of society.

In the end, mobility policy is therefore invariably a question of social policy in the sense of Gesellschaftspolitik. The quotation that I opened this article with is even more appropriate in closing it. “The philosophers have only interpreted the world, in various ways. The point, however, is to change it.”
References