Towards ecological urban restructuring: A challenging new eco-cultural approach

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Global urbanization

The topics with which I am concerned will not reveal their deeper sides without a closer look at the development of today's industrial society, the urbanization process that goes along with it, and its specific effects on the changing relationship between man and his environment.

Global urbanization started out with industrialization and scientific-technological progress, which led to an explosive, and continuing, increase in population. In less than 200 years, the earth's population has risen from scarcely 1 billion people at the beginning of the 19th century to over 6 billion by the end of the 20th century – more than a six-fold increase. This led to a historically unparalled urbanization process that, in the industrialized countries, practically reversed the ratio of rural to urban population. At the beginning of the 19th century, 80 percent of the global population still lived on and from the land and 20 percent in cities. By the end of the 20th century, the world's population had changed its collective preference and urbanized to the point that 80 percent of people now live in cities, with only 20 percent residing in the country.

While the urbanization process in the industrialized countries has stabilized at an urban population level of 80 to 85 percent, some initial countervailing trends are already beginning to appear. For instance, in the last 20-30 years urbanization got underway in the least developed countries and now continues unchecked there. Even today, more than 90 percent of world population growth is taking place in cities. In the underdeveloped countries, the urban population is presently growing by 60 million people per year, and it is likely that by 2020 as much as two thirds of the world's population will be living in cities.

From a broader perspective, the urban shift of modern industrial society and the social conditions typical of it are characterized by great dynamics. This process of change is unfolding as a function of incessant surges of innovation in modern industrialized society and its specific social conditions, which have differentiated and altered both the mode and the forms of the urbanization process. Thus today's forms of urbanization have little to do with the surges of urbanization typical, for instance, of the industrial societies in Europe and America at the end of the 19th and the dawn of the 20th century. Especially since the middle of the 20th century, the process of urbanization has continuously changed its face: first, due to mass motorization, then through major revolutions in social living conditions, in leisure and work, but also due to migration processes.

Urbanization was followed by a phase of suburbanization, then by de-urbanization, and we are now experiencing the emergence of new forms of reurbanization. But new and previously unknown types of city and of urbanization are also emerging; these range from the so-called Zwischenstadt (SIEVERTS, 1997), the intermediate city or interurbia, to the telecity or the sunbelt city and the colossal urban agglomeration of the megacity type; in other words, cities with more than 10 million inhabitants – Tokyo already has a population of over 30 million – or so-called global cities like New York, London, and, again, Tokyo, which are becoming the dominant nodal points and control centers of an increasingly globally networked world.

In the context of a dynamically developing world and the challenges it entails, the urbanization process continues apace – with current upheavals dominated by the triumphant advance of the new information and communication technologies, the reorganization of worldwide capital flows, the development and powerful expansion of new forms of the international division of labor, and related increases in poverty and poverty-related migration with their untold consequences.

Another form of differentiation may be seen in what is known

as "virtual urbanization." According to this theory, in the future urbanization (regarded as urban forms of living and working) will, at least for a certain segment of mankind, become detached from concrete places and develop in the direction of the virtual and global megacity.

We now come to the environmental factor. It continues to play a subordinate role in present urbanization theory and discussions, and I will focus on this factor in what follows. Proceeding from my studies on urban ecology and ecological urban restructuring (see HAHN, 1982, 1983 and 1993).[1] I will look into the thesis that the environmental factor will, in the course of the 21st century, increasingly come to be seen as the actual key factor of a new and crucial phase of urbanization. This I refer to as the catharsis phase of modern urban development. My thesis is that the sustainability of post-industrial urban society will be determined by the course taken by this phase, and that all past forms of urbanization will tend more and more to lead to an ecological dead end.

The environment factor

To start out with, a look back at historical developments. It goes without saying that pre-industrial urban cultures were not a model of ecological rectitude. If they were to survive, however, they had to ensure that the highest possible amount of the resources they needed were available in all important areas of basic needs (food, energy, water, building materials, and other essential goods), and they used recycling techniques to secure the longer-term availability of these resources. Depletion rates had to be kept to an absolute minimum. The concern was to deal economically with resources that were for the most part scarce. This also implied that manufactured products were mainly designed for high efficiency and long usage.

The size and prosperity of a city was essentially dependent on a region's fertility and resource potential. Resource management was handled in tight supply and disposal cycles within the city, between the city and its environs, and with the aid of a marked regional energy, water, and materials management. The guiding principle of system conservation was ecological efficiency and preservation of material ecological capital.

All of this was not done voluntarily or from a high eco-ethical consciousness but because it was the basis of what prosperity had been attained. At pre-industrial levels of development and technology, possibilities to import goods and externalize negative effects detrimental to the system were very limited. To maintain an often highly sensitive system stability, it was essential to organize lifestyles accordingly and to base them on appropriate ethical and behavioral norms. Ecological scarcity and system-stabilizing restrictions were decisive factors of land-use planning and urban development.

With the advent of industrialization, these millennia-old restraints on and obstacles to development were broken in favor of an approach allowing for some completely new liberties in relation to nature. Industrial science and technology made possible hitherto unknown potentials and seemingly boundless possibilities to overcome closed cyclical systems and to design open systems to replace them. It appeared possible to break away from local and regional dependencies, from the cycles of life and regeneration, indeed even from the cycles of the days and years. The resistance posed by time and space was overcome, and resources and sinks were made globally available for the development of industrial cities and industrialized nations.

A new urban civilization, released from ancient natural and environmental dependencies, seemed to have become possible. The result was the emergence of wholly new types of city and entirely new urban life cultures, freed from old attachments and marked by a previously unimagined prosperity: what we now refer to as the modern urban lifestyle.

This "triumph over nature" through modern technology and logistics seemed to have overtaken the model of an economy geared to traditional recycling principles. The task that architecture and city planning were now expected to address and find artistic and feasible practical solutions for was no longer dependence on nature, its scarcities, its sensitive effective and relational contexts, and the rules of behavior this meant for the inhabitants and users of urban environments. On the contrary, the focus now was the liberation from and triumph over these dependencies. While I was studying, I was part and parcel of this movement, celebrated it and drafted visions of the future, which very soon thereafter seemed highly questionable to me.

What finally emerged were urban city, settlement, and economic structures, consumption styles and lifestyles that multiplied the use of energy, water, and materials as well as the rates at which materials were depleted. The consequence was that growing consumption and depletion more and more had to be covered or compensated for with the aid of outside resources. Urban systems grew more and more dependent on the highly complex and sensitive logistics and transportation infrastructures required, on a global scale, to provide needed resources and to dispose of waste products. This called for a greater and greater use of matter and energy. This in turn led to an explosive increase of technological and political risks. An additional consequence was an autonomization of internal materials and energy requirements. The effectiveness and efficiency of the overall system declined apace, while at the same time emissions of pollutants and toxic wastes affecting climatic conditions increased exponentially, to say nothing of system-related social and cultural costs.

It became increasingly obvious that this model of urban prosperity cannot work out in the long term. It can only function as long as the majority of the world's population is excluded from this model of prosperity – i.e. until the global supply of resources and sinks for a privileged minority has been consumed, or until so-called "critical loads" have been exceeded, tipping the balance of ecological and social systems. Both are pushing toward increasingly obvious boundaries. These issues have been the subject of considerable research, from the Club of Rome's *The Limits to Growth* (1972) to the Rio Earth Summit (1992) and the UNEP millennium report *GEO 2000* (1999).

In summary, it can be said that the problems facing the overall system are intensifying and will continue to intensify as long as ecological system productivity and stability at the local and regional level continue to face unparalleled pressure.

The task

The theory of the key role of the city – on the one hand as the central causative factor of today's environmental crisis and on the other as the point of departure for the development of new, sustainable solutions – is not new. As already mentioned, it was developed in the early 1980s. But at that time it was highly controversial and found little acceptance.

Since then, this position has gained wide currency. Meanwhile we know very much more about the real extent of the task, in part up to and including magnitudes or even figures. The decisive breakthrough was achieved mainly at the World Conference on Environment and Development in Rio de Janeiro in 1992. The summit's final document, signed by 170 countries, set out the crucial role of the local level, particularly of municipalities, in implementing a sustainable policy of ecologically oriented development. To cite Article 28:

28.1: Because so many of the problems and solutions being

addressed by Agenda 21 have their roots in local activities, the participation and cooperation of local authorities will be a determining factor in fulfilling its objectives. Local authorities construct, operate and maintain economic, social and environmental infrastructure, oversee planning processes, establish local environmental policies and regulations, and assist in implementing national and subnational environmental policies. As the level of governance closest to the people, they play a vital role in educating, mobilizing and responding to the public to promote sustainable development.

Article 28.2 further states that "*... by 1996 most local authorities in each country should have undertaken a consultative process with their populations and achieved a consensus on 'a local Agenda 21' for the community ...*" and 28.3 goes on: "*... each local authority (...) should enter into a dialogue with its citizens, local organizations and private enterprises and adopt 'a local Agenda 21'...*"

In these formulations, the Rio summit laid the cornerstone for the worldwide local Agenda 21 process and a systematic ecologically sustainable restructuring of cities that has now been set in motion. Since then for example, in Germany the parliaments of more than 2,300 municipalities have adopted appropriate resolutions and initiated official Local Agenda 21 processes (as of September 2002). This interim result is in line with the situation in other European countries like Denmark, Austria, the Netherlands or the UK.

The Rio summit itself had little to say on what particular goals are to be attained in this worldwide process. The framework was to be defined by higher-level National Agendas 21, which the 170 signatory countries have committed themselves to work out over the short term: this is one of the conference's main results. Bearing in mind their very different national conditions as well as the principle of international equality, the signatories are to set out national goal and action frameworks for sustainable development in the 21st century.

In Germany this commitment, voluntary in nature, has been addressed in two different ways.

- One was described in the report "Towards a Sustainable Germany," published by the Wuppertal Institute for Climate, Energy and the Environment on behalf of MISEREOR and BUND (1996).
- The other came two years later with the publication of the findings of the so-called Enquete-Kommission of the 13th German Bundestag,[2] "Protection of Man and the Environment."

Referring to the "five basic rules of sustainable development" (fig. 1), both studies came to very similar conclusions. Both aimed at a quantification of goals, specifying time horizons in which the goals for sustainable development were to be reached. This is also indispensable for the creation of orientations and binding commitment at the national and local levels alike.

The findings of both studies demonstrate that the necessary goal and time targets can be met only through efforts and standards that go far beyond present environmental policies, i.e. by means of a paradigmatic reversal of current social trends and by achieving a turning point in socio-technological development. In particular, the studies note that dependence on fossil fuels and finite resources, on movements of goods and flows

The five basic rules of sustainability

1. **The rate of depletion for renewable resources should not exceed the regeneration rate of the resource in question.**

2. **Non-renewable resources should only be used if an equivalent renewable resource is created, or if an equivalent increase in resource productivity is achievable.**

3. **Insertions of material in the environment should be orientated to the load capacity of the environment. Of course all functions have to be given due weight, last but not least the unobtrusive and sensitive regulatory systems.**

4. **The time frame for human intervention must be in a balanced relation to the reactive capabilities of environmental systems and relevant processes.**

5. **Dangers and unacceptable risks for human health due to social activities must be avoided.**

Fig. 1: The five basic rules of sustainability. (Source: Based on 12. Deutscher Bundestag, Enquete-Kommission "Schutz der Menschen und der Umwelt," Drucksache 13/7400, 1966).

Table 1
Environmental goals for a sustainable Germany

Environmental indicator	Environmental target	
	short-term (2010)	long-term (2050)
RESOURCE WITHDRAWL		
Energy		
Primary energy consumption	at least –30%	at least –50%
Fossil fuels	–25%	–80 to 90%
Nuclear power	–100%	
Renewables	+3 to 5% per year	
Energy productivity [1]	+3 to 5% per year*	
Materials		
Non-renewable raw materials	–25%	-80 to 90%
Material productivity [2]	+4 to 6% per year*	
Land use		
settlements and transportation	• absolute stabilization • annual additional use: –100%	
Agriculture	• extensive conversion to organic farming methods • Regionalization of nutrient cycles	
Forestry	• extensive conversion to ecologically adapted silviculture • increased use of domestic timber	
SUBSTANCE RELEASE/EMISSIONS		
Carbon dioxide (CO_2)	–35%	–80 to 90%
Sulphur dioxide (SO_2)	–80 to 90%	
Nitrogen oxides (NO_x)	–80% by 2005	
Ammonia (NH_3)	–80 to 90%	
Volatile organic compounds (VOC)	–80% to 2005	
Synthetic nitrogen fertilizers	–100%	
Agricultural biocides	–100%	
Soil erosion	–80 to 90%	

1 Primary energy consumption per unit value added (GDP).
2 Consumption of non-renewable primary materials per unit value added.
* Assuming annual growth rates 2.5% in gross domestic product. It must, however, be stressed that continuing economic growth makes it impossible to achieve the long-term environmental targets.

and consumption of materials as well as the present use of land for settlement purposes must be reduced by a factor of 4-10 (table 1).

In practice, the ongoing German local Agenda 21 processes have tended more to shy away from any such concrete and binding confrontation with the findings of the national sustainability studies, agreement on concrete environmental quality targets, and the time frame they imply. Municipalities are for the most part concerned with more pragmatic, less demanding and more easily communicable environmental goals that can be reached with the limited means at their disposal.

One of the few cities where this agenda has nevertheless taken hold is Berlin. In 1998 the Berlin municipal parliament appointed a multiparty fact-finding commission called "Sustainable Berlin." By the end of 1999 the commission had presented its over 500-page-long report, including a number of comprehensive appendices. The report was an important step and contained an initial compilation of environmental quality targets based for the most part on current Berlin decisions, recommendations, and time frames for a sustainable development of the city of Berlin. This led, between 1998 and 2000, to the preparation of the so-called "Berlin Study"[3] (table 2).[4]

Table 2
Goals for a sustainable Berlin, Berlin Study 2001

Environmental goals for Berlin		
	approx.. 2010	approx.. 2050
Resource use		
non-renewable material	-25 %	- 80 - 90 %
household drinking water consumption	< 100 l per day and resident	
fossil fuels	-25 %	-80 - 90 %
renewable	portion of 12 %	Portion of 80 %
nuclear	portion of 0 %	
total	-30 %	-50 %
land use	s. action field cooperative region	
green areas in the city interior	+450 hectares near housing, +700 hectares settlement near	
nature/landscape protection	3 %/20 % of the city area	
material delivery/emissions		
carbon dioxide	-25 %	-80 %
nitrogen oxides	-80 %	
volatile hydrocarbons	-80 %	
benzene	< 2.5 µg/m3	
diesel soot	< 1.5 µg/m3	
dust (PM 10)	< 20 µg/m3 (-70 %)	
phosphate/water quality	EU water quality	Waters class II
Remainder waste	-50 %	
number of noise-concerned of residents	100.000 (-50 %)	0 (-100 %)
Market share of environmental construction products (erosion, nutrient entry, biocides)	Portion of 100 %	

Notes and sources: Base year usually 1990 (if indicated).
Not renewable material (raw materials with overburden): BUND/Misereor 1996: 80
Drinking water: Resolution of the Lower House from 15 October 1992, Drs 12/2054 (goal year 2000). Drinking water promotion altogether is determined as a reduction goal for regionally sustainable use (cf. 4.3.3.1).
Energy: BUND/Misereor 1996: 80. diagram ebd. 69. Renewable energies 2010: European Union commission 1997a: 1 FF.
Green areas: near housing: 6 m2 for each resident in 500 km distance with mind. 0.5 hectars; settlement near: 7 m2 for each Einw. in 1000 m distance with mind. 10 hectars, SenStadtUm 1994a: 127, 132.
Nature and/or landscape protection: SenStadtUm 1994a.
Carbon dioxide: 2010: Reduction for each resident in connection with federation and European Union measures 50 a %ige reduction is aimed at. SenStadtUm 1994b. For 2025 with nationalpolitical measures a reduction is aimed at 50 %; for SenBauWohnVerkehr 1998: Plant 1, S.2. 2050: Enquetekommission of the federal daily; UBA 1997; BUND/Misereor 1996: 80
Nitrogen oxides: SenBauWohnVerkehr 1998: Plant 1, S.2 (ozone forerunner materials). For 2050 also Enquetekommission of the Bundest.
Volatile hydrocarbons: SenBauWohnVerkehr 1998: Plant 1, S.2 (ozone forerunner materials); Board of experts for environmental questions; BUND/Misereor 1996: 80
Benzene and Diesel soot: SenBauWohnVerkehr 1998: Plant 1, S.2
Dust: Quality of the environment air guideline.
Phosphate/water quality: Water quality class II after Trophie yardstick. SenStadtUmTech 1999a.
Remainder waste: SenStadtUm 1995: 18. appropriate reduction of the total waste arising.
Noise: 2010: Residents concerned from the long term health-endangering noise > 65 db(A). Sen BauWohn traffic 1998: S. 22,
Agriculture: for the reason s. 4.3.3.3. BUND/Misereor 1998: 80
For sulfur dioxide (SO2) no goal was formulated, because of Berlin today already its output related to its population portion under the emission goal for Germany, suggested by the European Union commission, (KOM 99/123:51, 90)

The fact is that if the statistics are taken seriously and viewed in the context of the results of and requirements set out in the national sustainability study, they have virtually paradigmatic consequences for municipal policy and city planning. Confronted with both this truth and the binding commitment to action and programs expressed in the published figures and data, mayors, city councils, municipal parliaments, and planning department heads are, for understandable reasons, still hesitant to act. The same is even true of many environmental and NGO representatives in the ongoing Agenda 21 processes.

When things get really concrete, when we are forced to step out of the abstract and noncommittal security of national target frameworks and commission recommendations and instead demand feasible and verifiable action programs to achieve, in our own sphere of responsibility, goals that are widely seen as utopian and unrealistic, then even environmental actors themselves sometimes balk at getting down to work on this evidently highly unpopular task; the reason for this is the incalculable risk of drifting off into political isolation and no longer being taken seriously. One other reason is that national and local environmental policy at the lower level of "feasibility" is sometimes wholly successful, a fact that the author of the present paper is entirely willing to admit.

This goal dilemma has unfavorable effects on the Local Agenda 21 process in particular. In it, the process has tended to lose its orientation and actual task definition, to be hobbled, losing a measure of its strength and meaning. Many of those involved are now already more or less frustrated by the course that the Agenda 21 process has taken and fear that it may be relegated to obscurity and reduced to an excuse for not coming up with any genuine local environmental initiatives.

Even the municipal planning research and demonstration programs promoted with large sums of federal money have tended to assign a more marginal role to the goal and time frames for sustainable development. Endowed with generous promotion funding and included in the "City 2030" competition sponsored by the federal research ministry since 2001, which calls on municipalities and research institutes to draw up comprehensive visions for the 21st century, the competition, while clearly referring to the issue of sustainability, has largely failed to generate the intensive debate on national sustainability objectives that was originally envisioned. The results achieved by the federal building and housing ministry's urban development program for eastern German cities (since 2001) or the *Länder* Initiative on the development and testing of a new type of urban "quarter management" (since 1998) have led to similarly disappointing results.

In summary, it can be said that there is a striking contradiction between the required and defined environmental goals set by the national sustainability studies and the ongoing municipal development programs. This is in no way meant to disparage the municipal environmental and sustainability policies practiced by many towns, with their at times considerable successes. They have often and rightfully gained considerable national and international recognition in recent years, and in many respects they have an important pioneering function.

But if the matter at hand is to go beyond model projects and achieve the goals of a sustainable Germany as well as sustainable cities and municipalities by the middle of the 21st century, what is called for are strategies and concepts that extend far beyond the approaches advanced thus far. In this case urban environmental policy would have to take leave of the niche position to which it has more or less been relegated in connection with the so-called sustainability triangle (with its economic, social, and ecological corner points) and assume the role of a leading policy segment.

Is sustainable urbanization feasible in the first place?

How justified is the resistance to the task of taking on national sustainability goals in a more consistent manner at the local level – at least as a strategic orientation for the 21st century?

It is true that the basic political conditions for such a comprehensive social reorientation do not appear favorable at present. For example, at the national and local level the fiscal situation offers municipalities little leeway for a more comprehensive sustainable reorientation. Even though, for example, the first stage of Germany's eco-tax that has been implemented thus far, the new law on energy saving, the "100,000 Roofs Program" for the promotion of photovoltaic technology, or the basic idea of the German law on a circulatory management system, are important steps in the right direction, they do not go nearly far enough toward setting in motion a broad-based reorientation of policy. While concrete proposals aimed at reshaping the framework conditions for a really effective reorientation have been advanced, at present they are not capable of obtaining a majority. They will not be the subject of any further discussion here.

In the context of the present paper the more interesting question is how and/or according to what guidelines should cities and urban structures be transformed in such a way as to meet the requirements of sustainable development as set out in the target values in tables 1 and 2. Is the perspective of such transformation at all attractive for the people affected? Does it, in another words, have a chance of finding popular acceptance?

Now to the guidelines

As we have pointed out, since the 1970s and 1980s, guidelines, strategies, and concepts have been developed for a sustainable transformation of our present urban and settlement structures. I will now sum up the most important guidelines (see also figures 2 and 3):

- All in all, the sustainability goals called for can be achieved only by a paradigm shift away from the principle of a linear dependency on external resources.
- What is called for is a reorientation of urban and settlement development to the principle of a high level of cycle-oriented self-supply.
- The task at hand is to create the basic conditions needed for economic and supply structures that would make possible an optimal and highly efficient market-based use of local and regional resource potentials.
- An extensive reduction of dependence on external resources must be the aim in particular of the basic provision of resources in the fields of energy, food, building, housing, and water.
- In (re-)orienting local and regional recycling systems, attention should be given to higher levels of efficiency and reduction resource depeletion in the overall urban system and its subsystems.
- In keeping with the targets set, and bearing in mind specific local/regional conditions, it would be essential to effect a gradual move away from nonrenewable resources and fossil fuels to renewable sources of energy and raw materials.
- Measures aimed at transforming urban systems should always be guided by the "five basic rules of sustainable development" (see figure 1) as well as to a systematic increase of local and regional system stability.
- Man plays the key role here – and it is to people that the process of urban technological and structural change must be geared; effective ecological contexts should be rendered

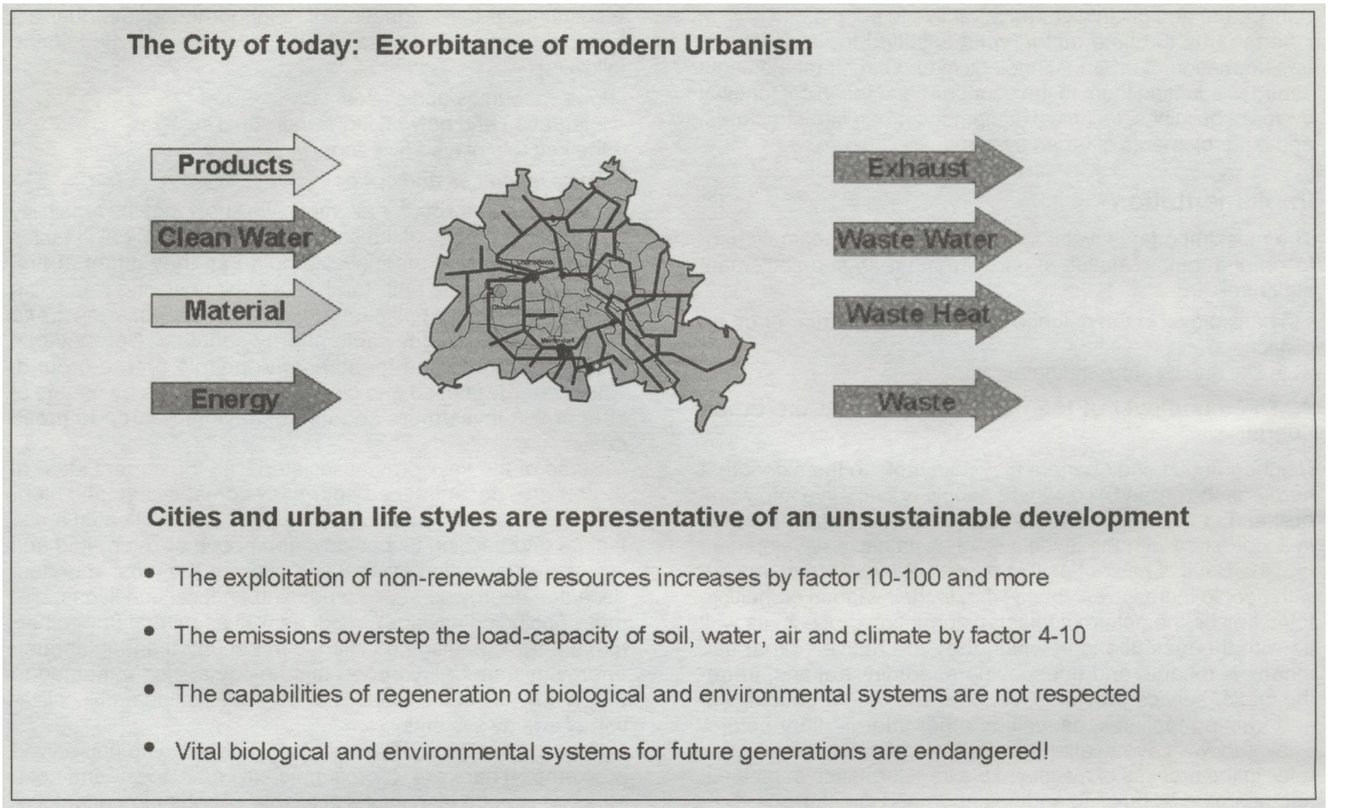

Fig. 2: The given situation: Exorbitance phase of modern urbanism.

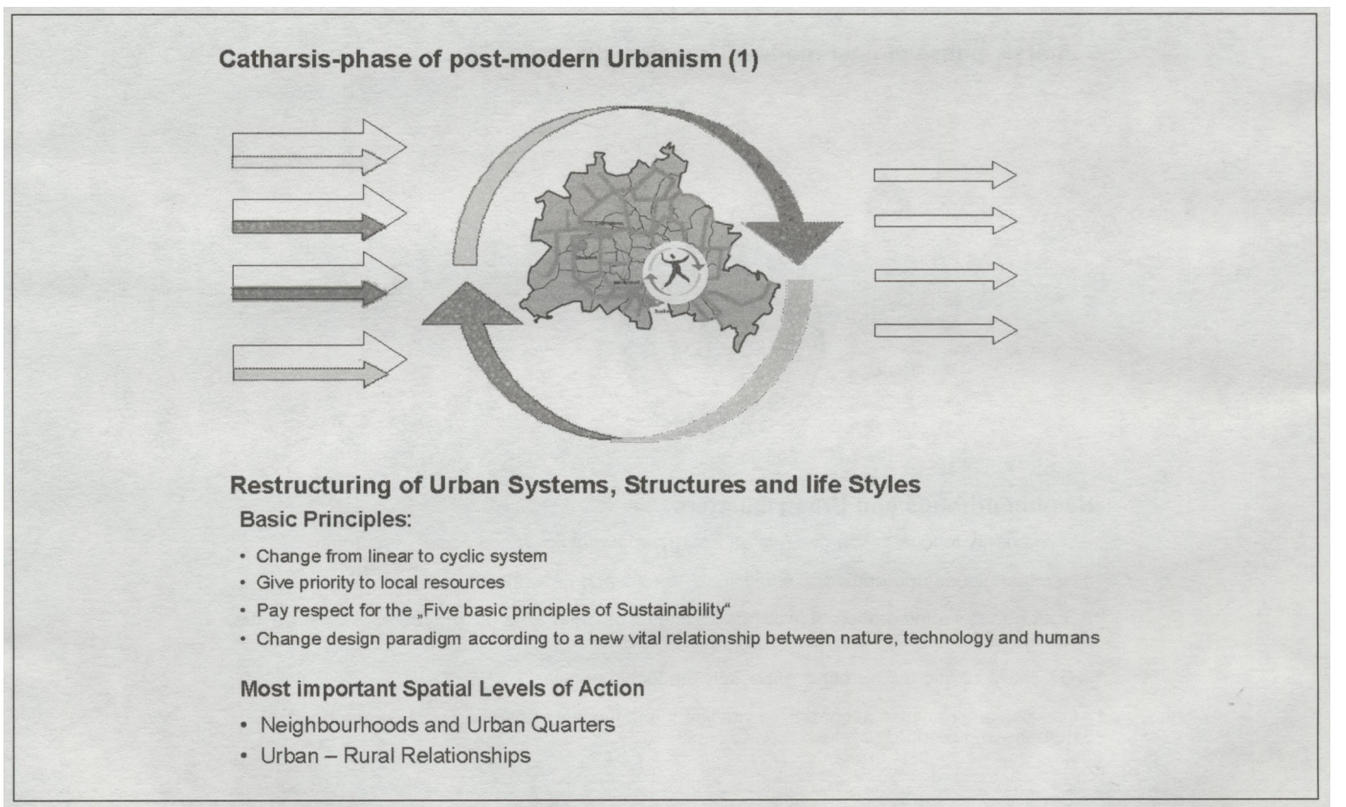

Fig. 3: Catharsis phase of (post-)modern urbanism.

transparent and given a shape attractive to people.
• As regards the time factor, what is called for is a gradual transformation of urban technological and structural elements aimed at adapting them to the economic and technical renewal cycles of buildings, technical equipment, urban infrastructures, and other elements of urban systems.

Implementation

The most important levels of action involved in the implementation of a transformation of our current urban and settlement structures are:

• the microlevel of the neighborhood and the quarter, or urban district;
• the city and its surrounding areas.

• The microlevel of the neighborhood and the urban quarter

Neighborhoods and quarters play a key role to the extent that here, "on the ground," i.e. where people actually live and work, built and unbuilt urban structures must gradually be reshaped in accordance with the guidelines of sustainable development (fig. 4). But this has not only to do with external structures but with people themselves, those who, in their various or multiple roles, will be the actors of this transformation process, as well as with the institutions in which they are active. What this means is tenants and houseowners, administrations, trade, the crafts, service providers, schools and others educational and training facilities, as well as other intermediary actors. They, too, will have to alter their behavioral patterns and actor roles in the process of a sustainable transformation of material and nonmaterial building and neighborhood structures.

I will now address the question of the technical feasibility of a sustainable transformation of neighborhoods and quarters based on the present state of our knowledge, focusing on the following:

– local resources and cycles
– integration and networking of individual systems
– the key role played by people

• *Local resources and cycles*

In the field of **energy**, for example, we know that the feasibility and the time frames of the sustainability goals set out in tables 1 and 2 are by no means as utopian as they might at first appear. This goes both for the necessary saving rates, like reduction goals for pollutant and climate-gas emissions, and for conversion to renewable energy sources. But they can only be implemented together with people on the ground, where energy is used and consumed, as well as by means of changes in investment and use behaviors geared to these goals.

Some of the keywords associated with the current state of the art are: decentralized energy systems, systematic high-efficiency thermal insulation measures, climate-oriented architecture and building technology, and above all a targeted and systematic utilization of local solar power, the most important decentral energy source. Depending on local conditions, biomass (including sewage), wind, as well as natural or geothermal energy can also be included in decentral and integrated energy systems. Hydrogen technology is also expected to play a key role in the process of decentralization and localization of energy systems.

On the other hand, however, there are still also unresolved problems. There are, for example, still no efficient and cost-effective storage techniques available. Another important element here is an energy management geared to user needs

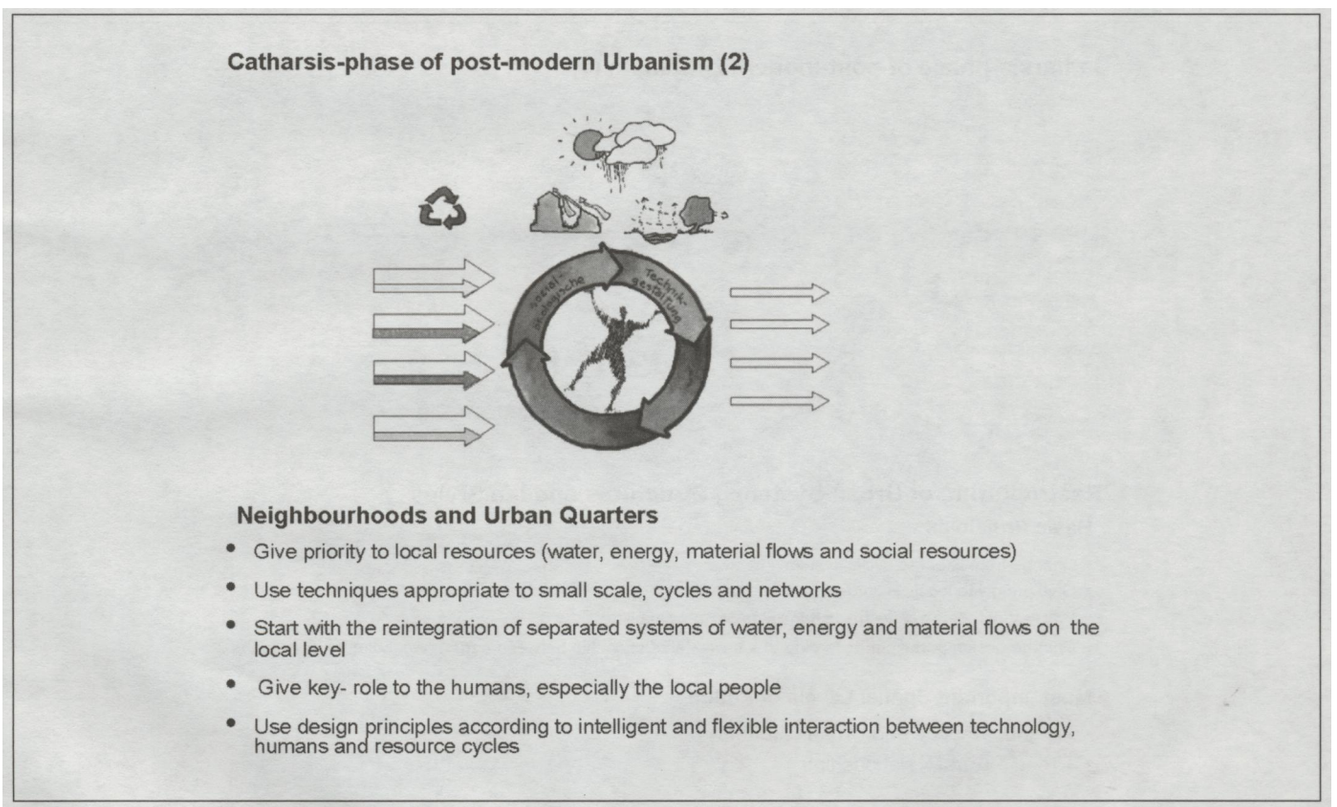

Fig. 4: The action level of the neighborhood and the urban quarter.

and local conditions. Many of the other components of a sustainable quarter-related energy management, cited here merely as examples, are already state of the art or in use in model projects, and offer substantial potentials to achieve technical, economic, and ecological efficiency gains. As a long-term scenario, even a reversal of the present situation should not be ruled out, because urban quarters or villages can be converted, on a sustainable basis, from energy-consuming to energy-exporting units, and even today, looking at the building level, there are already some plus-energy houses in operation.

A similar situation exists in the field of **water/waste water** – in global terms, even today the most important problem facing many cities. Here too, modern science and technology are in the process of developing completely new solutions for integrated, decentral circuit systems for urban contexts; some of these systems have already reached the stage of market maturity or are at least being tested in model projects. They indicate that it is possible to substantially reduce both present water consumption and dependence on external resources. This is made possible by consistently using modern water conservation techniques and taking advantage of unused, locally available water like rain, surface water and bank filtration. Further focal points include decentral cleaning and re-use of lightly polluted gray water for less demanding uses, but also the use of new decentral biological purification techniques and suitable monitoring procedures. Above all, however, the concern must be to use not only technical approaches for solving water problems but also to ensure that water is once again experienced as an "element of life." Here too, there are already many examples showing that the given sustainability goals can be met.

As regards **materials flows,** present levels of materials waste and material consumption can be substantially reduced by systematically introducing cyclic and multiple-use concepts, by lengthening the use and life cycles of products, by introducing suitable recycling and re-use concepts, and by making use of available leasing and contracting concepts for present materials waste and material consumption, more decentral materials and product management, including conversion to regenerative, above all biogenic, natural resources for industry, investment, and consumer goods.

There are various possibilities to revitalize vital microlevel **climate- and nature-protection functions** with the help of soil, water, flora and fauna systems that have been adapted to the urban context. This would make it possible to substantially (re-)strengthen ecological system productivity and ecological stability in urban quarters. Urban terrains such as fallow land, conversion areas, industrial, railroad, military areas as well as other municipal reconversion areas, but also rooftops and building façades, transportation and infrastructure areas would be available for the purpose.

• *Integration and networking of individual systems*

In the end, however, the main concern is not to use individual systems to reduce dependence on external resources, to rediscover locally available resources, and to step up conversion to renewable natural resources with the respective individual systems; the concern must be to come up with new innovations that make it possible to network and integrate such systems, in this way cashing in on potentials for systemic synergy effects. We know, for example, that it is precisely diverse and microlevel system networking that accounts for the high levels of productivity and system stability shown by natural ecosystems – a fact which applies as well for the anthropogenic urban and settlement systems of the pre-industrial age that were referred to above.

One example of how this post-industrial level could look, and one that has been realized in model projects, is the recycling of local bioproduction of biowastes, waste water, and sewage in new, local nutrient cycles to produce algae and fungi or for aquacultures or the production of local biomass and biogas to cover local energy needs – in connection with composting aimed at quarter-level soil improvement measures.

• *People play the key role*

The key role in this transformation of urban neighborhoods and quarters to achieve post-industrial sustainability is played by the people who work and live there. It is they who have to accept and operate the new, local-level, decentral technology and cyclic systems referred to above. Unless people decide in favor of reversing their lifestyles and their approaches to their natural environment and opt to break with consumption patterns that release them from responsibility for their immediate environs, it will be difficult to introduce such systems, or they will prove ineffective and not lead to the desired sustainable effects.

A further concern will continue to be to develop, at a new technological, social, and organizational level, appropriate new structures of cooperation, co-production and operational structures between different local actors. The task here is to develop management structures between residents, enterprises, new local service providers, urban administration, and intermediary actors suitable for an efficient operation of the new decentral structures and technical systems. But the chief concern is a new interplay between man, nature, and technology. That is what is meant by the call for a new eco-cultural communication on the ground – and without it, the path leading to a new, sustainable, post-industrial era of civilization will be and remain obstructed.

● The city and its surrounding areas

The ecological revitalization of the relations between the city and its surrounding areas and endogenous regional development (fig. 5) have a similar key role for sustainable development. The concern here, too, is to come up with a change of perspective from the presently dominant dependence on external resources to a reassessment of land in its potential as natural and culture land with a view to raising self-supply ratios and regional ecological system stability.

The aim must be to reshape the complementary ecologically, economically, and socially relevant functions that obtain between dense urban-use areas – including, for instance, the above-described urban neighborhoods and quarters or settlements in suburban or interurban areas – and nonurban agricultural and forestry areas, near-city leisure areas, river meadows, and wetlands, as well as other undeveloped areas or extensively used infrastructure areas in the surrounding areas of cities and in interurban areas.

Until now industrially defined regional and urban planning has paid little attention to these areas as regards the principles of sustainable development. This was a direct consequence of technological and economic development, which, as described above, is based on dependence on external resources and has until now, almost at will, been able to externalize negative ecological consequences.

It is time for a complete re-evaluation of these areas and their uses, if the paradigm shift to a sustainable definition of these complementary urban areas is to be achieved. A few keywords here:

• enlargement of ecological agriculture in areas close to cities, including processing of products into high-quality food that can be marketed directly at the local or regional level;
• designation of urban-area wetlands with a view to using nutrients contained in urban wastewater to generate biogenic energy or to produce biogenic raw materials;

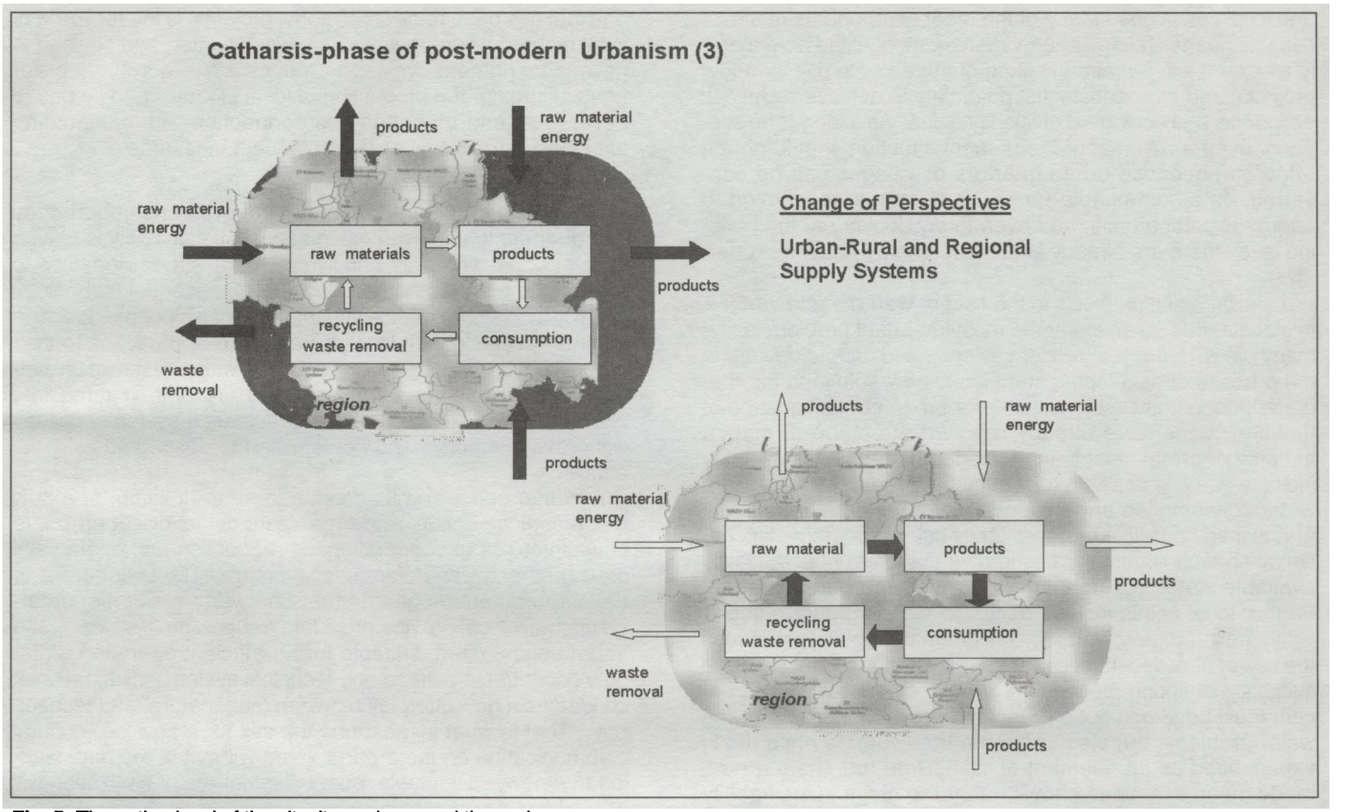

Fig. 5: The action level of the city, its environs and the region.

• agricultural and forestry-based production of renewable resources for the energy sector as well as for industrial production. Another important issue is the
• enlargement of urban-area for purposes of regionally accessible recreational, leisure, and health functions.

All in all, the concern here is to systematically develop regional product lines and foster clustering along service and value chains in all areas bound up with the provision of basic goods and services.

The more self-supply in all areas concerned with the basic goods and services as well as with ecological system stability is successfully strengthened at the local level, the greater the potential for a meaningful exchange of goods and services at a higher level of the value chain and the potential for an interpersonal communication that does not threaten the ecological foundations on which our civilization and its development is based.

An intermediate résumé: It should be noted here that there now exists a broad consensus on the absolute need for an ecological turning point to ensure the sustainability of our society. It is also widely accepted that this turning point will be primarily local, i.e. that it will be implemented in and by people where they live and work, where a new local and regional recycling-based economy will have to develop at a new technological and social level – in an increasingly urbanized world society, in settlement structures increasingly defined by urban lifestyles and marked by growingly differentiated manifestations.

There is also a large measure of consensus, at least in principle, on the goals which must be met on the way to a sustainable future based on the process of an ecological transformation of our cities and settlement structures.

In the meantime, we have a large stock of well-founded knowledge on how such a post-industrial, recycling-based economy could look, as well as on the means that could be used to reach this goal. The most important base information needed to begin the process of change is already partly available or is in the phase of testing and development. Many concepts and techniques have at least proven their worth in model projects. The obstacles in the way of their further dissemination are for the most part known and are generally regarded as manageable.

What we currently lack, or have yet to develop adequately, is a broad social consensus and the will to embark on a sustainable future, the faith in the feasibility of the project, and the will to overcome the obstacles to it in a more targeted and conscious manner. I would like to deal with this aspect in the last part of this paper. It has to do with the cultural dimension – and this means that a future of this kind can not only be approached by purely rational means but should also be imbued with positive symbols, with consensus- and motivation-building examples that inspire a yearning to get there.

New eco-cultural understanding on the ground

The idea that we should reduce our energy and material consumption, pollutant emissions and land use in our personal living environment by a factor of up to 4-10 is simply inconceivable for many people, seemingly unrealistic and unattainable, more apt to turn people off than to win them for the objective of sustainability. On the whole, our society has in recent years proven to be markedly sluggish and resistant to reform.

We have not yet fully succeeded in linking the undoubted need for an ecological paradigm shift to positive, attractive,

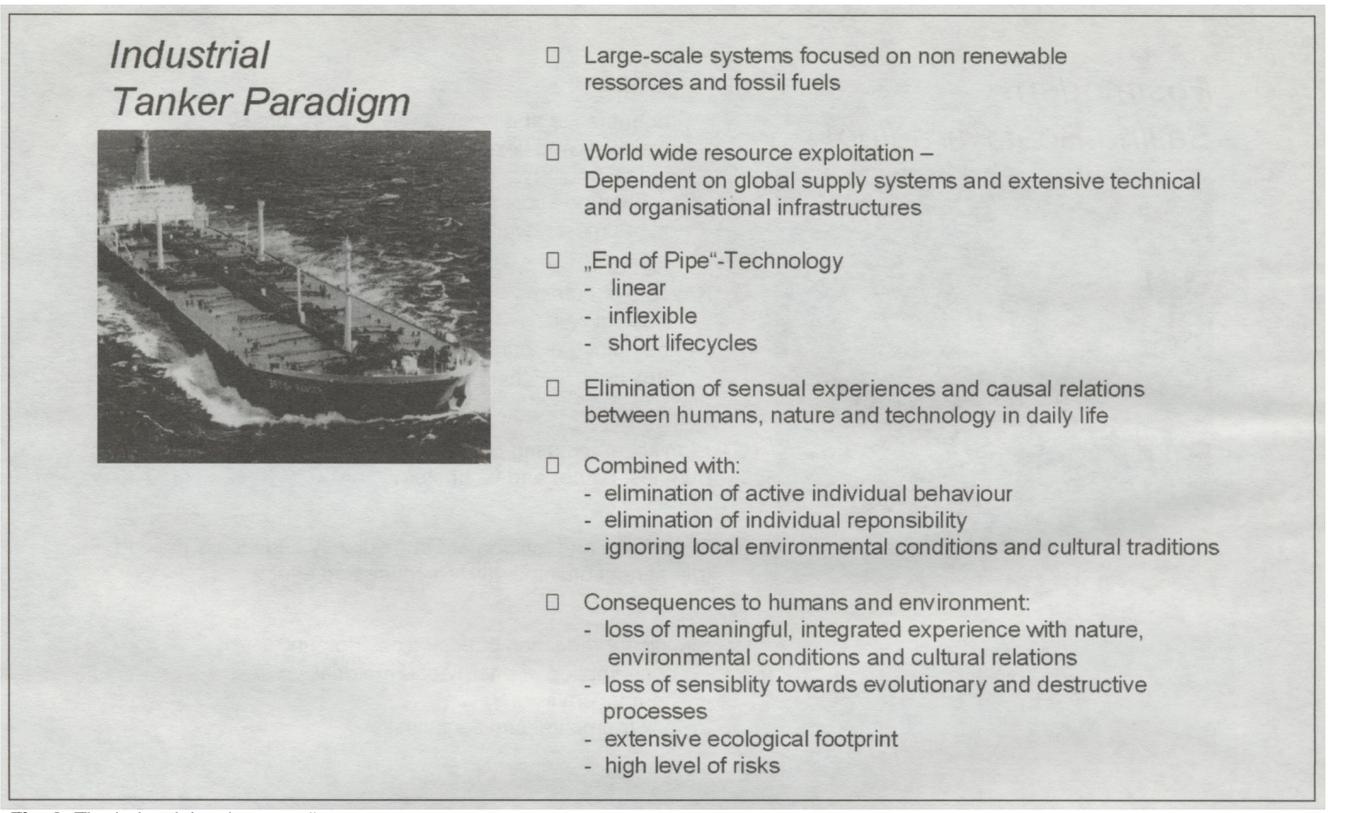

Fig. 6: The industrial tanker paradigm.

exciting, and desirable notions and images – i.e. in generating the proper attitudes, curiosity, desires, fantasies, and interests. Instead, a majority of people continue to see environmental issues as antimodern and backward-looking, restrictive and holier-than-thou, as narrow and control-related, as something that requires us to disavow beloved consumption patterns, to do without the achievement of our consumer society. Also, as has been suggested by the experience of the eco-tax, few people are prepared to shoulder additional costs.

How can we manage to ensure that the task of achieving this ecological shift in society, city and settlement structures will come to be seen as one of the most exciting challenges of the 21st century, as a quantum leap of our civilization, one that opens up new qualities, perspectives, possibilities, and chances, and one that is worth working for?

Given past experience, pure rationality alone will not be sufficient. We have to start out at a deeper level, where the majority of people, according to the results of almost all recent polls, have arrived – on an emotional, subconscious level – but are still waiting to be picked up. This also has to do with communicating the concept of a new post-industrial "existential community of man and nature" (Florenskij) as a worthwhile sustainable future at the level of attractive symbols and examples. The latter must stimulate pleasure, be easy to communicate, and above all awaken longing. Antoine de Saint Exupéry expressed something along these lines, in his famous sentence:

> If you want to build a ship, don't drum people together to procure wood, prepare tools, assign jobs, and divide work, but rather awake in them a longing for the wide, endless sea.

It goes without saying that the tools, the material, the technical know-how and the required capital are also tremendously important. Nor is it this that we are presently lacking. What *is* lacking is consensus-building longing that motivates people to set out, to get down to work on the problem.

The quote from St. Exupéry inspired me when I was busy with the task of working over the issue of sustainability for my spatial planning students with an eye to ensuring that they do not perceive it as just another annoying compulsory subject, one whose practical value seems rather secondary to most students compared with other subjects. I was challenged by the question of how to successfully instill exactly that longing in my students, the spatial planners of tomorrow.

An important piece of help came from the nature philosopher K.-M. Meyer Abich (1997), who created the metaphor of the transition from an industrial tanker technology to a post-industrial sailing boat technology.[5] I took up the subject, further developed it for our discussions, and observed that this metaphor is able to motivate, stimulate and promote students' fantasies and longings.

The image of the tanker symbolizes, in an unusually impressive way, the characteristic features of our past industrial system. In this form the system is not sustainable and, if we look more closely, not particularly attractive, either, revealing itself instead to be more ponderous and awkward than intelligent. Albert Einstein once characterized this kind of (tanker) technology very aptly in his words: "... what we call technology today is the application of raw force, nature works with form ..."

Einstein, a visionary of his age, recognized the unsustainable and hence transitory character of this kind of technology. The central characteristics of this "tanker paradigm," which aptly describes today's technological, social, and settlement structures, are discussed and summed up in figure 6.

The characteristics of the post-industrial "sailboat paradigm" are completely different (fig. 7). The ultramodern sailing boat, equipped with the most advanced technology, cogently sym-

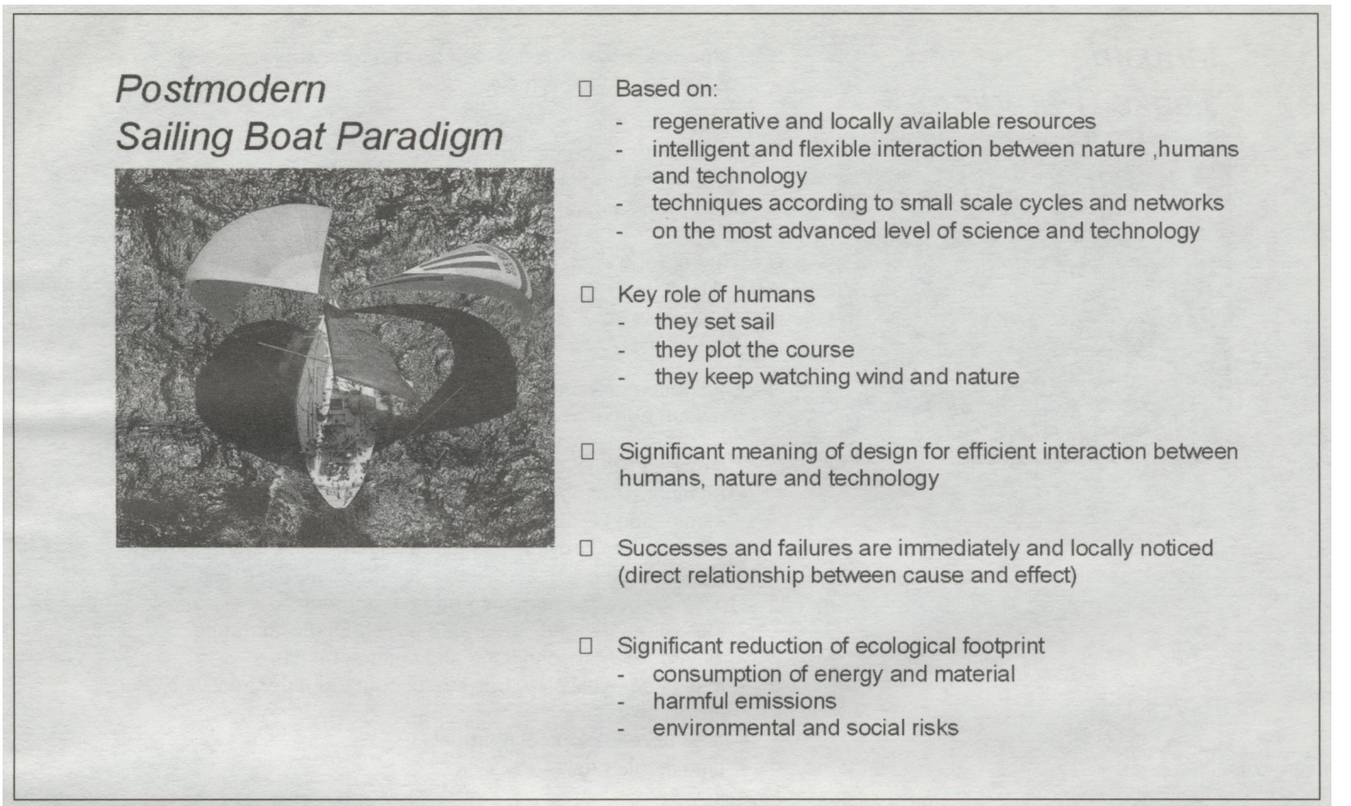

Fig. 7: The post-modern sailing boat paradigm.

bolizes the move to a new post-industrial and sustainable era of civilization. It calls for a far more differentiated management of technological and social resources. The aim it involves is high efficiencies, minimization of resource depletion, extensive reduction of dependence on external resources, and an optimal use of local solar and wind energy. What is needed here is a constant adjustment to continuously changing natural and environmental conditions. The modern sailing boat is characterized by its intricate, flexible, network- and synergy-oriented system structures, which are based on the most advanced state of scientific knowledge.

In contrast to the tanker paradigm, man again has the key position in this new configuration: man who sets the sail, determines the course, observes nature, learning again to deal honestly with it – by experiencing day by day how reliant he is on it; man who again learns to respect nature's splendor, beauty, endless secrets, but also its dangers and unpredictability – using it and trying his strength with it.

Nor is there much space for passengers here. Everyone is in some way part of the crew, contributes his ideas, lends a hand wherever needed, observes nature, develops ideas and assumes responsibility. On a sailing ship it is the crew, people using technology and nature, that play the actually crucial role.

The concern here is no longer yesterday's technology, defined as the "use of brute force," but rather the development of ultramodern technology for optimizing the interplay between man, nature, technology and their design. What *is* emerging here is not only a technological paradigm shift but a far more comprehensive cultural or ecocultural shift of paradigm. To that extent, the design dimension is the third core characteristic of this post-modern and sustainable paradigm that we have called a sailing boat paradigm.

A paradigm shift of this kind is one in the truest sense of the word, a paradigmatic break with the industrial-society consumption model, with a cultural phase that aimed at breaking away from the dependencies, the cycles and laws of nature. What is now emerging at a new level of civilization is a totally new configuration of man, nature, and technology – and in my opinion, this is the only chance available to build a sustainable post-industrial society.

Notes

1. See also Hahn and Simonis (1992).
2. Abschlussbericht der Enquete-Kommission "Schutz des Menschen und der Umwelt – Ziele und Rahmenbedingungen einer nachhaltig zukunftsverträglichen Entwicklung," eingesetzt durch Beschluss des Bundestages vom 1. Juni 1995, Drucksache 13/1533, veröffentlicht als Drucksache 13/11200 am 26.06.1998.
3. BerlinStudie, Zukunftsstrategien fur Berlin, im Auftrage der EU und des Regierenden Bürgermeisters, Endbericht, Feb. 2000.
4. *Ibid*, p. 336.

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