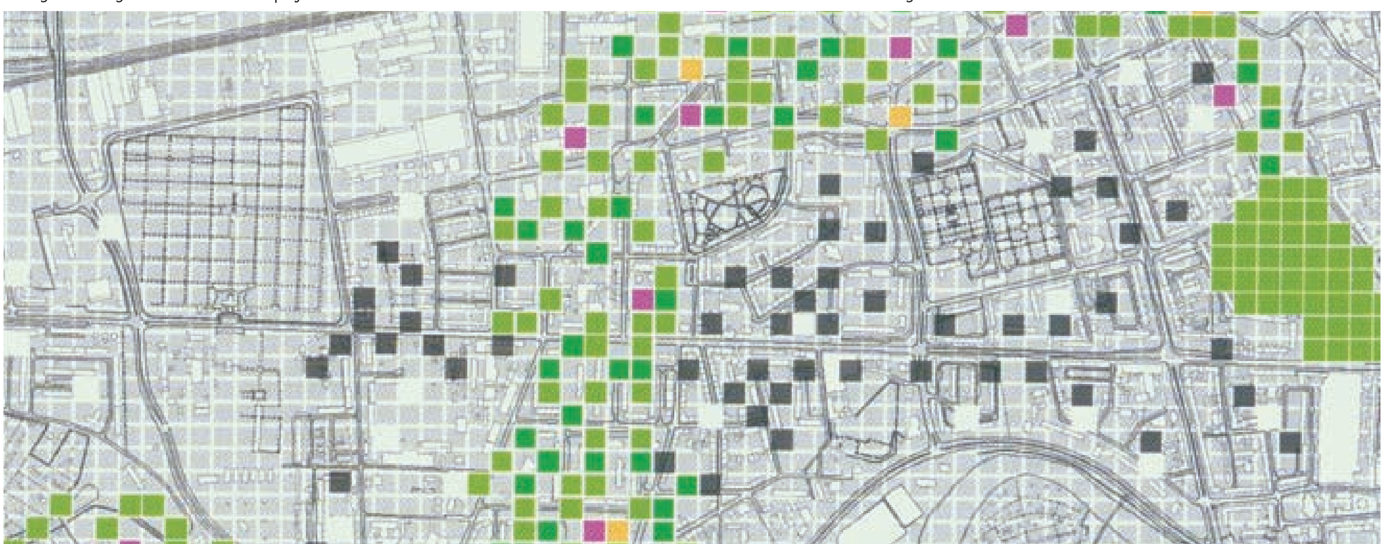
VOLUME 5

Urban Futures 2030

Urban Development and Urban Lifestyles of the Future



HEINRICH BÖLL STIFTUNG
ECOLOGY

URBAN FUTURES 2030

HEINRICH BÖLL STIFTUNG
PUBLICATION SERIES ON ECOLOGY

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Urban Development and Urban Lifestyles of the Future

Edited by the Heinrich Böll Foundation

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PREFACE

This publication is a result of the international “Urban Futures 2030 – Urban Development and Urban Lifestyles of the Future” conference organized by the Heinrich Böll Foundation and the Bauhaus Dessau Foundation and held in Berlin on the 3rd and 4th of July 2009. Urban Futures pursues two corresponding ideas. Our first objective is to deepen the transnational dialog over the role of cities in solving the climate crisis. How do cities respond to the great challenge of our time – the drastic reduction greenhouse gas emissions and adoption of a sound new development path for the future? How can they meet the demand for energy and the mobility needs of an urban population that is growing worldwide without ruining the ecosphere once and for all? From the perspective of global climate justice, it will be crucial to reduce the carbon emissions of highly-industrialized countries by 80 percent by the year 2050. Yet the rising economic powers of the South will also need to make the transition to lower emissions in the foreseeable future in order to keep climate change within manageable limits. The signs are encouraging: China, for example, is in the process of planning CO_2-neutral cities for hundreds of thousands of inhabitants that will cover their energy needs using renewable resources and be designed for carbon-free mobility. The impulses for urban transformation in Europe and North America arising from such projects were discussed in detail during the conference.

Our second objective is to collect visions and models of sustainable architecture and urban planning and present them to a broader public. Dealing with climate change will mean taking a critical look at our building work – work that can only be truly described as “building culture” if it lives up to the need for sustainability. What is needed is a “low-carbon building culture”, as described in this volume by the climate researcher Fritz Reusswig. Constructing, operating and demolishing buildings alone accounts for 40 percent of German greenhouse gas emissions. Together with traffic and industrial production, building-related energy consumption is one of the major sources of urban CO_2 emissions. Future-oriented urban planning and architecture must provide answers to climate change, and “greening the city” is the new megatrend, as numerous architectural conferences and a genuine boom in ecological building activity testify.

This publication contains contributions by numerous presenters of the Urban Futures conference, and I would like to take this opportunity to thank everyone involved for their support in its swift production. This compilation makes no claims with regard to completeness or academic rigor. Nevertheless, it covers a noteworthy range of the current discussion on climate change, architecture and life in urban settings.

The contributions cover fundamental thinking on the future structure of cities and an "energy revolution as a paradigm of urban development" (Peter Droege). They also highlight intelligent architecture that unites ecology, aesthetic appeal and technology in a new synthesis. Other contributions present approaches to sustainable architecture that go beyond "eco-building". Interested readers will discover numerous visionary ideas ranging from climate-appropriate passive air conditioning of buildings in the desert of Abu Dhabi to urban agriculture on New York City rooftops. It goes without saying, of course, that the future of the city is not just a matter of individual new buildings. In Europe in particular, cities are essentially complete, and visions therefore focus on transforming them to protect the climate while improving quality of life and ensuring greater social justice. Some of the possibilities available here can be seen in sustainable cooperative projects in Switzerland as well as in experiments in local power generation in the IBA building exhibition in Hamburg, Germany. How technological innovation can work more closely with grass-roots climate protection movements will require further discussion. With this publication, we hope to deliver numerous impulses to the debate, and above all, to the practical aspects of planning and building.

Sustainable urban development and transformation is a creative challenge for society as a whole. Policymakers at all levels will also need to do their part. Reaching climate goals in the building sector will require more stringent renovation and construction standards than those currently in place in Germany. Beyond regulations and economic incentives, it will be crucial to excite investors, enterprising building project initiators and the urban public for ecological urban redevelopment. Low-carbon cities could then become a reality in Germany and elsewhere.

Berlin, June 2009

Ralf Fücks
Co-President, Heinrich Böll Foundation

SABINE DREWES AND WALTER PRIGGE

Urban Futures 2030 – the Sustainable City of Tomorrow

An Introduction

Visions of how cities should be built or transformed reflect the diversity of views and perspectives on how people will and should live in cities, since planning in any form always also pursues normative goals. Architecture and urban planning reflect the designs that urban society makes of itself and the conflicts of interest related to the use of cities. Problems of the present tend to concentrate in urban centers, as do experimental solutions to those problems. The built environment, its design and its redesign are themselves becoming objects of the debate over the city of the future.

Climate change is a major problem of the present. It has become common knowledge that the world's cities account for around 80 percent of all CO_2 emissions, and that they conversely offer numerous options to mitigate emissions. Along with industrial production and transportation, buildings are among the most important sources of greenhouse gas emissions. In virtually every corner of the globe, the energy efficiency of existing buildings leaves much to be desired. In Germany, for example, 80 percent of all buildings currently exceed the primary energy consumption ceiling of 70 kWh per m^2 per year stipulated in the German Energy Conservation Ordinance (ENeV) of 2007. Yet the standards of the ENeV are not particularly ambitious. If the climate-friendly conversion projects of the KfW development bank were to continue at their current pace, an additional 25 percent of Germany's residential buildings could be brought up to current energy efficiency standards by 2030. However, private builders in Germany invest several times the total of the funding available from the KfW in residential construction projects without benefiting climate protection. Furthermore, population growth and urbanization is putting considerable pressure on many countries for new residential building – especially the newly-industrialized China and India – and ecological criteria are applied to such construction projects only in exceptional cases. The sustainable city of tomorrow faces not only ecological, but also major social challenges, and these are reasons enough to dedicate a conference and this associated compilation to urban development and urban lifestyles of the future.

This publication contains contributions from nearly all of the conference's speakers that illuminate a variety of aspects of sustainable architecture, as well as future building and redevelopment. It is structured in three sections: Philosophy, Predictions and Positions, Projects and Policy.

Philosophy, Predictions and Positions

The global trends of climate change and urbanization, as well as philosophies and positions on how architecture and building should respond to those challenges, are the subject of the first section. The international energy expert Peter Droege takes his very own prognostic look at the future of cities. He believes that dangers to the affluence and stability of cities will arise from the same sources that permitted them to grow to their current size and wealth – fossil fuels and nuclear energy, with their finite natures leading to the predictable or welcome end of their predominance. In his view, an "energy revolution" in favor of decentral sources of energy from renewable resources will be indispensable – an option for the future that is technically feasible thanks to the availability of intelligent network technology and suitable storage media, but which will require political will to implement. Weiding Long highlights urban development trends in China that are typical of a number of major newly-industrialized countries and illustrate the relationships between population and economic growth, urbanization and increasing CO_2 emissions. According to World Bank estimates, in 2015 half of all building activity worldwide will be taking place in China. At the same time, the Chinese also look forward to improving standards of living – this is all too easily understandable considering that many Chinese apartments have an average temperature of 14 °C in winter and 29 °C in summer. These developments will exacerbate climate change despite Chinese plans to build a number of new eco-cities and deploy renewable sources of energy. This underscores the need for action by the West, which still uses considerably more energy per capita – especially in the building sector – and which must reduce that consumption drastically to remain credible with regard to climate policy.

In 1994, Philipp Oswalt developed a rather visionary philosophy for rethinking architecture in light of growing energy consumption and unhealthy buildings which remains valid today and is gradually beginning to fall on fertile ground. He called for holistic, integrated planning of intelligent buildings that encompasses the building's structure, façade and technology, and which no longer looks upon the inhabitants as a disruptive element. At the same time, Oswalt presented a number of thoughts about the social context of the new thinking in architecture: He called for "new building clients" that place the long-term interests of society before short-term profit maximization and for political instruments to help them to assert themselves. Even though private building clients are showing much more interest in sustainable building than they did ten years ago, these questions remain relevant in the context of a generalization of sustainable building practices.

Fritz Reusswig continues in Oswalt's vein. After establishing the rather lamentable ecological state of German building culture, he calls on the professional ethics of architects to use their creativity and dedication to breathe life into a low-carbon building culture – in keeping with Bauhaus traditions.

If Piet Eckert had his way, he would rebuild European cities from the ground up as energy-optimized cities of the future. That will not be possible, however, so he is hoping for a greater acceptance of urban density among Europe's city dwellers.

Projects

A number of architects pick up the thread from Oswalt and Reusswig. Sebastian Jehle describes sustainable architecture as the art of planning and design that applies "simple technology" – systems that rely much more on reactive and self-regulating natural processes than active, dedicated technology. This involves using technology to optimize natural processes such as air circulation, the changing time of day and the incidence of light rather than creating them artificially – an approach to architectural design that preserves the experience of the natural environment while maintaining the protective function of the building. It is also interesting how these options, with suitable regional variations, are applicable in a variety of cultures and climate zones. Jehle's examples are based on an office building in Landshut, Germany, and the headquarters of Q-tel, a telecommunications provider in Doha, United Arab Emirates.

Matthias Schuler and the SMAQ team Sabine Müller and Andreas Quednau have similar things to report from their respective viewpoints about how current planning, in this case in various developments in Abu Dhabi, works with the natural environment instead of against it. In doing so, the engineers borrowed a number of ideas from local traditional building techniques.

While Schuler considers the planning of Masdar as a CO_2-free city to be a vision waiting to be repeated elsewhere in the world, it is not entirely surprising that these simultaneously simple and highly complex technological solutions for sustainable building can be found increasingly in the United Arab Emirates. As encouraging as it may be to have European architectural offices performing highly innovative work in the Emirates, one must nevertheless hope for investors for the transfer of their techniques. Those who assume that truly innovative sustainable building solutions can only be realized in new buildings are mistaken, however.

In his contribution, Michael Müller highlights new efforts to certify sustainable building in Germany's existing buildings. Energy savings of up to 90 percent are technically and economically feasible. Further research and – above all – implementation of the available options for existing buildings will be crucial, as new projects now make up a negligible share of building activity and investment in Europe and even in North America and will continue to do so in the future.

In Europe and North America, visions of tomorrow's building cannot be based primarily on individual, new structures. Visions of the buildings of and for tomorrow must arise from the reinterpretation of quarters and concepts of urban redevelopment. Interested readers will find inspiration to that effect in the Projects section as well. The New York-based BrightFarm Systems urban agriculture company is increasingly making a name for itself. Every hectare of roof area used to grow tomatoes, cucumbers and pumpkins in solar greenhouses frees up ten hectares of land, saves 75,000 tons of fresh water and mitigates 250 tons of CO_2 that would otherwise be emitted transporting conventionally-grown vegetables, explains Ted Caplow in his contribution. This is a key project not only to mitigate climate change, but also to address the impending world food crisis. Power generation – preferably using renewable resources – can also be integrated into existing city quarters, as Simona Weisleder explains in her article on the IBA Hamburg building exhibition. An old flak bunker and a former landfill are being used for that purpose. The Kraftwerk1 cooperative in Zurich, Switzerland, is a special example for civic dedication to sustainable urban redevelopment. The initiators realized the first large-scale residential building according to the Swiss Minergie standard on the site of an old mechanical engineering factory and financed it for the most part out of their own pockets. Andreas Hofer, who was involved in the project from the start, emphasizes that the behavior of its inhabitants is a significant factor for a building's energy performance, and this easily optimizes itself when residential property is communalized in this manner. Joachim Eble uses the EU Ecocity project in Tübingen, Germany, to illustrate the planning of the controlled expansion of residential areas while minimizing the rise in motorized individual transportation that this normally entails. Last but not least, Stefan Denig presents the “Sustainable Urban Infrastructure: Munich – Paths toward a Carbon-Free Future” study which was commissioned by Siemens and provides a city-based perspective on a 90-percent reduction of CO_2 emissions.

Policy

Sustainable urban redevelopment needs a suitable policy framework, and representatives of various political institutions and positions provide an orientation here. Ulrich Hatzfeld describes the relevant programs of Germany's Federal Ministry of Transport, Building and Urban Development. For example, 865,000 apartments have been built or renovated with support from KfW development bank programs promoting energy-efficient construction. Climate protection and global responsibility are also focal points of Germany's national urban development policy.

Peter Hettlich outlines the positions of the Green Party, asserting that sustainable building can only succeed if binding regulations are put in place for energy consumption and building materials to be used. The Green Party favors energy consumption standards of 60 kWh/m^{2}a for existing and 15 kWh/m^{2}a for new buildings – figures well below the currently applicable limits. They also advocate certifying building materials and broadening the scope of Germany's Renewable Energies Heat Act (EEWärmeG) to include existing buildings.

Franziska Eichstädt-Bohlig would like to see a federally funded model project patterned after the cautious approach to urban renewal pioneered in West Berlin in the 1980s to create an economically, socially and ecologically sustainable city in the northern part of Berlin's Neukölln district.

Climate-friendly cities also need good communication: Ulla Schreiber relates how the town of Tübingen is winning an increasing number of citizens over to the cause of active climate protection with its Tübingen macht blau campaign.

Indeed, a citizen's movement for climate protection in the building and residential sectors remains sorely needed – not only to realize radical lighthouse projects, but to spur legislators on. Renovating existing buildings in Germany to improve their energy efficiency would, for example, have called for a substantial, dedicated stimulus package – an opportunity that has so far largely been missed. The city of tomorrow contains many construction sites – literal and figurative – that will only become sustainable if as many people as possible contribute.

I

Philosophy, Predictions, Positions

PETER DROEGE

The Sustainable City: the Energy Revolution as a Key Urban Development Paradigm

Globalized Cities

Many perceive the global economy as an urban phenomenon in which business processes appear to take place in cities and urban networks. Despite their dependence on logistical streams outside of the cities, the world's leading political systems have organized their communal spaces and public institutions as urban societies. These, in turn, shape the political systems – as Churchill noted in his famous one-liner: "We shape our buildings; thereafter they shape us."

A lesser-known fact is that cities – their form, economy and growth dynamics – have always been shaped by the energy systems predominant in their respective epochs. The great peril of our time – for any city or nation, or the global balance of power – lies in the nature of that relationship. While this applies to historical urban development as a whole, the speed and scope of the current wave of development and the rise of megacities as a simultaneous and worldwide phenomenon are without parallel. The explosive growth of urban dwellers as a share of the world population in the first half of the 20th century was foreshadowed by the earlier expansion of a number of major cities such as London. As of the 1950s, the trend accelerated dramatically, leading to the abrupt growth of many urban areas. The highest population growth is taking place in urban regions, which today are home to half the world's population. Vast, dynamic forces are at work consolidating the pre-eminence of the cities, and that development includes the growth of world trade and accompanying structural changes in many agrarian states.

A major share of that new growth is occurring in the slums sprawling outward from major cities in developing countries – slums whose growth was stimulated by structural change programs of the World Bank and International Monetary Fund in the 1980s that proved disastrous for autonomous development aspirations (Davis 2007). Yet next to all of these individual mechanisms, no single force has had such a comprehensive effect on urban growth as the fossil fuel economy and its underlying network of production, distribution and consumption (Scheer 1999).

The regenerative future of the city is inevitable

Pathological dependence on oil and ostensibly cheap coal power promoted the development of cities and transformed regions, created global supply networks and disengaged cities from their agricultural hinterlands. At first glance, the global rise of cities appears to be a phenomenon related to fossil fuels. This very significant fact is not mentioned in literature related either to cities or to energy. It is also quite apparent, however, that the main risks to global security, the global market and affluence in the 21st century do not arise directly from urban growth or the leading position of cities within society. The survival of cities is endangered by the very driving force behind their development: an all-embracing dependence on fossil fuels. While the fossil energy revolution bestowed unprecedented affluence on industrialized nations, the geographical limitations of fossil fuel and uranium reserves now pose a significant threat to the continued existence of markets and global security – the classic Faust syndrome. Forty major oil fields cover nearly two thirds of the world's oil requirements, and three quarters of them are located in risky, conflict-ridden and war-torn regions. Over three quarters of all documented world oil reserves are in the hands of national oil companies, making them potential instruments or weapons of foreign policy. The rest are held by major energy conglomerates and multinational companies.

The prevailing system is currently being given a major and dangerous – but potentially healthy – damper: regional endeavors to develop renewable energy sources and make "green" power available as a primary energy source within the next two decades will soon become an absolute priority of the cities. By the middle of this century, we could have an energy system completely free of emissions or nuclear power: a virtually complete harnessing of the abundantly available resources of solar, wind, hydroelectric, tidal, geothermal and bio-energy. This will require the construction of intelligent grids with both real and virtual storage capacities; of decentral, free-standing and grid-bound power-generation systems; of intelligent electric vehicles that serve as mobile storage units, as well as powerful national, market-based frameworks that will liberate worldwide capacities for the urban use of renewable energy from their current constraints. This future does not require emissions trading: rates for feeding power into the grid, regulations pertaining to the public and private sectors and financing, as well as a steady reduction of subsidies for fossil fuels will not only meet the requirements, they will be even more effective – faster, fairer and less costly. Despite the overall pressure to continue with business as usual, the future lies in the construction of climate-compatible cities that are not vulnerable to the volatility of the present energy market – a future that a number of hopeful pioneers are already striving toward. The regenerative future of the city is not only economically and socially feasible – it is the inevitable conclusion of every careful analysis of the conditions.

The last gasp of fossil-fueled vitality – which is now reaching the apogee of its extreme trajectory – should be used to ensure a soft landing by using the added value of the current boom to provide the economy with a viable and sustainable framework and an economical, highly-developed infrastructure.

Projecting the current trends forward would mean doubling annual greenhouse gas emissions by 2030. This nightmare scenario sets off alarm bells considering that the atmospheric CO_2 concentration has already exceeded sustainable values (Hansen et al. 2008). The concentration must be reduced from its current level of 390 parts per million (ppm) to a maximum of 320 to 350 ppm to prevent an irreversible slide toward a climate chaos capable of putting an end to the Holocene epoch and the sophisticated, increasingly urban civilization that has evolved since 10,000 BC. Hansen's work is backed by common sense: values of 450 ppm, or even 550, as stated in numerous agreements and political declarations of intent, are based on the illusion that global warming by 2 °C is safe – overlooking the fact that this would mean being in constant danger of exceeding that value. But even if it were possible to limit the temperature increase to 2 °C, it could still cause the situation to take a turn for the worse when considering the unexpected, catastrophic shrinkage of the Arctic ice cap in the summer.

Can the trend still be arrested – by means other than the merciful but destructive collapse of the great thermohaline circulation, also known as the Gulf Stream, which would help the biosphere in its current development, but paralyze our carbon-emitting civilization? And while this horror becomes more concrete by the day, we have almost reached our peak fossil fuel production (Campbell 2005), or – according to recent research and market analyses – have already passed that point. According to Energy Watch Group, the peak was already reached in 2006. A drop in production of at least 3 percent per year can be expected from that point onward, while demand continues to soar (IEA 2007).

Unprepared urban dwellers who do not have functioning regenerative sources of energy at their disposal will be confronted with the apparent paradox of paralysis at the end of the fossil fuel era while facing the specter of runaway climate change. As long as we do not face the facts, the danger of collapse increases hourly, while expeditions to the world's remotest resources are mounted as the last serious way out: Canadian oil sand, Siberian gas and oil and – as a final tragicomedy – a stream of supertankers in the Northwest Passage racing to the melting Arctic.

Increasingly, however, people are attempting to distance themselves from the dire consequences of their own actions. While many national and international institutions are still ignoring the problem or are paralyzed by vested interests or a lack of momentum, major cities and other communities are more willing to express the deep concern they share with many grass-roots groups and city-supported programs and alliances.

Urban autonomy thanks to renewable energy

For some time now, a number of Austrian villages and towns have been attempting to exploit renewable resources to secure their energy independence:

solar and wind power, as well as biogas, have a strong tradition in the country's rural areas. Energy-conscious Switzerland has long been the home of numerous sophisticated, successful city-wide initiatives to increase energy efficiency. Davos, home of the World Economic Forum and an international luxury ski resort, made a name for itself early on by setting out to improve its carbon footprint. Thanks to the successful German law prioritizing renewable energies, legislation on feeding power into the grid and the use of solar technology beyond simple building integration, several small towns in Bavaria have founded cooperatives that operate a number of the world's largest solar farms. Jühnde, also in Germany, has become known as a community that has made itself independent of fossil fuels thanks to its locally-produced biogas for stationary and mobile applications. In Denmark, population groups on the islands and the mainland from Samsø to Thisted have switched to economic models that are viable entirely without fossil fuels. In Sacramento, California, senior public leaders transferred state-run and private power companies into municipal ownership to control the future of the utilities themselves. In the 1980s, Sacramento's investment in decentral combined heat and power plants, biogas, photovoltaics and wind energy led to the closure of a nuclear power plant and consumers attaining control over the municipal supply area – thus putting the sixth-largest utility company in the United States in the hands of consumers. Local governments in the United States from California to Massachusetts have developed a number of initiatives to promote energy efficiency and renewable energy sources. In mid-2007, the Delaware Sustainable Energy Utility was founded. This public company is funded by bonds and manages local investment efforts related to energy efficiency and sustainable energy generation. State and local utility companies and decentral energy companies are being launched at a record pace around the world. In Denmark, a country that has one of the best models for cooperative ownership, the city of Copenhagen assisted in establishing Middelgrunden, an offshore wind farm belonging to thousands of cooperative members who were involved in successfully planning, designing and realizing it.

Dramatic changes are also afoot at the regional and local levels in terms of public law. The city of Barcelona passed a solar energy ordinance in the 1990s requiring all new and renovated apartments and homes to obtain at least 60 percent of their hot water – and a number of other energy shares – from solar energy. The model, which was originally designed for Berlin, was so successful that it was initially adopted by dozens of cities throughout Spain and is now a widespread system. Berlin will now be following suit after publishing a solar framework for all of the city's districts and quarters (Berlin Senate, 2008). Furthermore, the German federal government has issued a study that will permit all German cities to have their potential for supplying themselves with heat and power from renewable resources evaluated. Developing countries are also home to an increasing number of efforts to provide both cities and informal settlements with renewable sources of energy. They are being realized with the assistance of bilateral aid programs and multilateral initiatives, as well as cooperative and quasi-nongovernmental networks such as the Global Village Energy Partnership (GVEP), the Renewable Energy and Efficiency Partnership (REEP), the development and environmental programs of the United Nations, and even the World Bank. But the most promising measures remain those developed and realized at the local level – even if they are still quite rare and sporadic, as are the international programs. Rural areas that had the fortune of not being reached by past electrification programs are now profiting somewhat more than cities from advances in the renewable energy sector. Bangladesh is the home of Grameen Bank, the world's largest microlender, whose founder Muhamad Yunis recently received the Nobel Peace Prize. Grameen Shakti is a spin-off specialized in financing and realizing solar power systems that have given tens of thousands of rural dwellers in dozens of developing countries access to electricity. The nonprofit company is managed by Dipal Barua, who in addition to the 2009 Alternative Nobel Prize also received the first Zayed Future Energy Prize, an award from Abu Dhabi with a million-dollar purse.

The current transformation is marked by a rapidly growing, mixed field of studies and practical experiments. Influenced by the dynamics of global urban changes in the energy sector, it is taking shape through informal public discourse, crystallizing formal policies, technological innovations in related sectors, sociological research and critical journalism. It links numerous disciplines such as business, community development, architecture and urban development, transportation planning, energy policy, renewable resources and energy conservation technologies. In the process, the energy infrastructure itself is becoming a driving force behind a new and promising, yet increasingly urgent and overdue revolution.

The original German text was published in Vol. 2 of the publication series of the IBA Hamburg building exhibition: METROPOLE: RESSOURCEN, 2008. Printed with kind permission of IBA Hamburg GmbH.

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PHILIPP OSWALT

Well-Tempered Architecture

High energy consumption is one of the prime causes of today's environmental problems. The operation of buildings accounts for over 40 percent of Germany's energy requirements. An ordinary office building, for example, requires 300 kWh per square meter of floor space annually. Yet the indoor climate created at such great cost is unhealthy. Users of climate-controlled rooms can suffer from a range of ailments known as sick-building syndrome. Improving conventional building technology will not solve these problems – the answer calls for a new type of architecture. This will require no longer viewing houses as enclosures equipped with technical devices, but developing houses that control their own indoor climate. The contrast between the two concepts can be compared to the difference between a motorboat and a sailboat. In the 1960s, architects enthusiastically regarded the outboard motor as an archetype of progressive technology. As Reyner Banham observed in 1967, an outboard motor converts virtually any buoyant object into a controllable vessel – adding a small, concentrated package of machinery thus transforms undifferentiated entities into vehicles with a function and purpose. A sailboat, on the other hand, can make do without a motor, because the boat itself is the machine. The hull is designed for minimum drag, while the sail uses the wind to maximum effect and can be adjusted to suit a variety of wind conditions. The crew members are a part of the system, applying their weight to balance the boat's heeling action. This analogy can be applied to buildings designed as climate-control devices – as perpetual-motion machines that leverage existing physical forces rather than resorting to artificial power sources.

Achieving this takes a sound understanding of the energetic behavior of buildings. The dynamics and complexity of the climate behavior of a building becomes apparent when analyzing light, heat and air currents within them. Indoor climate is not static, but a continuously changing steady state. A building interacts with its environment. It reflects, filters and absorbs energy currents, stores and transforms them. Numerous factors are intertwined. Room temperature, for example, is influenced by solar radiation, the outdoor temperature, the building materials, the shape of the room, its ventilation, and heat emitted by persons and devices in the room.

Intelligent planning

The climate behavior of a building is too complex to reduce it to a simple set of rules. Methods have therefore been developed that permit such behavior to be simulated and planned. Climate simulations allow the effects of the environment and building use, form, materials and building technology to be studied. After decades of research, we now finally have the basic knowledge required to calculate the indoor climate of a building as systematically as the load-bearing capacity of its structure. Using computer simulations, we are in a position to adapt the natural energy flows optimally and develop new passive temperature control concepts. Deploying new planning techniques permits building service technology to be reduced to an absolute minimum. With intelligent planning, the building itself becomes a climate control device. Rooms act as ventilation ducts, windows and doors serve as vents and façades become radiators.

Such planning presupposes that the building is designed jointly by an architect and an HVAC engineer. Close cooperation from the outset is essential to create buildings that consume a minimum of energy while still meeting architectural standards. Partnering with HVAC experts does not restrict architects in their creative freedom – on the contrary: they are not forced to comply with rigid rules, but are merely given suggestions about how to take advantage of natural energy currents to control the temperature of their buildings. The advantages and disadvantages of various design alternatives are shown in order to provide an overview of the consequences of each individual design decision. Thanks to the cooperation between the architect and engineer, the building is once again designed in its entirety and the individual aspects of the design are planned in their mutual dependence. This not only permits problems to be identified early on, it also presents new opportunities. Beneficial interactions and synergies between individual aspects can discovered and exploited. Controlling the interplay of individual factors becomes an active part of the design process. Design, engineering and climate concept are integrated in comprehensive solutions that arise from the specific conditions and possibilities of individual building projects.

This holistic view of buildings leads to integrated climate concepts in which the building climate is regulated by the interplay of the building structure, façade and technology. Such concepts give the building's façade a completely new function: it is no longer a fixed border, but a mediator between indoors and outdoors. It uses natural energy currents to control the temperature of the building.

Buildings are subject to continuously changing environmental influences. Solar radiation in the winter is only one tenth as strong as in the summer. The coats of animals change, plants lose their leaves and people wear different clothes as needed. Energy-efficient buildings must also change accordingly. Components were thus developed to regulate energy currents by changing their energetic properties. The available energy is reflected, absorbed, transformed, stored and conducted as required. Today's microelectronics let buildings collect information, process it and respond to changing situations. Sensors on the façade detect solar radiation, the temperature and wind conditions. The building envelope varies its conductivity for warmth, light and air as required. Just as such an "intelligent" building responds to the weather, it also takes changes in its utilization into account. Sensors in the building detect the presence of people and their individual requirements with regard to the indoor climate. Energy is only used when it is actually needed. The building thus becomes an open system that responds dynamically to changes in the environment and its utilization.

Interactive temperature control

After the passive temperature control of traditional structures up to the end of the 19th century and the active control used up to the 1980s, the concept of interactive temperature control has been taking shape. While passive temperature control was mainly based on warding off the undesired effects of the outside climate and active temperature control relied on technology to create an artificial indoor climate, interactive temperature control links the indoor and outdoor climate: the building temperature is the result of natural environmental energy currents regulated by intelligent control systems and building envelopes with variable conductivity.

Information technology is the cornerstone of this new climate concept. Intelligent planning and control turn the building into a technical ecosystem engaged in a close interchange with its environment. Ecology and technology are no longer adversaries – on the contrary: new, gentle technologies are the prerequisites for ecological building design – a well-tempered architecture in tune with varying uses and the changing environment. Johann Sebastian Bach's "Well-Tempered Clavier" is a collection of piano pieces that can be played in all 24 keys, the piano reflecting a variety of emotions. The functionality of well-tempered buildings has its own unique aesthetic appeal, playing with light, sound and warmth – an architecture with a range of moods.

It is possible to reduce the energy consumption of buildings to a fraction of today's values. But taking advantage of those possibilities not only requires the willingness of architects to apply new planning methods and technologies, it also requires different clients. Today's clients – often investors who will be putting the building up for rent and don't intend to occupy it themselves – are mainly interested in swift amortization and short-term profits. They regard low building costs to be more important than reducing operating costs, as these will be borne by the future tenants. These short-term interests of the architect's clients thus contradict the long-term interests of society in reducing energy consumption. In a sense, architects are the advocates of the common good, and their mission is to reconcile the private interests of the building client and the project's context in society. They must consider how to successfully realize their ideas. The Neues Bauen estates of the 1920s, for example, would not have been realized if the modernist movement had not also stated a political and social agenda. It was the new building clients – cooperatives and communities with social-democratic governments – that realized the majority of modernist projects. To build ecological architecture today, it will similarly be necessary to develop instruments with which to ensure that such projects are realized by a market-oriented construction industry. The long-term interests of society must be enforced through higher energy prices and stricter legal requirements. Only then will the concept of well-tempered architecture be realized in general building practice.

FRITZ REUSSWIG

Architecture and Climate Change

Climate change

Global climate change has progressed from a scientific hypothesis to a reality that has captured the attention of the mass media and policymakers (Rahmstorf and Schellnhuber 2006). Yet the continual messages of doom and gloom from certain media outlets may have numbed us to the point of not giving the scientific community's warnings the attention they deserve (Risbey 2008). Since the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2007) received the Nobel Peace Prize, climate impact research findings increasingly indicate that climate change will be faster, more drastic and above all more irreversible than previously anticipated. Worldwide greenhouse gas emissions are also increasing faster than previously assumed (Canadell et al. 2007). If we intend to avoid dangerous climate change – and the governments of most states on Earth have formalized their intentions to that end by signing the United Nations Framework Convention on Climate Change (UNFCCC) of 1992 – then we should do everything in our power to ensure that global warming does not exceed 2 °C (Schellnhuber et al. 2006). In light of the greenhouse effect of the "carbon debt" we have already accumulated, we must reverse the global emissions trend by 2020 at the latest – otherwise we will be facing a completely unknown climate that will involve substantial damage and/or adaptation costs (Meinshausen et al. 2009)

We can draw two conclusions from this. Firstly, we must adapt to unavoidable climate change to keep the resulting damage to a minimum. Adapting to climate change – long misunderstood as resignation and at times ideologically stigmatized – has become a necessity, especially with regard to architecture and urban planning, where we will have to contend with increasingly extreme weather conditions, winter flooding, hot, dry summers and water shortages. Germany has launched national and Länder-specific programs (cf. http://www.anpassung.net/), but in many cases they are still marked by a lack of solutions and instruments – and of appropriate awareness on the part of decision-makers. That also holds true for building and urban planning.

Secondly, contrary to what some proponents of the adaptation strategy believe, adaptation cannot do without the successful mitigation of emissions. It will make a vast difference whether we have to come to terms with a world that is 2 or 5 °C warmer. For that reason, a rapid, significant reduction of emissions is also crucial. A reduction by around 80 percent by 2050 will be needed, and we will not be able to achieve that by adding a couple centimeters of insulation or two or three compact fluorescent light bulbs to our houses. We need a third industrial revolution – the transition to a low-carbon economy. Leading economists have calculated that this is both technically and economically feasible, and above all that it will be less costly than waiting and doing nothing (Stern et al. 2007). Technological and behavioral changes must take place at the same time. The low-carbon economy will also require a low-carbon culture. A sweeping technological and economic transformation of the magnitude required now has never been realized in history without an attendant, supporting cultural reorientation. Urban and land-use planning have a role to play here, as does architecture: we urgently need a culture of low-carbon building (LCB) and a suitable regulatory framework to promote it.

The role of architecture

Around 40 percent of Germany's primary energy consumption, or around 1,000 terawatt hours a year, is used for building and water heating, with private households accounting for nearly 70 percent of that figure. Building, operating and demolishing buildings accounts for 40 percent of greenhouse gas emissions in Germany. The energy performance of a building or apartment depends on a wide range of factors, including the insulating properties of the building material, the technology deployed, available networks and concrete user behavior. With their designs, architects determine the corridor for the ecological footprints of their buildings for the next fifty to one hundred years.

The ecological performance of existing structures in Germany currently leaves much to be desired. Our residential and business buildings still waste too much energy instead of using it intelligently – or even serving as virtual power plants. In Germany, 80 percent of all buildings currently exceed the primary energy consumption ceiling of 70 kWh per m^2 and year stipulated in the German Energy Conservation Ordinance (ENeV) of 2007. Yet low-energy, passive and energy-plus houses have been technologically feasible and financially viable for some time now. This especially holds true in light of the long-term rise in oil and gas prices. 75 percent of the buildings in Germany were built before 1979, making renovation measures related to energy conservation a special challenge. The German Energy Agency was able to demonstrate in pilot projects that significant energy savings (in some cases up to 90 percent) can also be realized here, and that such measures pay for themselves in the medium term.

However, owners and managers of older buildings still take far too little advantage of routine renovation measures to make their buildings climate-friendly and energy-efficient. Roughly € 50 to € 55 billion are invested annually in new housing in Germany, while € 70 to € 80 billion a year go toward maintaining existing residential buildings (IÖR 2007). The KfW development bank has been financing climate-friendly renovation measures (insulation, solar heating, heat pumps, etc.) for years with a variety of programs. In 2006, around € 1.4 billion were spent for such purposes, renovating 360,000 apartments (or one percent of existing apartments) to improve their energy efficiency. At that rate, a further 25 percent of existing apartments could be upgraded to energy-efficiency standards approaching those of new buildings by the year 2030, in addition to those already optimized (EWI/EEFA 2007). In light of the climate change already occurring, issues such as building safety in storm-force wind conditions and climate-neutral air conditioning must also be taken into consideration.

Costs, amortization periods and profits are major considerations for private building clients and commercial building managers alike. Despite rising energy prices, rents and income per square meter are significantly more important factors. It is therefore also necessary to think about the collateral benefits of energy-optimized buildings with regard to health and occupational psychology. Studies of the Fraunhofer Institute for Industrial Engineering IAO as a part of the Office 21 project have shown that buildings designed for modern work routines (such as the increasing relevance of teams in lieu of individual offices), physical and psychological well-being, as well as aesthetic quality, lead to higher productivity.

According to the Jones Lang LaSalle real estate consultancy (JLL 2007), ecological criteria will play a much bigger role for decision-makers in future – for cost, value and image reasons. The public and investors are increasingly taking an interest in the corporate carbon footprint of businesses. To date, however, this issue has been dominated by a vicious circle, with users, the construction industry, developers and investors passing the buck to each other. Vicious circles are systematic faults, and isolated intervention will not break them. Architects – on their own – will not achieve this either. But in concert with improved laws, ecologically-oriented urban planning, smarter investors, more dedicated entrepreneurs (such as Tom Bonham of Urban Splash in Manchester) and users with greater awareness, it is certainly possible to turn a vicious circle into a virtuous one. And that is exactly where architects need to become increasingly involved. After all, the zero-emissions buildings of the future should also be the more functional, flexible and beautiful structures. Where else can they take shape but in the head – or gut – of the architect?

Ethics and professionalism

We expect architects to have a professional mastery of the rules of building that lets them constructively and creatively address the varied requirements – and budgets – of their clients. For some time now, those rules have included observing certain, increasingly strict energy efficiency regulations. Merely complying with those regulations will not make an architect “good”, however. Just as we would never forgive a “star architect” for taking part in the aesthetic and ecological sin of unrolling sprawling carpets of suburban uniformity, we cannot consider an architect to be particularly virtuous for only meeting the minimum standards stipulated by energy conservation regulations. Exceeding those dictates should be a matter of professional ethics. These should also include convincing unwilling clients of the necessity and feasibility of such designs – and that is only possible if the architect has internalized climate-friendly building as a desirable practice and expresses it accordingly in imaginative engineering.

It will require an interplay of ethics and professional standards to shape the low-carbon building culture that we urgently need. This does not mean pushing all architects into becoming “eco-architects”. That would result in aversion and resistance that might do even more damage than simply maintaining the status quo. The objective here should be to internally and institutionally anchor the goals and principles of climate-friendly planning and design as a perfectly normal framework for professional action.

How can such professional ethics take shape? Aristotle once responded to the question of how to raise a child to become a good person as follows: “by making him a good citizen in a good state.” This was not intended to be quietistic: conforming to existing conventions and proper manners without the ability to judge whether they are truly appropriate is of limited ethical value at best. The actual message behind Aristotle’s answer is twofold: firstly, an individual can best become good by doing so in a community that shares and supports the corresponding attitudes and courses of action. The African saying that it takes a whole village to raise a child is similar in its intent. “Good” architecture from the vantage point of low-carbon building culture requires a network of like minds – a partly supporting, partly challenging, interdisciplinary environment ranging from low-carbon design to low-carbon urban planning, and it must be solidly anchored in the formal training of architects. A sea change in society rarely starts with an uprising of the masses. It generally begins imperceptibly and can be triggered by minorities – provided they are sufficiently dedicated, compelling and connected to attain the critical mass needed to present the majority with a credible alternative.

Secondly, Aristotle states – and we will probably never know whether this is what he actually wanted to say – that it also depends on our judgment and actions whether a state (community, association, government) truly is “good”. “Making someone a citizen” involves a rich fabric of attitudes and actions: the provision of good examples, the discursive justification of good practices, the criticism of bad examples and practices, etc. It does not mean pedagogues pressuring someone into blindly accepting existing institutions; it is about embracing them through active and critical reflection, and that in turn also shapes those institutions. That is how societies evolve. In our context, it means that a low-carbon building culture can only evolve if it is experienced as a culture of innovation, and if the above-mentioned critical mass is sufficiently differentiated and contains enough creative divergence from which the new can take shape.

In favor of low-carbon building culture

Enter the string “zero emissions city” into a search engine and the results will currently lead you to Masdar or Dongtan. Both cities are still on the drawing board. If and when they are built and used in day-to-day life, they will leverage the ecological strengths of cities that were built from the ground up as prestige objects, at great expense and with state-of-the-art technology. There is nothing wrong with that – especially since the oil-exporting countries and China are more often sources of worrying news for the world’s climate. But what do these examples teach us for old Europe, with its historical building stock – and for the United States, which in this respect is not that much younger? They show us that renowned architecture and urban planning offices take the ecological challenge of climate change seriously, and that it is possible to address it with answers appropriate to our time. They show that European offices are also in a position to deliver those answers in other building cultures. They should spur us to not underestimate our own experimental potential. Why are there no low-carbon cities (or quarters) in Germany? Siemens AG commissioned the Wuppertal Institute for Climate, Environment and Energy to perform a study on that topic using Munich as its subject and 2058 as the target year (Siemens 2009). Setting precedents requires lighthouse projects, examples and fields of experimentation. Why not stage a Climate IBA in Berlin in 2017, for example? These ideas should prompt us to seek solutions for the existing buildings in evolved cities as well. After all, even Masdar and Dongtan – if and when they are completed – will require adaptation to changing circumstances someday.

That brings us to “building culture”, an appealing concept that responds to the unappealing realities of building and living with buildings. It is not necessary to have the works of Le Corbusier and Frank Lloyd Wright in mind while strolling through our (trans-) urban spaces to experience the kind of shock that the likes of Baudelaire hoped would shape the aesthetic outlines of the modern era.

It goes without saying that the transition toward low-carbon cities and a low-carbon building structure will require a legislative framework that covers issues such as the taxation of fossil fuels, emissions trading, urban development planning and building standards. But even then, it will still require building culture to implement all of these considerations in terms of aesthetics, planning and practical execution. We are still at the beginning in this regard. Bundesstiftung Baukultur, a nationwide foundation for building culture, was recently established in Potsdam. While this is a laudable move, issues such as climate change and energy efficiency are not to be found among the numerous aspects covered by the foundation’s work. While this is admittedly an insignificant example, in our experience it is symptomatic for the need for change – a change that must take place well before 2020.

The history of building culture is not without examples, and the sometimes-disparaged Bauhaus could serve as a reference here. Bauhaus was not primarily a style, but an attitude that resulted in a style. This attitude was marked by an insight into the need to counter the unchecked functional and aesthetic proliferation of budding Modernism with a consistent and transparent alternative concept that would be able to respond to its challenges. A contemporary day-to-day culture arose out of closely meshed disciplines ranging from design to architecture and urban planning. And that's exactly what we need today – a low-carbon Bauhaus.

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WEIDING LONG

Mass Urbanization and Climate Change in China: Challenges and Opportunities

China is undergoing a rapid urbanization development stage. The ratio of urbanization reached 45.7 percent by the end of 2008. It will reach 60 percent by 2020. It means that by 2020, about 300 million of China's population will migrate into the cities to live and work (the figure is equivalent to the current US population). Population in cities and towns reached 606 million by 2008. There are 118 cities with a population over one million. The top 10 cities with integrated competitiveness in China are: Hong Kong, Shenzhen, Shanghai, Beijing, Guangzhou, Taipei, Wuxi, Suzhou, Foshan, and Macau.

The process of urbanization has promoted large-scale urban infrastructure and housing construction. There is a large demand for cement and steel production in China. No other country can provide for the Chinese steel and cement industry on such a large scale. Therefore, the demands of China's urbanization on high-energy-consuming industries is great. Even if technological progress were to increase energy efficiency, the demand to meet the economic growth and social modernization means China's total energy consumption will continue to experience high growth.

Fig. 1: Urbanization growth rate of China (%).

There is an enormous need to provide adequate housing and work for a growing urban population. According to the World Bank, by 2015 half of the world's new building construction will take place in China, and more than half of China's urban residential and commercial buildings in 2015 will likely have been constructed after the year 2000. A vast majority of these projects are very large, such as commercial office buildings with 1–1.5 million square feet and residential developments involving 5 million square feet of construction area.

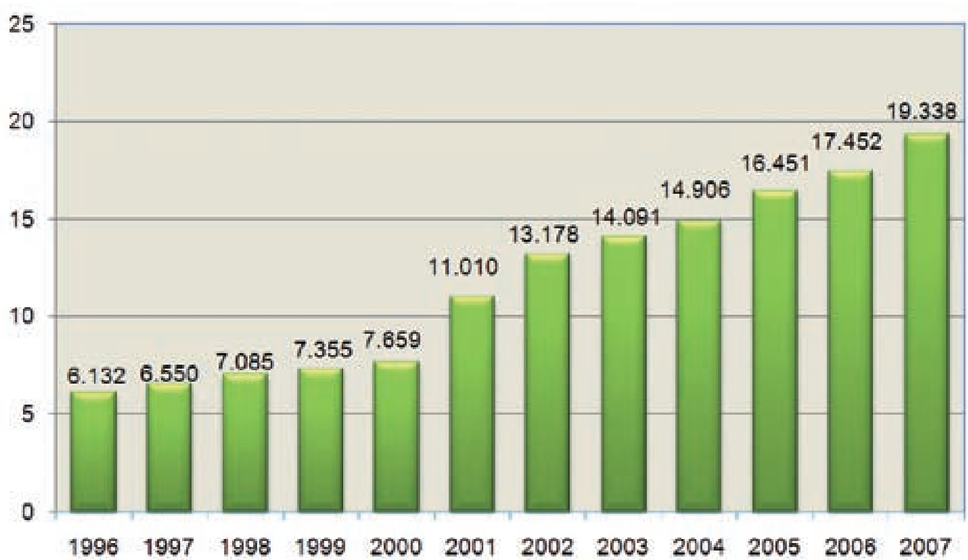

Fig. 2: Gross building floor area in cities and towns (billion sq. m.).

China's private car ownership levels have increased with the rapid rise in income levels, followed by changes in lifestyle. Civilian car totals across the country reached 64.67 million and the volume of private cars reached 19.47 million by 2008, a rise of 28 percent over the previous year. Car sales in 2009 will exceed 10 million. The Chinese car market now exceeds the German and Japanese markets and sales will likely surpass domestic sales in the United States by 2015. It means that every year China needs at least 20–30 million tons of additional petroleum supplies. China has now become the second largest consumer of petroleum, and third largest net importer in the world.

China is facing serious challenges:

- polluted environment – heavy price to pay for fast growth over the past 30 years
- huge demands due to population growth and rapid urbanization
- export-oriented and low-end manufacturing economic structure
- now a major producer of energy-intensive goods
- coal-dominated energy structure
- energy poverty in rural areas among low-income residents

Coal use, the primary source of energy, reached a 2.85-billion ton coal equivalent level in 2008, ranking China second worldwide with a share of over 20 percent. Seventy percent of energy consumption is from coal-fired sources.

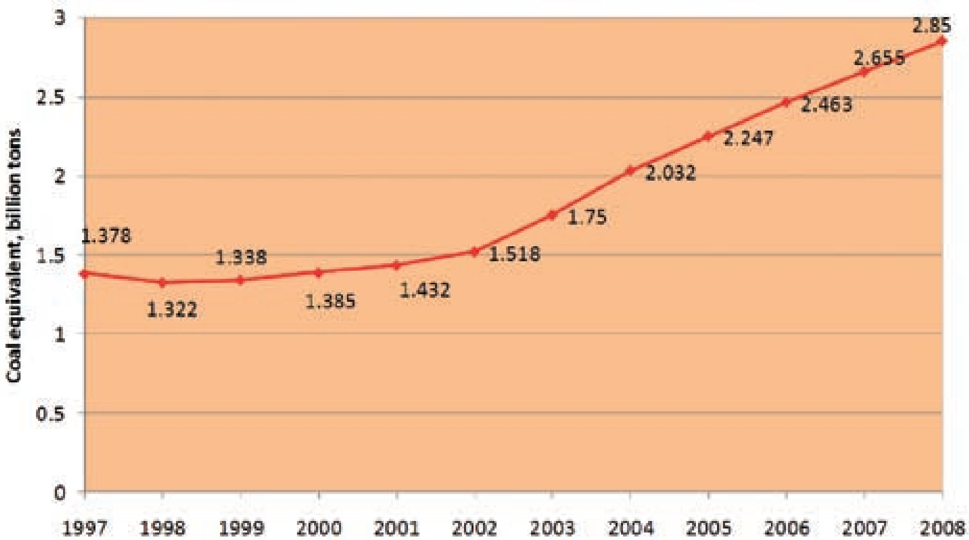

Fig. 3: Growth of primary energy consumption in China.

According to the Netherlands Environmental Assessment Agency, the CO_2 emissions of China have already exceeded those of the United States and ranks China first worldwide. (But if only estimating CO_2 emissions from the energy sector, the United States is still in first place).

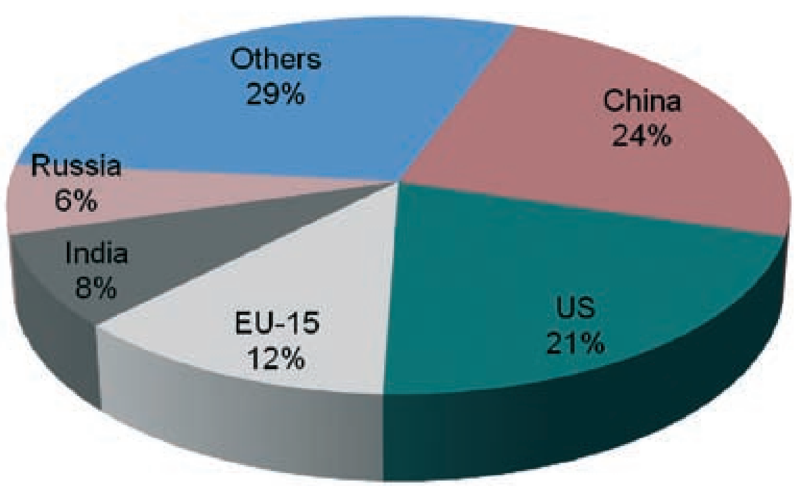

Fig. 4: Shares of the world CO_2 emissions in 2007 (source: Netherlands Environmental Assessment Agency).

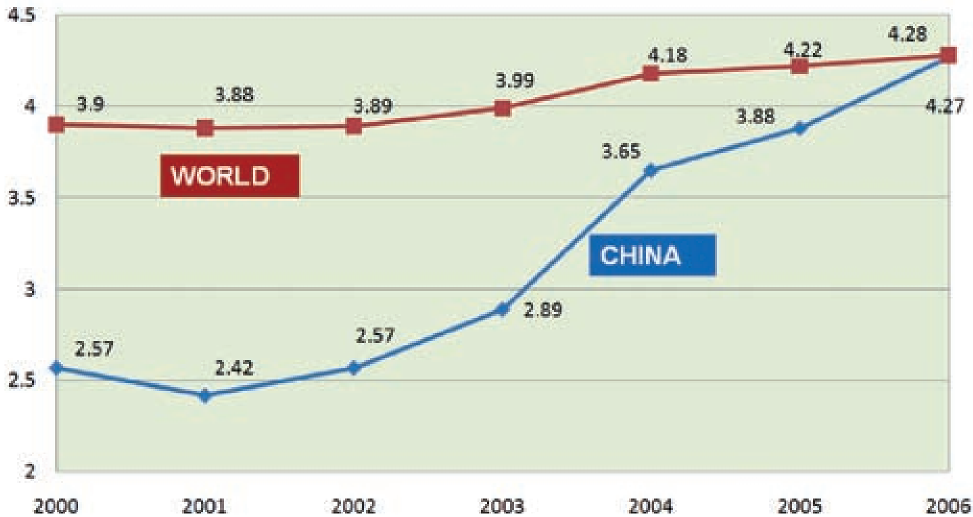

Fig. 5: Development in per capita CO_2 emissions in China and the world.

From 1950–2002, China's cumulative CO_2 emissions from fossil fuel combustion accounted for 9.33 percent of the world's total in the same period. In 2006, Chinese scholars estimated that the embedded energy in net exports exceeded more than a quarter of all energy consumed. China's CO_2 emissions from the production of export commodities is almost equivalent to total emissions of Japan.

Building energy consumption in China

As to the building energy sector, although there are no official statistics, most scholars believe that China's building energy consumption is still very low, only about 20 percent of total energy consumption.

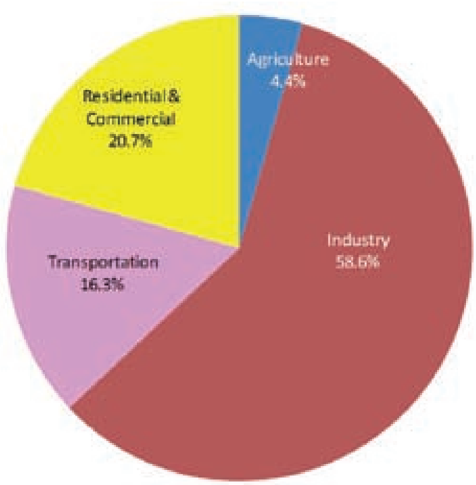

Fig. 6: Shares of energy consumption in 2005.

Most energy is consumed by industries. Most reports in China have overestimated energy consumption by the building sector, especially in the residential sector. Compared to other cities in the world at the same latitude or higher, most cities in China have colder winters and hotter summers. They need both cooling and heating for staying healthy and retaining a comfortable indoor environment. Nevertheless, in 2004 the annual primary energy consumption per household in Shanghai was only 973 kgCE (kilogram of Coal Equivalent), less than a third of that in the United States. Per household, electricity consumption in Shanghai is only a fifth of that in United States.

According to surveys, the average annual energy charge for Shanghai's household accounts for 26 percent of the disposable income in lower-income families. The room temperature in most households of Shanghai is lower than 14 °C in winter, due to poor insulation and intermittent operation of heat pumps. Most households turn on their air-conditioners in the summer only when the room temperature is higher than 29 °C. We learn from surveying data that over 80 percent of houses are out of the ASHRAE (American Society of Heating, Refrigeration, and Air-Conditioning Engineers) comfort criteria zone. Most households have to suffer indoor humidity higher than 70 percent during the rainy season every June. We can conclude that building-energy consumption will grow considerably in China. Building-energy consumption growth is to some extent a measure of people's living standards and the development of the service industry.

Coping with climate change

The Chinese government adopted a series of measures to deal with challenges faced. The government released the China National Plan for Coping with Climate Change, and the National Assessment Report on Climate Change. At the APEC meeting (Asia-Pacific Economic Cooperation) in 2007, Chinese President Hu Jintao said:

We should ensure that both production and consumption are compatible with sustainable development. We should optimize the energy structure, promote industrial upgrading, develop low-carbon economy, build a resources-conserving and environment-friendly society and thus address the root cause of climate change.

The government has promoted industrial structure adjustment. A lot of excess production capacities have been eliminated. The measures are to:

- shut down excess production capacity in heavy industries;
- accelerate the development of high-tech industries;
- speed up the development of modern service industries;
- continuously upgrade the scale and level of the equipment manufacturing industry;
- markedly increase energy, transportation, and other basic industries;
- further improve the industry concentration.

It is estimated that the energy savings for every ton of steel that is not produced are enough to cover the heating energy demands of a Beijing family in winter. We can predict that with the improvement in people's living standards and the development of the service industry, the share of building-energy consumption will increase, and energy consumption will move from industrial production to maintaining a properly built environment.

The Chinese government has tried to encourage residents to replace their old high-energy-consuming appliances and polluting cars through the use of subsidies. This is also seen as a "New Deal" in the context of the financial crisis. The government has drawn up a renewable energy development plan. According to the plan, by 2010 the share of renewable energy as a total of energy consumption will have reached about 10 percent, and by 2020 15 percent. Additional capacity from 2006 to 2020 should include:

- 190 GW of hydropower;
- 28 GW of biomass power generation;
- 29 GW of wind-power generation;
- 1.73 GW of photovoltaic;
- 62 million rural household biogas devices;
- large-scale biogas projects;
- promotion of universal solar water heaters, geothermal, bio-liquid fuel production and molding of solid biomass fuel.

The government plans to invest two trillion renminbi into nuclear power. By 2020 the share of energy derived from nuclear power generation would be 5 percent.

A number of construction projects have started to implement the idea of CO_2 mitigation. For example, in construction of the Shanghai 2010 Expo Park, there are many new technologies used to improve energy efficiency:

- river-water source heat pump system with a cooling capacity of 61,975 kW and heating capacity 24,705 kW;
- solar photovoltaic with power of 4.5 MW (Asia's largest at present);
- pile-base ground source heat pump system with a capacity of 12,250 kW (the world's largest of this kind);
- thermal storage using ice and water with a capacity of 23,136 RTH;
- natural gas direct-fired absorption chillers with a capacity over 80,000 kW.

The results would be:

- annual electricity savings of 10 GWh;
- annual primary energy savings (except electricity) of 3000 tce;
- annual emission reduction of 50 000 ton CO_2 equivalent;
- peak power shift of 45 MW.

Chongming Island

The government has publicly funded universities and research institutes to carry out a series of major research projects into the low-carbon city. Tongji University has been involved in these projects. One part of these projects is focused on the development of Chongming Island. Chongming is an alluvial island in the Yangtze River Delta. It is the third largest island in greater China at 1,229 square kilometers with a population of 635,000. Although Chongming Island is close to Shanghai – a megacity which has the fastest-growing economy in China – it is a less developed region, due to the fact that there are no traffic links with the mainland. Therefore, it maintains its original rural features to a large extent.

According to the plan, there will be one city (with a population of 200,000), seven towns, and 188 villages in Chongming Island in 2020. More than two-thirds of the population will live in the city and towns. An enormous development will be built after the tunnel and bridge have been finished. How can we select the development projects, considering the huge investment and fast progress of urbanization? How can the ecological environment be preserved during rapid development?

We have a project funded by SMSTC (Science and Technology Commission of Shanghai Municipality) for Research on the Guidelines for the Construction of Eco-City and Eco-Town in Chongming Island. We will get another project funded by MST (Ministry of Science & Technology) for Research on Industry Development, Application of Know-how Integrated Technologies and Demonstration in Chongming Low-carbon Economy Demonstration Zone. The project's duration will be from 2010 to 2013. The contents are:

- research on innovation management tools and new policies of Chongming's low-carbon economic development zone
- research on key technologies in Chongming's low-carbon economic development, including key technologies of low-carbon energy, integrated optimization technologies of low-carbon urban traffic, key technologies of low-carbon buildings, key technologies for protection and enhancement of carbon sinks, key technologies for development of low-carbon industries
- research on integrated applications and demonstration of key technologies in low-carbon economic development (Chenjiazhen Town)
- research on demonstration of modern agriculture on Chongming Island

We have established the Chongming Sustainable City Networks in cooperation with EPSRC (Engineering and Physical Sciences Research Council, UK). More than 10 key universities in the United Kingdom, such as the University of College London, Imperial College London, University Of Southampton, etc., are involved in the initiative.

My vision for Chinese cities to 2030

In my opinion, future urban development in China should look like this: Cities should have a reasonable industrial structure with an emphasis on services, high-tech, and modern manufacturing industries. China should have a polycentric city structure with a more or less even distribution of the population as well as a multicultural society. These cities ought to have a compact city form with high density, high rise, and high plot ratio. The potential impacts from resource consumption should be reduced, as well as the carbon footprint from energy consumption. The ecological and carbon-sink functions of the land shall be preserved. Energy efficiency has to be improved and the circular economy should be promoted. Highly developed information and communication technologies will help to increase working efficiency and support daily life. With urban transit systems, usage of private cars will be reduced. Consumer responsibility has to be promoted.

PIET ECKERT

"And next to it, at an appropriate distance, go build the city of our time"

In a time in which the realization is gradually gaining traction that technology can no longer keep up with the breathtaking speed of calamitous global environmental phenomena, irresistible growth and consumption, the moment has come in which the technology of design has become significantly less relevant than the design of technology.

Departing from the direct deduction that technology should comprehensively solve our problems and cater to our needs dictates that we expand our idea of technology conceptually, assigning it additional, "ethical" criteria that let us project it onto the individual and society – a projection that can grant people a comprehensible awareness for actions and decisions. In particular, the way in which today's development increasingly removes technology physically from the awareness of the individual, conceiving it as an automated atmosphere, represents an increasing risk of uncoupling.

Unsurprisingly, the current state of the art expresses premises that attempt to realize buildings that comply as closely as possible with mathematical "models" (such as Minergie[1], rated primary energy figures). User interaction is defined as "psychological inefficiency" and deemed an acceptable malfunction to be addressed by a precautionary performance margin. It remains notable that humans not only represent a problem in relation to the environment, but also vis-à-vis the technology developed to serve them, and so we seem to be constantly on the move in a giant hamster's cage with generously-dimensioned wheels – one that caters to our every need and supports us optimally with its technology.

Achieving a 2,000-watt society not only implies sweeping technological prerequisites and essential innovation in the near future, but also a self-respon-

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1 Minergie is the most important Swiss energy standard for low-energy houses. Around 13 percent of new buildings and two percent of renovations in Switzerland are currently certified as Minergie-compliant. These are generally residential buildings; in some of the other categories, not a single building has been realized to date. The Minergie standard is partially comparable with the German KW40 (new buildings) and KW60 (renovation) standards.

sibility subject to feedback and a judicious reduction of energy and resource consumption. Innovation thus faces a major dilemma in having to simultaneously deliver an ongoing improvement of technological possibilities and a decisive reduction of resources and options in accordance with individual responsibility. Technological progress is taken for granted today, while reductions prompted by individual responsibility have been negligible. The way in which these two antagonists are managed will be one of the great challenges for our society in future in order to even achieve sustainability in principle. The innovation that will be vital in the future will thus become a strategic form of organization – a form that redefines the relationship of interaction between humans and technology on the scale of a building and a city.

Like the performance of hybrid drives, a strategic organizational form is capable of grouping a variety of requirements and placing them in an interdependent relationship in which the performance needed to meet "true requirements" is gained from interaction, and a dual principle arises from the old duality of performance and self-responsibility.

The city in today's European context remains indebted to an idea of coherence of form and organization. Our cities have not only evolved throughout history – with very few exceptions, they have not experienced any real paradigm shifts over the course of their development and expansion. With regard to a new energy and consumption society, their legacy represents a heavy burden. Our instruments of enhanced ecological standards are therefore confronted with massive inertia and sluggish change.

Renovating the existing stock of buildings can only be accomplished with extreme incentives and new economic models, as the enormous surplus of existing areas are viewed according to normal real estate life spans. In the Swiss context with its very well-maintained assets, for example, it is clear that steadily increasing ecological standards are hardly capable of compensating for the continued inefficiency of existing buildings over time. On average, renovations will be required in the far too distant future.

In effect, renovating our cities ecologically today would mean rebuilding them from the ground up. Renovation work alone will not suffice to ensure a CO_2-free future of our existing structures. As the use of alternative energies involves smaller temperature differences over time, they cannot be deployed in the existing stock of buildings without their significant optimization in terms of insulation and sealing. In other words, we will have to start at square one with regard to our existing buildings.

With the need for effective moves toward an intelligently recycled post-fossil consumer society, we appear to have our backs to the wall at the start of the 21st century, realizing how Max Frisch's demands – albeit prompted by a different issue in the early 1950s[2] – have gained currency: "And next to it, at an appropriate distance, go build the city of our time," urged Frisch, in order to give modern life and its performance demands an adequate context, thereby reducing the old cities and their limited adaptability to museum pieces.

New acceptance for density

Europe will not be building energy-efficient replacement cities on the green field. Not only would this mean unacceptable losses for today's cultural substance, the financial resources are not available, and there simply is not enough space to realize cities with the same, if not optimized, ecological footprints – unless one were to do away with the old cities.

The question does arise, however, to what extent our overall conception of the city will change in the face of the impending situation. With the tendency toward suburban sprawl on the wane, clear political changes with regard to formerly cherished programs promoting suburban development such as commuter subsidies and Vinexplänen[3] and an associated reduction of general European anxiety vis-à-vis urbanization, a new acceptance of urban density can arise that could result in substantial, metropolitan improvements. In doing so, the time-honored idea of the coherent urban form will fall by the wayside due to its relative hostility toward innovation, knowing that it will be necessary to apply high-density urban models to its system as a whole. This resistance will wane and cities will begin to establish test areas and density models contrary to their current morphology.

The result will be significantly greater location-related competition between cities. Those who organize and drive urban transformation will enjoy location-specific advantages. The zero-emissions city will be successful and boast a high quality of life; it will establish attractive conditions in the medium term by breaking its dependence on the exploding cost of fossil fuels; it will have introduced practical, economically sound renewal models, thus putting itself in an attractive competitive position.

Ultimately, there will be a further race of the cities to determine which can develop the greatest appeal and maintain their importance, while others wane or are given up.

Those who do not invest today run the risk in the medium term of managing a location that no one wants any longer – not unlike the steady decline of the auto manufacturing centers in the United States, moribund locations that may soon be abandoned.

2 Cum grano salis: eine kleine Glosse zur schweizerischen Architektur. Lecture on occasion of the June meeting of the BSA Zurich local group, 1953. Edited to essay form in: *(Das) Werk*, Vol. 40 (1953), pp. 325-329.

3 A management and promotion program introduced by the government of the Netherlands in 1993 to plan new suburban extensions, generally on land reserves on the periphery of cities, with a quota of 360,000 newly-built residential units between 1993 and 2001. The program continued until 2005, creating approx. 600,000 residential units in total.

II

Projects

SEBASTIAN JEHLE

Sustainable Architecture

A built environment is the product of a long and costly planning period, and the essential goal of our planning work is to realize spaces that provide a worthy quality of life. It is geared toward reconciling socio-cultural, ecological and economic aspects as completely as possible and integrating form and function, engineering and aesthetics, architecture and nature in a complex whole. As airy or abstract as the goal may seem, the road there is a rocky one, filled with challenging, often contradictory factors. Simple formulas intended to integrate those diverging components within a holistic system fall short of the mark.

According to our understanding, sustainability is not primarily or exclusively expressed by substantial, unchangeable designs. Similarly, ecology is not a matter of technically sophisticated solutions, but of systems that intelligently adapt to local and climatic conditions, and do so differently time and again, as there is no one solution that is correct in every circumstance. These systems are based much more strongly on passive, reactive and self-regulating natural processes than on active systems supported by technology. Activating storage masses, exploiting thermal and aerodynamic effects for ventilation and the use of evaporation-based cooling are examples of such processes. Wherever appropriate, modern technical and mechanical systems are deployed in a judicious manner and become an integral part of the architectural concept.

Structure and design

We know that many of the problems affecting our environment are the consequence of the ever more efficiently structured specialization in our society. Not only does it result in the needless optimization of partial aspects of processes, products and materials to apparent perfection, it also negatively affects our entire natural living space, as the optimization methods do not take the balance of the overall system sufficiently into account. This criticism is not a call to retreat from technically advanced systems, but an argument in favor of the measured and balanced embedding of state-of-the-art technology in the target constellation of socio-cultural context, ecology and economy.

A future-oriented, sustainable office building design therefore has more to offer than a mere climate envelope. The link between the indoors and the outdoors, for example, has gained significance in our lifestyles to the same degree in which new materials and technologies have made it easier to realize

a building's purpose as a shelter against nature's influences. Buildings are thus integrated more tightly into their surroundings, energy currents become easier to control, the transitions within the envelope become increasingly graded – light, for example, can be conducted, filtered, dimmed, refracted and reflected. The psychological benefits of a transparent building envelope – of seeing and experiencing day and night, wind and weather, summer and winter – became an important element of an open architecture that offers rich experiences. It is one of the goals of our time to work with natural light, not only channeling it with regard to energy aspects, but also integrating its effects on the physical and psychological well-being of humans into architectural concepts.

From this vantage point, the goal must not be to optimize energy-related building concepts exclusively for their own sake and at the expense of spatial and living quality, but to create valuable and innovative utility concepts for day-to-day life that pave the way for new energy conservation options. In the best case, this will lead to holistically developed architectural living spaces that not only depend on solid elements such as walls, ceilings and floors, but also less tangible but equally discernable parameters such as light, temperature, air circulation, scents and acoustics.

Material and location: LSV Landshut

The client – the agricultural and forestry social insurance authority (LSV) – wanted an economical, ecologically-sound headquarters building with low energy requirements. The south of the building features a hall as a unifying thoroughfare for the office tracts. The hall's concave glass façade serves as a thermal buffer zone in the winter. In the summer, shade from the trees in front of the building, sunshading integrated in the façade, and the natural ventilation concept prevent the hall from becoming overly hot. The hall also offers effective protection against the noise of Niedermayerstrasse, a busy street that runs along the building. Without this noise protection, it would have been impossible to open the windows of the office tracts for natural ventilation – a mechanical ventilation system would have been the inevitable consequence.

Using wood as a resource-friendly, renewable building material also reflects the purpose of the LSV, as one third of its policy holders are active in the forestry sector. The wooden design and the generous, elegant sweep of the glass hall resulted in a highly effective, economical and ecological symbiosis of simple and sustainable technologies. The principle of natural ventilation is a key feature of the building's thoroughfare: concealed vents along the lower edge of the curved glass façade ensure that fresh, cool air streams into the hall by day – and especially at night – during the summer months. The thermal mass of the building is thus cooled overnight, leaving it ready to absorb heat the following day. The ecological approach is apparent throughout the structure, both visually and at the tactile level, in the shaping of the wood and the variations of its coloring and grain structures. Yet the design's environmental properties are self-explanatory and do not take an ideological stand.

Culture and climate: Q-tel Doha

Compound curves of shells and cable structures evoke the versatile tent architecture of the Emirates, integrating the past, present and future into a compositional whole. They are also central elements of the energy concept of the headquarters of Q-tel, a telecommunications company.

The photovoltaic modules integrated in the envelope convert sunlight to electricity directly, while providing shade for the façade and reducing the cooling requirements of the interior. Their basic material is sand – in the form of glass and silicon. They have an appearance similar to that of a glass façade, but nevertheless exhibit a structure entirely their own. In this case, photovoltaics represent an ideal symbiosis of form and function. Together with the outside and inside glazing and the shading, the photovoltaic modules in the parapet area and the light-deflecting louvers in the lintel area form a climatic buffer that absorbs heat and draws it off through an air extractor system. The supply air for the climatic buffer is drawn from the rooms themselves.

Water is a basic element of life, and that especially holds true in Arab countries. It stands for affluence and atmosphere – important attributes to be perceived by customers entering the Q-tel office building. Water surfaces and fountains are integrated in the entrance area for that reason. The water is not just intended to provide atmosphere, however, but thanks to adiabatic cooling, it is also part of the climate concept. Adiabatic cooling systems are as old as Arab culture itself. Evaporative cooling was already used in the ancient "wind towers": tall structures with wind catchers would draw air out of the building. The incoming air would enter the building through a ground-floor or basement room and pass over a water surface for an evaporation cooling effect. This principle is used in a modified, modern form in the Q-tel building.

MATTHIAS SCHULER

The Masdar Development – Showcase with Global Effect

Introduction

In 1998, the World Wildlife Fund (WWF) began its Living Planet Reports showing the state of the natural world and the impact of human activity upon it. The 2006 report confirmed that we are using the planet's resources faster than they can be renewed – the latest data available (for 2003) indicates that humanity's ecological footprint has more than tripled since 1961. Our footprint now exceeds the world's ability to regenerate by about 25 percent. The message is clear: We have been exceeding the Earth's ability to support our lifestyles and we need to stop. If we do not, we risk irreversible damage. The biggest contributor to our footprint is the way in which we generate and use energy. The Living Planet Report indicates that our reliance on fossil fuels to meet our energy needs continues to grow and that greenhouse gas emissions now make up almost half of our global footprint. A significant part of this global footprint is used by the buildings we live and work in: About 40 percent of the world's energy is used for heating, cooling, and lighting buildings.

As with the growing worldwide recognition of the impacts of this energy use, Transsolar's views of its own role has grown, too. More than 15 years after Transsolar was founded, our purpose of climate engineering for buildings has changed from a focus on passive strategies and energy-efficient systems to include how these principles fit into the global context.

Masdar City Master Plan

As a member of the design team – consisting of the architects, traffic planners, infrastructure and renewable energy systems engineers, and us as climate engineers – for the Masdar City Master Plan in Abu Dhabi, we developed a new and holistic approach for defining sustainable urban development: The 6-square-kilometer city, designed by Foster and Partner for the Abu Dhabi Future Energy Company, is eventually to house 50,000 people in accordance with WWF One Planet Living sustainability standards, which include specific targets for the city's ecological footprint. Masdar City plans to exceed the requirements of the 10 sustainability principles: zero carbon, zero waste, sustainable transport, sustainable materials, sustainable food, sustainable water, habitats and wildlife, culture and heritage, equity and fair trade, and health and happiness.

Independent and public verification of Masdar City's performance in meeting these standards is just one of the features distinguishing the project. Another is the commitment that the project will not just preserve existing regional biodiversity but enhance it. The design team developed all of these targets that are to be achieved by the time Masdar City is completed and fully functioning in 2012.

Masdar City is intended to be one of the world's leading research and development hubs for renewable energy strategies and components and based at the Masdar Institute of Science and Technology. The laboratories and light-industry production facilities are to support the vision of the United Arab Emirates in developing from a technology-importing into a technology-exporting country with a focus on renewable energy technologies. This also reflects the UAE's approach in preparing for the era after oil.

Approach: Reflecting the local conditions as climate and culture

The first step for the climate engineer is always to analyze the environment and setting of the buildings. A close look is taken at all existing weather data, which needs to be compared before use if more than one source exists. For Masdar, this led to the decision that an environmental data measurement station should be set up on the building site to collect more data for verification. Also, the proximity to the airport called for quantifying noise and other pollution to be taken into account for protection measures.

It is important in a second step to study the cultural background, which reflects solutions of city planning and building designs that have developed in this areas in the past. For Masdar City, the closest related cities with a historical cityscape are Dubai and Muscat. These cities, built in a similar climate, show certain patterns: buildings separated only by small streets (almost pathways) and shaded courtyards, all in order to minimize solar gains in the streets.

By reviewing natural adaptations of flora and fauna in the UAE, strategies were identified for solar use, sand dust protection, water collection from dew, and minimized water consumption for body waste disposal. We studied the historical height-layering of plant growth in an oasis with mint growing below bushes and fruit trees that are shaded by date palms. We also analyzed the adaptation of the local mangroves to the increasing salinity of the Arabian Gulf. All of these analyses are the basis for the Master Plan of Masdar City.

Sustainable approach for Masdar City: Fresh air without heat, light in the shade

The urban density is one of the most important measures for the sustainable approach in Masdar City. It has the greatest impact for reducing the energy demands in this hot and humid climate. All energy consumption must come from renewable sources, and materials have to be recycled. Due to the limited capacities of renewable energies, like sun, wind, and geothermal, the first essential step is to minimize the demands. The local natural adaptations showed us the way to reducing energy and material consumption. A sustainable approach cannot be solved only by technical solutions – it demands rethinking lifestyles. This means a change in our daily behavior in respect of mobility, comfort expectations, water, energy and material consumption, and waste production.

Sunlight and air are the most important natural resources for a city. Outdoor and indoor spaces need to be illuminated and fresh air has to be provided for the citizens. Considering the local climate conditions in Abu Dhabi – with high outdoor temperatures and humidity levels in summer and zenith sun positions – this demands specific guidelines and recommendations.

The primary decision based on the CO_2-neutral approach for Masdar's development was to ban cars with combustion engines from the inner city. This reduced the function for ventilation in the city to simply providing fresh air and cool breezes, instead of also removing car emissions to a level people can tolerate. Even without these emissions, the outdoor air quality demands a certain city ventilation, in which predominant wind directions, annual temperature swings, and heat island effects due to solar absorption and in-city emissions have to be considered.

Starting with an isothermal air-flow analysis to research the impact of air infiltration from the wind-flow above the city into the street canyons, the model allowed for the determination of preferred street widths and lengths as well as piazza locations. To determine the microclimate above the city through solar absorption from the photovoltaic roofs, a simplified calculation model of the whole street was defined. It was evaluated with and without wind in respect to the local temperature increases above the city. Based on the results of the generic models, an optimal street- and piazza design was calculated. More detailed models were used to study the analysis of the dynamic behavior of a street and piazza climate in the arcade area, and the rules to achieve a "cold island effect" for even lower temperatures than outside were identified. A new interpretation of the historic UAE wind tower for use as a ventilation device as well as wind and sun protection concluded the air-flow analysis.

With the proposed orientation and dimensions of the city grid, the air-quality demands could be met and the local climate demands optimized. In the Masdar development, streets are mainly used for circulation, fresh air distribution, and microclimate protection. Two green park bands that stretch throughout the city are oriented toward the sea breeze and the cool night winds. They create the necessary fresh air corridors through the large city grid.

Being exposed to solar radiation is very important for the human body and soul. Due to the high light levels in exposed locations in Abu Dhabi, comfortable indoor and outdoor spaces have to be carefully sun-protected, but not totally darkened. The design guidelines for the sizing of façade openings have to be adjusted to respect the high levels of direct radiation on the project site.

In a first step, the solar exposure and illumination of street locations for different street widths were analyzed with the help of sun-path diagrams and shading analysis. Using the generic building model, the impact of street or courtyard widths, building levels, and glass facade ratios have been calculated and finally extended to a full matrix as a design-support for the typology design development. Finally, the analysis for extreme conditions for direct sun exposure in the streets concluded the evaluations.

Based on the evaluations, the project team decided to illuminate the buildings through the courtyards and not via openings to the streets. Therefore, the streets can be narrow and a better thermal comfort can more easily be achieved. The courtyard designs differ depending on the type of building usage. All courtyards need either retractable shading – to protect this microclimate from high temperatures – or at least external shading of each façade opening. Façade ratios have been determined for the different floor levels based on the final typology design.

The city design determines the city climate and city heat or cold island effect, which are important boundary conditions for the building loads. These depend on the building design and construction as well as the external and internal loads, which are determined by the use. Therefore, each building type required a separate model, reflecting internal schedules and the hourly weather data for Abu Dhabi.

Boundaries: 80 percent demand reduction

In a global evaluation, solar energy is the way to go for Abu Dhabi, using an energy and heat source that maintains the global balance of our atmosphere and does not add additional heat. The Masdar Development concept as a carbon-neutral city, which can be spread around the globe, demands applicability for any other location. Even when other locations have annual solar irradiation potentials of only 1,000 kWh/m²a, the energy concept and the solutions of the storage and distribution problems in the Masdar Development can be applied but have to be adjusted for local conditions.

The limitations of the energy production areas on the roofs are combined with the decision to develop the small squares, necessitating the reduction of energy consumption even further. Compared to today's UAE standards, a reduction of 80 percent needs to be achieved. This has serious consequences for each different building typology, for example offices, laboratories, housing, retail shops, light industry, etc. These boundary conditions are not only related to the building construction but also to the building equipment and outfit. Without their compliance, the targeted numbers cannot and will not be reached.

The three following steps will lead toward a sustainable development with a carbon-neutral operation: The first step is a load reduction through passive design strategies, which will reduce primary energy consumption by 40 percent compared to today's Abu Dhabi references. The second step is to optimize the supply systems and the energy-demand strategies, which will allow a further saving of 30 to 40 percent. Finally, renewable energy sources and active renewable strategies will reduce the primary energy demand by the remaining 20 to 30 percent.

Conclusion

Our involvement in the Masdar City Master Plan project has given us the chance to view the possibilities of our work differently. Up to this point, we saw ourselves as experts in planning highly comfortable environments for the building user with a minimized energy demand. Through our work as a member of the design team for Masdar City, we were challenged to set the highest targets possible for energy savings and comfort protection in a city, enabling the team to plan a self-sufficient sustainable city – by realizing a high-density living and working space, which still allows for a modern but responsible lifestyle. If this can be showcased, it will have global impact. Some of the key concepts of Masdar City are very innovative and have never been built on such a large scale. They demand further development and adjustments. To plan and realize these concepts within seven years will be a great challenge.

The high standard of living in the world is responsible for the tripling of our ecological footprint. To prevent irreversible damage, we not only need to see our personal lifestyles and their impact in a global context but also to see the chances within our work and in the way we work. We see the Masdar Development concept for a carbon-neutral city as a concept demanding replication in other locations around the globe.

TED CAPLOW

Building Integrated Agriculture: Philosophy and Practice

High-efficiency urban food production has recently become a subject of intense interest across a range of professional and academic disciplines. In simple terms, food grown in the city – for consumption in the city – reduces carbon emissions resulting from transport and water pollution resulting from agriculture while providing a fresher product to consumers. This fledgling movement challenges not only the preconceived notions of a building's purpose, but also fundamental notions of the urban–rural divide.

The challenge

Increasing urbanization and the global construction boom have underscored the importance of efficiency in the environment already built. In the United States and Europe, buildings account for about 40 percent of energy use, 65 percent of electricity consumption, 15 percent of water consumption, and 40 percent of CO_2 emissions.

Agriculture has an equally significant impact. Modern farming feeds billions every day but is the world's largest consumer of both land and water and the primary source of water pollution. It requires approximately 0.3 liters of diesel fuel, 1.2 grams of pesticide, and 140 liters of fresh water to produce a single kilogram of typical field-grown tomatoes in the United States. During this process, about 0.8 kg of CO_2 is released into the atmosphere – most of it stemming from fossil fuel consumption during the average 2,500-km journey the vegetable takes from farm to table.

Three major trends will strain the global food system over the next half-century. First, global population is expected to exceed nine billion by 2050. Second, more than two-thirds of these people are expected to be urban dwellers, requiring that food produced in rural areas travels hundreds or thousands of kilometers to reach consumers. Third, global climate change is predicted to lead to widespread regional shortages of food, water, and arable land by 2050.

Building Integrated Agriculture

Building Integrated Agriculture is a new approach to production based on the idea of locating high-performance hydroponic farming systems on and in buildings that use renewable, local sources of energy and water. Hydroponics refers to the growing of plants without soil but in water that contains the essential mineral nutrients the plants need. Recirculating hydroponics – the most modern and efficient method – can produce premium-quality vegetables and fruits using 10 to 20 times less land and 5 to 10 times less water than conventional agriculture. Producing food this way also eliminates chemical pesticide use, fertilizer runoff, and most of the carbon emissions from farm machinery.

A recirculating hydroponic greenhouse yields between 50 and 100 kg of vegetables per square meter in temperate climates. The average Western consumption of fresh vegetables is around 100 kg per year. As a theoretical example, the 5,000 hectares of unshaded rooftop space in New York City is capable of meeting the vegetable needs of over 30 million people. Some similar calculations from around Europe and the Mediterranean illustrate the theoretical potential of urban food production. Barcelona, with a population of 1.6 million and an area of 100 square kilometers, could grow all of the city's fresh vegetables within 2 to 3 percent of that area. Central Cairo, with a population of 8 million and abundant sunshine, would require 5 percent of the city's surface. Istanbul would need 1 percent.

The environmental benefits are significant: Each hectare of rooftop vegetable farm would free up approximately 10 hectares of rural land, save some 75,000 tons of fresh water per year, and mitigate an average of 250 tons of CO_2 emitted from food transport. Building Integrated Agriculture reduces our ecological footprint, cuts transportation costs, enhances food security, and enriches the urban fabric. The approach is pragmatic and requires no new technology. The success of today's rural hydroponics industry indicates that urban systems – enjoying proximity to the market and the absence of middlemen – also present a compelling business case.

Hydroponic greenhouses: suitable for cities

Many urban structures, due to their size, dense occupancy, and internal power consumption, ventilate out substantial amounts of heated air all year round. This heat is often difficult to recapture for building use, but in colder climates it can be harnessed to help warm a rooftop greenhouse. In addition, plants thrive on the high levels of CO_2 in building-exhaust air. Hydroponic greenhouses are lightweight and suitable for rooftop deployment. Ecologically designed systems capture rainwater for irrigation, reducing urban storm water runoff. Rooftop greenhouses also reduce solar heat gains to the building, mitigating urban heat islands. Cooling is achieved with evaporation systems and high-volume passive ventilation. Solar panels – integrated into the greenhouse design – can power the necessary fans, automatic vents, and water pumps: loads which fortuitously peak at times of maximum solar energy.

Applications

Supermarkets, hotels, convention centers, hospitals, schools, apartment blocks, prisons, warehouses, and shopping malls all provide ideal settings for building integrated agriculture. In temperate climates, the availability of waste heat is an important bonus. A selection of projects from BrightFarm Systems illustrates the range of applications. All of these projects are either built, under construction, or engaged in a formal feasibility study.

The Science Barge, Yonkers, New York
Built in 2006, the Science Barge is a prototype sustainable urban farm on a mobile platform, including a 120-square-meter recirculating hydroponic greenhouse. It is climate-controlled by passive ventilation, evaporative cooling, and a vegetable oil furnace. The facility is self-sufficient, with all irrigation via rainwater capture, and all electricity provided by solar panels, wind turbines, and a biodiesel generator. The farm grows tomatoes, cucumbers, squash, bell peppers, lettuce, and herbs, with zero net carbon emissions, zero chemical pesticides, and zero runoff. The Science Barge is a powerful environmental educator. Since opening to the public in May 2007, the facility has hosted over 20,000 visitors, including students from over 200 local schools, and journalists from 45 countries.

School Sustainability Laboratory, Manhattan, New York City

The Manhattan School for Children – a publicly funded state school – is developing a new 150-square-meter greenhouse classroom on a fourth-floor rooftop. The greenhouse will include: seating for 35 students; hydroponic systems to grow lettuces, tomatoes, peppers, cucumbers, eggplant, and squash for the school cafeteria; an aquaponics module with tilapia, catfish, and mollusks; a composting and vermiculture operation; solar panels; rainwater capture; and a web-based interface for data logging and display. This second-generation pedagogical system will support classes in biology, chemistry, physics, ecology, and nutrition, and serve as a pilot project for possible adaptation to hundreds of other public schools in New York City. Of particular significance, this system will become the first step for future "green collar" job training in ecological urban food production.

Public Housing, Bronx, NYC

A 1000 m^2 facility on the roof of a six story affordable housing block will operate as a cooperative, meeting 100 percent of the fresh vegetable demand for 400 people while retaining 750,000 liters of stormwater per year, capturing 225,000 kWh of waste heat, and mitigating 80 tons of CO_2 annually. If an optional grid-tied solar photovoltaic system is installed, the net electrical footprint will be zero.

Commercial Rooftop Farm, Queens, NYC

A facility of similar size will begin construction in the fall of 2009 on the roof of a pre-existing one story building, becoming New York City's first commercial hydroponic rooftop farm. An annual yield of 30 tons per year of premium-quality fruit and vegetables will have a wholesale value of approximately $500,000. Over a 20 year design life, this greenhouse will save up to 4,000 barrels of oil compared to a conventional greenhouse, and conserve 80,000 tonnes of fresh water.

Carbon-neutral vegetables in the desert, Abu Dhabi, United Arab Emirates

A strong case for local agriculture can be made in the Gulf region, where fresh vegetables air-freighted from Europe and South Africa have a carbon footprint as high as 7 or 8 kg of CO_2 per kg. BrightFarm Systems was retained to estimate the performance of a proposed 5,000-square-meter sustainable rooftop greenhouse producing lettuce and tomatoes on a shopping center. This facility would save 34 million liters of water per year, compared with field agriculture, and almost 3,000 tons of CO_2 could be mitigated by replacing air-imported produce.

A more ambitious concept incorporates both horizontal and vertical growing systems into the roof and facades of a new type of civic structure with a large interior volume that could serve as a marketplace or stadium. A total building envelope of 60,000 square meters would meet the vegetable needs of over 50,000 people, and offset the entire CO_2 footprint of several adjacent buildings of similar size.

SABINE MÜLLER AND ANDREAS QUEDNAU

Master Planning of Xeritown, Dubai

Xeritown is a 59-hectare sustainable mixed-use development in one of the fastest-growing cities of the world: Dubai. It provides housing for approximately 7,000 inhabitants. It is located in Dubailand, a new extension of the city by the inland desert. Instead of considering the site as an isolated entity, Xeritown takes the desert and local climate into its context, within which the urban form emerges by working with the natural environment instead of against it.

Master plan, urban form, and sustainability

The objective of the master plan is to set the foundation for the physical design of Xeritown. It defines location and layout of development plots, land use, building heights, and massing. It also identifies the location of communal facilities, infrastructure, utility provisions, and open spaces.

Xeritown appropriates the tools inherent to the master plan procedure to introduce key features of ecological and social sustainability already during this first stage of development. Through a climate-sensitive layout and orientation of building mass, passive and therefore no-tech handling of sun, wind, soil and water conditions can be embedded – at no additional cost. The same applies to the envisaged social openness and sense of community, which depends, for example, on the topology of transport infrastructure and is worked into the project through the networked placement of social facilities and open spaces. On the level of architectural characteristics that can be described through the development code, the topic of sustainability is tackled through the development of typologies that wed traditional climatic expertise with contemporary lifestyle. Thus, the project takes urban form – as much as it can be regulated by master planning – as a starting point for bio-climatic principles: This has a huge potential that should be explored as an alternative to dominantly technological approaches.

Integration of sun, wind, soil, and water conditions

The urban master plan is composed of a number of dense urban clusters located within a landscape setting resulting in a low-impact half-half distri-

bution of built and open areas. This relation has been achieved through two measures. One concerns the appropriation of the Bawadi building regulation, which specifies a 10-percent share of the site's area be dedicated to "attraction." This area was attributed to the landscape, with the idea that the development's main attraction would be its natural scenery. The landscape is then cultivated in areas where sparse vegetation of the desert indicates the most humid spots, thus leaving the other non-vegetated areas for the building development. The gardening design follows a simple rule: Planting must be irrigated only from the gray water that is produced and recycled on site. Water is featured as a precious singularity. A low-maintenance, mainly dry landscape is the result – thus the name Xeritown.

The second measure responds to the harsh local sun conditions. The required gross surface area was condensed with the aim of creating a self-shading urban fabric. Narrow streets in the north-south direction keep the morning and afternoon sun out and provide a friendly outdoor pedestrian circulation area. Building structures are oriented toward north/south in order to minimize solar gains – a vital measure in a climate where most energy is consumed by air conditioning.

The shape and composition of the clusters not only recall the image that the wind draws in the desert sand, but also help the development to profit from the cooling sea winds that streak between and through the built islands. The channeling of this natural resource through urban forms helps in reducing air-conditioning needs at the building level but also adds to human comfort outdoors. In contrast, the hot desert winds coming from the south are led across the built islands by means of upward-sloping building heights toward the interiors of the clusters. The rugged skyline enhances air movement inside the core's courtyards, since it creates small-scale turbulence by breaking the wind's flow. The urban fabric is formed by courtyard townhouses, courtyard villas, and apartment buildings of varying heights that create the iconic skyline of Xeritown. Each segment benefits from the close relationship to the landscape through an improved microclimate and grand vistas.

Public life outdoors

An urban boulevard surrounds the clusters and connects them. It not only serves as the means to reach private homes but also forms the base of a well-connected network of public programs such as neighborhood kindergartens, a swimming pool, a public library, a desert museum, as well as a mosque that is open to all Dubai residents and visitors.

In contrast to other developments, car and pedestrian traffic are not separated, but road size is designed in such a way that cars must travel slowly. The boulevard is also the backbone of Xeritown's bus lines and provides easy access to public transport. A lively space of interaction emerges. From here, narrow alleyways lead into the core of the clusters – in the case of the largest cluster to an open souk. While being the realm of everyday movement, the boulevard ties together urban elements of cafés, restaurants, lobbies, and retail shops – all shaded by deep arcades on one side of the promenade and landscape on the other.

This most public part of the development is framed by the urban sun shading – an ornamental roof structure composed of photovoltaic panels providing low-voltage direct-current electricity. It functions as the necessary symbol for the values of sustainability that Xertown stands for. But most importantly, this iconic structure is utilitarian and, combined with flowing water channels, it turns the promenade into a place for strolling, sitting, and watching, or waiting for the bus. As one of the main attractions of the development, the landscape can be explored by walking – or via a jogging and cycling track – running through it. The additional public programs mentioned above turn Xeritown into a destination with urban flair in its own right, with close ties to sports and a characteristic local landscape. Xeritown thus encourages a public life outdoors, at least in the winter months. It therefore suggests an alternative to the supposed unavoidability of indoor malls in the region.

Technical equipment enhancing resource-saving performance

While the foundation for a climatic, robust development is laid in the urban landscape, its performance is enhanced by a multitude of state-of-the-art technologies such as earth pipes, dimmable LED street lighting, and rooftop turbines. The demand for potable water is reduced thanks to low water-use appliances and water-saving irrigation systems. Waste-recycling facilities and the reuse of soil on site are uncommon practices in the Emirates but are standard for the project.

Xeritown is characterized by the search for solutions that focus both on resource-saving principles and on creating a pleasant environment for social interaction. Its spatiality may recall traditional settlements, yet it is not the image that informs the project but its climatic and communal performance.

SIMONA WEISLEDER

The City in a Changing Climate: Key Theme of the International Building Exhibition in Hamburg

Shaping the future of the city in the 21st century is the declared objective of the International Building Exhibition (IBA) in Hamburg, Germany. In a seven-year process, it intends to show how cities and metropolitan areas can meet the challenges of the globalized world and deliver lasting impulses to German building culture. The Elbe islands and their cityscapes are marked by diversity and contradictions, and IBA Hamburg is bundling their transformation in three key themes, one of which is the city in a changing climate. The other themes are:

Cosmopolis – turning diversity into strength
Hamburg's Wilhelmsburg neighborhood is home to people of over forty nationalities. IBA Hamburg sees this diversity as an opportunity. Its activities include improving the quality of public spaces, creative quarter development, new models for integrative residential building, and an education offensive to develop new learning concepts and educational spaces for intercultural learning.

Metrozones – building a new town within the city
Stacks of shipping containers, harbor cranes and industrial areas next to residential quarters and brownfield sites, interspersed with highways, abandoned docks and marshland – spatial breaks and contrasts shape the exciting faces of the Elbe islands. IBA calls these places – which are so typical for border and transition areas of many inner cities – "metrozones". IBA Hamburg is showcasing architectural and urban planning solutions on the Elbe islands that are designed to strike a balance between a variety of interests and uses, creating an infrastructure with places for business activities, open spaces and urban density.

The city in a changing climate – paving the way for renewable sources of energy

Climate change confronts the Elbe islands with special challenges. The storm tide of 1962 has not been forgotten. Wilhelmsburg is also grappling with the legacies of its industrial past, such as the Georgswerder toxic-waste dump. With its Renewable Wilhelmsburg climate protection concept, IBA Hamburg is setting new standards for the renewable-energy era. The concept rests on four strategic pillars: high technical standards for new buildings and renovations to conserve energy, combined heat and power stations and energy networks to improve efficiency, the gradual switch over to renewable resources, and communication and economic incentives to encourage the inhabitants to take part.

The IBA projects to be realized by 2013 are essentially the first steps on the way to a climate-neutral Elbe island. Energiebunker and Energieberg are two especially striking projects in this concept.

Energiebunker

The project consists of two modules: establishing a supply of renewable energy and putting a ruin to new use. The bunker was "defortified" by blasting work in 1947 that destroyed the interior while leaving the external shell intact. Once renovation work is complete, the forbidding structure will offer a panorama of the quarter and Hamburg's harbor from a terrace and café at a height of over 30 meters. An exhibition will provide information about the (wartime) history of the flak bunker and the quarter. Additional usable floor space can be made available in the ground floor of the structure. The Energiebunker has the potential to become the nucleus of a renewable energy supply for the Reiherstieg quarter. It complies with the "no (urban) heat generation without power generation" rule and expands it by using renewable energy sources and industrial waste heat as well as biogenic waste. The three core elements of the energy concept (solar system on the roof and south façade, biomass CHP, thermal storage) will supply over 800 households in the neighboring Weltquartier with heat from renewable resources while also covering a part of the quarter's electrical power requirements. The project thus encompasses multiple components of a future-oriented energy supply:

- efficient, large-scale deployment of renewable and regional energy sources
- heat and power cogeneration using biomass
- (thermal) energy storage to compensate for the lack of regulation of solar energy and to increase power generation in the CHP
- deployment of a large-scale solar power system of over 3,000 m^2.

The project still offers scope for further development, and in a further step it will be expanded to use the waste heat and materials of a nearby factory at the Veringkanal to provide CO_2-efficient heating and power to a large part of the Reiherstieg quarter in the northwest of the Elbe islands. This will not only provide a CO_2-neutral heat and power supply for those buildings, it will represent an actual reduction of overall CO_2 emissions.

Energieberg

The Georgswerder landfill, a hill of 40 meters, is rich with potential energy forms. IBA not only intends to exploit that potential, but also use it as a demonstration object for the public. Over 2,000 households can benefit from electricity from the Energieberg. A large-scale wind power system is slated to be set up on top of the hill – one of the first energy projects of the new HAMBURG ENERGIE utility company. The southern slope of the hill offers space for a photovoltaic system covering up to 16,000 m². The first phase, measuring 5.000 m², is scheduled to be installed already in 2009. Landfill gas containing a large share of methane is produced by continuous decomposition processes within the covered dump. The gas is already being collected systematically and delivered to Aurubis AG, Germany's largest copper smelting plant. Leachate and groundwater from the landfill are collected, monitored, purified and discharged. A heat pump could exploit

the thermal energy of the water to heat the buildings of the facility and the future visitor's center. IBA's planned urban biogas project also intends to use clippings from mowing the hill for biogas production. The Energieberg concept foresees the controlled opening of the secured landfill site and its development into an attractive destination. A visitor's center at the base of the hill will document the problems of contaminated sites and the cleanup of the landfill, and will highlight the use of renewable energy resources.

ANDREAS HOFER

KraftWerk1 – Cooperative Sustainability

Roots

In the 1980s, Zurich's chronic housing shortage escalated to a veritable emergency. The rapidly expanding financial-services industry attracted young urban professionals who settled in luxuriously renovated apartments in traditional working-class neighborhoods, displacing the original residents. This triggered widespread protests and an extensive squatting scene. At the same time, financial-services representatives demanded a revision of the zoning plan to permit a general opening of commercial and industrial properties for use as their back offices.

Young activists, artists and architects linked these two developments in a debate over the future urban character of the city and called for a more integrated and sustainable management of its spaces. The place where their demands were to be realized was the factory compound of one of Switzerland's largest mechanical engineering companies, Sulzer-Escher-Wyss, which was restructuring at the time (the downsized factory still exists on the site).

This political protest against urban development trends grew to a small movement within a few years. In 1995, the KraftWerk1 building and residential cooperative was established. The choice of the traditional cooperative model – an important one on the Zurich housing market –, resourceful and tenacious development work, and the adaptation of the bolo'bolo model invented by the utopian author p.m. into a realistic project development model soon thrust the planning proposal into the limelight. Decisive assistance for the project came from an unexpected quarter in 1997. Zurich's property-market bubble had burst in 1992, and new construction had been rendered impossible by massive vacancy rates. In desperation, one of the major players on the local market, the Oerlikon Bührle defense and real-estate conglomerate, offered the young cooperative a partnership for their project model. The cooperative became more professional in the course of its architectural planning work, scraping together money and support and developing a rental and administrative structure. After a two-year building period, around 300 residents and 100 workers moved into KraftWerk1.

After a period of internal organization and consolidation, KraftWerk1 began seeking additional properties in the greater Zurich area in order to expand as a cooperative and realize further innovative concepts related to new residential forms and sustainable project construction. Work on KraftWerk2 – the conversion and expansion of a former children's home into a project focusing on new residential forms for people in the second half of life – has progressed to the point that the building permit has been applied for and is now pending. KraftWerk1 is involved as a potential investor in the planning process for two further sites.

Sustainability, integration, autonomy

At the time it was opened, KraftWerk1 was the largest residential building in Switzerland to comply with the Minergie standard. It uses waste heat from a nearby incinerator for heating and produces electricity for its operation (not including household consumption) using its own photovoltaic system. The cooperative considers ecology to be a broad, integrative concept: all of the buildings' materials are deemed safe according to the principles of building biology, the ecological balance sheet is reviewed periodically to identify potential for savings on the part of the operators and residents, a water conservation concept is in place to reduce consumption, and all members of the cooperative have the option of joining Mobility – a car-sharing organization with vehicles stationed in Building 3 – at a preferential rate. Only around 25 households in the entire project own cars – and this without contractual restrictions or other pressure to reduce car ownership.

The 100 apartments in KraftWerk1 cover the full range of urban life, from 45 square-meter (485 square-foot) studios to 500 square-meter (5,380 square-foot) apartments for large-scale communal living. KraftWerk1 is not rooted in an ideology, but considers itself to be an open platform. Apartment rentals are subject to socio-demographic quotas to ensure a sound mixture of residents. KraftWerk1 also cooperates with the Domicil foundation – which refers apartments to immigrant families with many children – and the Altried foundation – which organizes residential groups for the handicapped – to provide housing for people who are in a disadvantaged position on the Zurich housing market. The KraftWerk1 project does not include government-subsidized apartments, but uses an internal redistribution and discount model.

Fundamental legal and financial issues are governed by a professional administrator elected and monitored by the general assembly of the cooperative. All other routine matters are managed by the inhabitants in numerous self-organized groups. The required funds are allocated to the individual projects by a residents' assembly. Examples for such activities include a small shop that stocks exclusively organic products, a guest room, a small bar, and a community room for use by a cooking club, a movie club, gymnastics events and children's play groups.

Background and future: nonprofit housing projects in Zurich

Nonprofit housing forms in Switzerland include municipal housing, foundations and cooperatives. Such organizations adhere to the cost-rent principle – i.e. setting rents to cover the actual costs incurred. They do not charge excessively for administration work or aim to make a profit, and in the case of a sale or liquidation, they ensure that the property is transferred to another nonprofit operator. Municipal housing in Zurich makes up a modest six percent of the market. 19 percent of all apartments belong to over 120 cooperatives – from small-scale house cooperatives with four apartments to the Allgemeine Baugenossenschaft Zürich (ABZ) with around 5,000 – and a small number of foundations.

The cooperatives are tenant groups – legally independent companies whose capital is provided by the residents, and the bulk of the capital of older cooperatives today is the value of the amortized property that was once purchased at a low price. Only a small share of the cooperative apartments are state-subsidized public housing. With their inexpensive apartments, the cooperatives are an important source of relief for the chronically tight housing market in Zurich.

The cooperatives were established in two waves: in the "Red" Zurich of the 1920s and the postwar boom of the 1940s and 50s. The cooperative movement is currently undergoing a change in generations as the traditional working and clerical classes pass on. The modest houses and small apartments require

considerable renovation work and are not suitable for the more lavish demands of today's family households. Many cooperatives complain of a loss of cooperative awareness, self-help and solidarity. While municipal housing projects are under neoliberal pressure – as is the case in other countries –, the independent cooperatives are not in any danger in this regard.

In recent years, the movement has been strengthened considerably by various developments: young chairpersons have been moving the development of cooperatives forward, reforming their structures and renewing housing (often by demolishing and rebuilding entire projects). In other cases, recently-founded cooperatives (such as KraftWerk1, www.karthago.ch, www.kalkbreite.net, www.wogeno.ch, www.dasdreieck.ch) are opening the cooperative idea to new social strata and residential forms. A whole series of new, high-quality residential projects have been realized.

The genossenschaft mehr als wohnen cooperative (www.mehr-als-wohnen.ch) was recently established as an experimental platform of the Zurich cooperatives. genossenschaft mehr als wohnen is borne by 50 established cooperatives and is designed to explore the potentials of communal and cooperative living for urban development with an exemplary cooperative project. The city of Zurich placed a large brownfield site in the city's northern periphery at the project's disposal. In late 2008, the cooperative launched an international architectural competition. Like the model housing developments of the Werkbund, the project was to be realized jointly by multiple architectural teams working within an urban development master plan. In early May 2009, the master plan, building designs and victorious teams of the architectural competition were presented, and the teams are currently merging their individual efforts to a single project in a dialog phase. The 450 residential units, quarter infrastructure and commercial space are set to be completed in 2013.

genossenschaft mehr als wohnen is of interest for the discussion of urban renewal in a number of respects. In the course of a demanding communication process, it succeeded in getting numerous urban development actors to commit to a joint project at a challenging location. The broad support results in an unusual diversity of ideas with regard to residential and community aspects (integration models, volunteer work, child care services and support for older inhabitants). The experiments of the young cooperatives, which appeared exotic only a few short years ago, have thus arrived in the mainstream and now contribute to the renewal of traditional cooperatives.

"We are not building a housing project, we are building a city quarter." This sentence of the winning architectural team places the residential utopias of the twentieth century – which were frequently anti-urban and escapist – back into the dense European city.

Documentation and background (in German): www.kraftwerk1.ch

MICHAEL MÜLLER

Sustainable Building: More Than Eco-Architecture

Tomorrow's architecture will not be merely ecological. Sustainable building calls for an integrated planning approach for operating buildings economically, substantially reducing their impact on our environment and enhancing the well-being of their inhabitants. This holistic view of sustainable building goes beyond "ecological building" or "ecological architecture" by dispensing with the one-sided evaluation focus this entails. Only buildings that reconcile all of the above factors are fit for the future.

The sustainability movement in building has expanded enormously worldwide over the past eight years. Investors and operators are increasingly recognizing that sustainable building offers demonstrable quality gains with regard to operating costs, workplace productivity and resale value. The economic appraisal of a building project is no longer limited to investment costs. When taking costs during their use and conversion phases into account, sustainable buildings are generally more economical thanks to their optimization of economic, ecological, functional and social aspects. Internationally, this has been promoted in recent years with the aid of recognized building assessment systems such as LEED, BREEAM, CASBEE and HQE. Supplementary structures and systems were developed to attain German sustainability goals, which are very ambitious in an international comparison. The Deutsches Gütesiegel Nachhaltiges Bauen certification system published in 2008 was designed for the assessment of newly-constructed office buildings. In its ongoing development, the system is no longer restricted to new buildings, but is increasingly focusing on existing structures. The available planning tools permit the potential of sustainable renovation work – which had been severely underestimated previously – to be unlocked. In this regard, the Deutsches Gütesiegel Nachhaltiges Bauen is currently being revised thoroughly to accommodate the certification of additional building types and entire quarters.

The numerous buildings in Germany that are no longer or only inadequately used can thus play a special role in determining how the ecological architecture of tomorrow will look, highlighting their utility and resource conservation potential – which is not only immense, but also completely underrated in the general public awareness.

The introduction of practical simulation and assessment processes permits the advantages of existing buildings to be quantified, refuting old prejudices against their modernization. Numerous research findings and technical reports document that modernization work can lead to significant savings in investment and operating costs while meeting stringent user requirements with regard to the building structure, workplace quality and building image. They generally note that consistently utilizing the resources of existing buildings will be indispensable to meet the environmental protection goals of the German federal government and the EU.

Parallel to the development of certification systems for reconstruction measures, a research project supported by the German Federal Environmental Foundation (Deutsche Bundesstiftung Umwelt, DBU) used the modernization of the Remscheid municipal waste disposal company administration and service building as a model to demonstrate the current possibilities of sustainable, integrated planning.

Potentials of building reconstruction: the Remscheid municipal waste disposal company

Reconstructing the Remscheid municipal waste disposal company administration and service building proved a significantly better solution than demolishing the existing building and constructing a new one. The following is a summary of the results of the DBU research project:

- The investment costs for the reconstruction work were roughly 40 percent less than those for a new building.
- The reconstruction and restructuring work reduced floor space requirements by around 15 percent.
- The post-reconstruction building properties meet or exceed the standards for new buildings.
- The building's primary energy requirements were reduced by 75 percent, now amounting to half the permissible value for new buildings stipulated in the German Energy Conservation Ordinance (ENeV) of 2007.
- The resource savings for the new façade were documented at a factor of up to 25 using the calculations of the MIPS concept.

For detailed information, please see final report AZ 22566, available at www.acms-architekten.de and www.dbu.de (in German).

STEFAN DENIG

Munich's Path Toward a Carbon-Free Future

It is possible for a major city like Munich to reduce its CO_2 emissions by up to 90 percent by the middle of the century without adversely affecting the quality of life of its inhabitants. That is the key finding of a new study, Sustainable Urban Infrastructure: Munich – Paths toward a Carbon-Free Future. Siemens AG commissioned the Wuppertal Institute for Climate, Environment and Energy to examine how modern cities can drastically reduce their CO_2 emissions, using Munich as a model. The analysis used a model urban district to show how Munich can be transformed into a virtually CO_2-free metropolitan area in concrete infrastructural and technological terms. Factors that can be leveraged for CO_2 reduction include highly efficient energy applications – especially in buildings –, infrastructure adaptation with regard to heating, power and traffic, as well as the most complete switch possible to renewable and low-carbon sources of energy. Half the world's population currently lives in cities, and that figure is set to rise to 60 percent by 2025. Cities must therefore take a pioneering role in climate protection, as they are not only the biggest contributors to climate change, but will also suffer the consequences most strongly.

Overview of key findings

A major city such as Munich can not only meet, but significantly exceed the demands of EU environmental ministers to reduce global greenhouse gas emissions by 50 percent vis-à-vis 1990 levels – and thus to less than two tons per capita on average – by the year 2050. Reaching that ambitious goal will not adversely affect standards of living. It will, however, mean a comprehensive paradigm shift with regard to buildings, heating, the power grid and power generation. Optimized building insulation, regenerative and low-CO_2 power generation, the judicious deployment of cogeneration and efficient electrical appliances and lighting systems offer the greatest leverage for reducing emissions. In the transportation sector, the biggest potential for savings lies in the reduction of individual transportation through the wider use of public transportation, as well as a switch to electric vehicles in inner-city traffic.

Savings in heating pose new challenges for utility companies: optimized building insulation reduces heat requirements so drastically that district heating

networks become difficult to operate economically. The further development of new concepts such as low-temperature networks must therefore be pursued vigorously.

The study's examples show that many investments in efficiency measures are also economical. Applying the particularly stringent passive-house standard to new buildings and renovations in Munich until the middle of the century, for example, would cost € 13 billion more than under the currently applicable energy conservation regulations from 2007. Expressed on a per-capita basis, that would amount to around € 200 per year – roughly one third of the annual gas bill. However, the additional investment would result in energy savings of € 1.6 to € 2.8 billion in the year 2058, or annual per-capita savings of € 1,200 to € 2,000.

If all possible savings with regard to electrical power were exploited, it would be possible to obtain most of the needed power from renewable and low-CO_2 sources. Investments in energy-efficient technology may be high initially, but they generally pay for themselves through lower energy costs.

Low-carbon urban quarters within 30 years

Siemens AG commissioned the Wuppertal Institute for Climate, Environment and Energy with performing the study. The goal was to show which courses of action are available and how they can be bundled intelligently into sound concepts for the future. Two possible paths were studied using Munich as a model for the period from 2008 to 2058, the city's 900th anniversary: an optimistic target scenario and a transitional scenario that was more conservative, especially with regard to the behavior of the city's inhabitants. In the target scenario, emissions can be reduced by around 90 percent to 750 kg a year per capita. In the transitional scenario, Munich is still in the process of becoming a largely CO_2-free metropolitan area. It would nevertheless be possible to reduce carbon dioxide emissions by 80 percent to 1.3 tons per capita – still well below the two tons per capita called for by the EU environmental ministers. In a second step, the study uses a model urban district to analyze how the identified factors can contribute to transforming Munich into a virtually CO_2-free metropolitan region. The model urban district analysis demonstrates that individual, extremely low-carbon quarters could be realized in a period of only 30 years.

Lawmakers must provide a suitable framework

The study also indicates that the actual transformation of a major city into a virtually CO_2-free urban area is a major undertaking that can only succeed if the goal is seen as a high priority by everyone involved – decision-makers, public administration, utility companies and urban planners, but also investors and citizens. To achieve ambitious carbon targets, the city's inhabitants need support and encouragement in the form of financing and rebate strategies and targeted educational campaigns for them to invest in efficient and low-carbon technologies and use environmentally-friendly modes of transportation more consistently. An important task for the public sector is therefore to portray the advantages and financial benefits of energy-efficiency technologies more clearly in the future and to eliminate obstacles to their adoption.

For more information please visit www.siemens.com/sustainablecities

JOACHIM EBLE

ECOCITY – A European Approach to Sustainable Urban Planning

ECOCITY EU Project

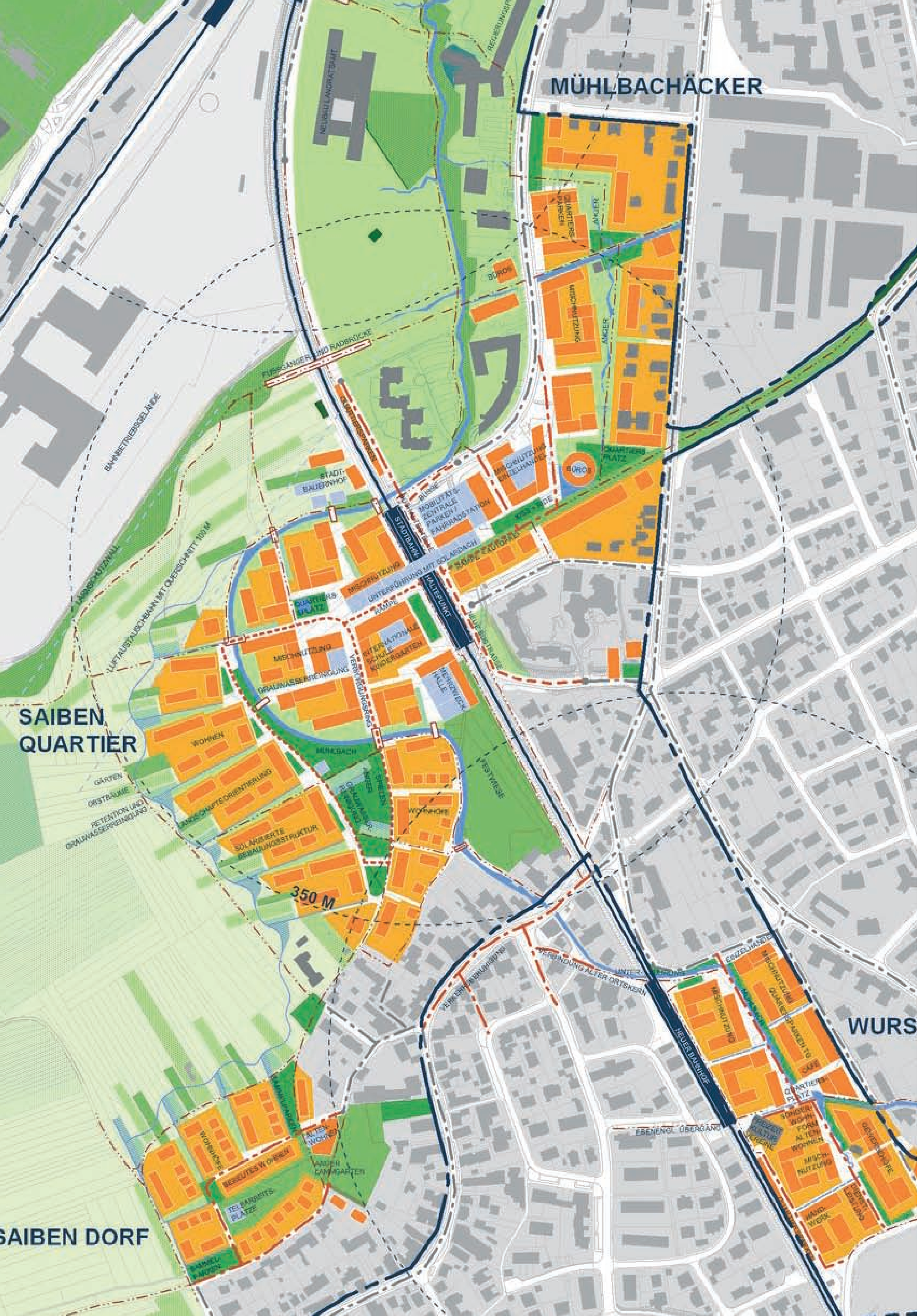
In the ECOCITY project, new city quarters were planned for Tübingen, Germany, and six other European cities with the primary goal of realizing urban structures designed to guarantee sustainable mobility. In keeping with an integrated understanding of sustainability, the interdisciplinary project also took other important planning sectors such as energy, material flows, water, socio-economic aspects and participation into account.

ECOCITY Tübingen-Derendingen

The basic idea of the project in Tübingen-Derendingen was to prevent further urban sprawl by allocating new development areas around the stations of the planned regional light railway system. The ECOCITY project encompasses three different areas: the Wurster & Dietz brownfield site (now Mühlenviertel), the Mühlbachäcker consolidation area, and the Saiben greenfield site. The goal was to develop a strategy to resolve the conflict between minimizing land use, landscape conservation and the need for new development areas.

Public participation
At the start of the public participation phase, a perspectives conference to develop visions for 2020 and a list of common interests were placed before the development of the master plan. These formed the basis for developing two different scenarios that were discussed with citizens and interest groups in a second workshop. A considerable degree of common ground between the overall goals of the ECOCITY project, the Tübingen 2030 sustainable development guidelines and the wishes of the public were noted.

Urban structure
A car-free Saiben quarter was proposed as an element of Tübingen's star layout. The new quarter would be linked with Alt-Derendingen and would have a green zone toward the railroad yard in the north. A dense, compact urban structure was



MÜHLBACHÄCKER
SAIBEN QUARTIER
SAIBEN DORF
WURS
350 M
QUARTIERSPARKEN
ANGER
BÜROS
MISCHNUTZUNG
QUARTIERSPLATZ
FUSSGÄNGER- UND RADBRÜCKE
BAHNBETRIEBSGELÄNDE
STADTBAUERNHOF
MOBILITÄTSZENTRALE PARKEN / FAHRRADSTATION
UNTERFÜHRUNG MIT SOLARDACH
STADTBAHNHALTEPUNKT
RAMPE
MISCHNUTZUNG EINZELHANDEL
INTERNATIONALE SCHULE KINDERGARTEN
GRAUWASSERREINIGUNG
MEHRZWECKHALLE
WOHNEN
MÜHLBACH
SPIELEN
WOHNHÖFE
FESTWIESE
GÄRTEN
OBSTBÄUME
RETENTION UND GRAUWASSERREINIGUNG
LANDSCHAFTSORIENTIERUNG
SOLAROPTIMIERTE BEBAUUNGSSTRUKTUR
VERBINDUNG ALTER ORTSKERN
NEUER BAHNHOF
EBENERDIGER ÜBERGANG
CAFE
QUARTIERSPLATZ
HANDWERK
ALTENWOHNEN
ANGER
BETREUTES WOHNEN
TELEARBEITSPLÄTZE

envisaged for the central area extending from the consolidated Mühlbachäcker across the railway line. A courtyard structure will establish a southward connection to the village-style buildings of the old town center, while a landscape-oriented, solarized building structure will complete the quarter at the western edge. A small-scale village extension was planned for the western edge of Alt-Derendingen, and a compact, dense mixed-use and commercial property structure for the Wurster & Dietz site.

Open-space concept
A new town periphery was planned as part of the ecological open-space concept that would contain traditional open-space elements such as meadow orchards and small garden plots, as well as ecological infrastructure for water purification and infiltration, thus limiting the further growth of residential development in the future. An urban farmyard on the northern edge of the Saiben development will use the adjacent green zone for ecological agriculture, market its products directly and also serve as a children's farmyard. The public spaces were designed specifically for pedestrians and cyclists through the use of urban landscape elements and water.

Urban climate
The quality of the urban climate was taken into account with measures including the expansion of the green zone north of the Saiben quarter as an air exchange tract and by not building in the Mühlbachäcker section immediately to the east.

Water concept
A sustainable water concept will ensure that peak run-off will not become greater, the evaporation share will be reduced and the infiltration share will increase in Saiben vis-à-vis the undeveloped land. The goal is to create a "groundwater-neutral" quarter. This will include measures for infiltrating rainwater and treated graywater in the Saiben quarter.

Mobility concept
Within the overall mobility concept based on a planned regional light railway or improved regional express connections as attractive public transportation, custom concepts were developed for individual areas according to their classification: reduced car traffic in eastern Mühlbachäcker, low car traffic for the Wurster & Dietz site, and a car-free zone in Saiben at the proposed regional light railway station and mobility center. The car-free concept will be supported by services within the quarter and an urban logistics concept including pick-up and delivery services.

Energy concept
The urban structures were optimized for energy efficiency and the energy supply concepts formalized as an "energy framework plan". For example, a local heating

network fueled by wood chips will be the first priority for the Wurster & Dietz site, while the Saiben quarter will rely on wood pellets and bio-oil produced directly in Saiben or at sunflower or rapeseed farms in the region. A passive-house development is slated for the western periphery.

Socio-economic concept

Subtly differentiated mixed-use concepts with a variety of residential and ownership forms and options for businesses were developed for the individual sections. An international school and a multipurpose hall have been proposed as attractors for the new Saiben quarter. The hall north of the fairground would be used by the school directly, but also as a facility for Derendingen as a whole.

Thanks to an integrated planning process and considerable public participation, it proved possible to combine a variety of urban activities with ECOCITY criteria into a sustainable urban development concept for Tübingen-Derendingen.

EVA Lanxmeer Culemborg

Lanxmeer, an area of approx. 40 hectares that had previously been used for agriculture and gardening, is located in the southeastern part of Culemborg, Netherlands. Previously, Lanxmeer had been zoned as a water catchment area. Downgrading it provided the municipality with a valuable development area for urban use near the old town and railway station (15 minutes to Utrecht). Already in 1994, Culemborg chose an innovative sustainable development concept that was recognized by the Dutch building ministry (VROM) as an exemplary project for sustainable building. Urban development and building realization goals and a socio-ecological structuring of the planning process were defined with comprehensive public participation and in cooperation with the EVA Foundation.

Quarters with a variety of uses and identities cluster around the central green zone and water tower: a residential quarter with car-free sun yards, office and service quarters at the railway station, the Pioniersveld for experimental living, a mixed quarter along the railway line, and the EVA Center as a socio-cultural link and integration point.

Achieving high social diversity and mixing was an important goal. Realized model projects include the Kwarteelhof residential community for the elderly, the therapeutic concept of the Wohnsorg project for dementia patients and young families living together with animals, and a project for the temporarily homeless, as well as initiative schools and new models for living and working.

The urban development approach is derived from the landscape and hydrogeological structure and encompasses an ecological urban farmyard in the northeast. The permaculture concept, with vegetation varying according to zones, underscores the area's garden-city character. The development and management of the open spaces is shared by the resident's association (BEL).

The association is also responsible for the self-administration of the project and publishes a newspaper for the quarter.

The complex ecological community water management project was integrated in the open spaces. Rainwater is retained, street run-off is infiltrated, and graywater from kitchens and bathrooms is treated in plant-based helophyte filter systems in the area. In future, blackwater will also be treated locally using a Living Machine. The carbon-neutral energy concept combines high building energy standards, active and passive solar energy, as well as the utilization of heat from drinking water extraction in conjunction with a local heat network. The material catalog, which is highly ambitious in ecological and health terms, and the urban color concept link the individual quarters and give the EVA Lanxmeer area its unmistakable character.

The master plan was created as an open development concept to permit ecological and social residential concepts and innovative business and mixed-use projects to be realized. Quality assurance and urban development supervision is managed by the design group, the office of Joachim Eble Architektur serving as the urban planner, and the project group.

Funding

The "ECOCITY – Urban Development towards Appropriate Structures for Sustainable Transport" project is supported by the European Commission in the “City of Tomorrow and Cultural Heritage” key action in the 5th Framework Program as a research and demonstration object.

For further information please visit www.eble-architektur.de

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III

Policy

ULRICH HATZFELD

Paths Toward a Sustainable City

In recent years, sustainable urban development has increasingly become the subject of public interest and has moved into the focus of policymakers at the federal, Land and municipal levels. Over 60 percent of the EU's population lives in cities and towns with more than 50,000 inhabitants; in Germany, the figure is around 74 percent. 77 percent of all jobs and 79 percent of actual taxable capacity is created in cities.

Ambivalent development of cities

To start with the asset side of the balance sheet, in a worldwide comparison, European cities are attractive and safe and offer a high quality of life. On average, they are even growing; that especially holds true for small and mid-sized towns with their above-average dynamics (population growth of six percent between 1990 and 2006). European cities also feature an impressive cultural diversity and infrastructure. Finally, cities belong to the winners of economic globalization, being home to major enterprises and the creative economy.

These positive factors are balanced by equally impressive challenges: social polarization has been growing in European cities for decades. Between cities themselves, the gap between winners and losers has also been widening. At the same time, environmental burdens due to noise and pollutants are on the increase, especially in bigger cities. It has not been possible to curb the consumption of land for development and transportation. Biodiversity is also declining in urban areas. Furthermore, cities contribute significantly to carbon emissions and climate change.

Approaches for action: national urban development policy

The Leipzig Charter on sustainable cities was adopted in 2007 during the German presidency of the Council of the European Union. At the national level, the charter was coordinated with the Länder, municipal governments and civil organizations. Ultimately, it was adopted by all 27 EU member states as a general policy foundation. The national urban development policy may be seen as a concrete expression of the charter. This political approach sees itself as a forum for the city as a public topic, a driver for urban innovation and a platform for related information and communication. It intends to keep the most important fields of action at the national level – especially legislation and urban development subsidies – continuously up to date.

The policy relates to two fields of action: In the first, good practices, well-known and proven instruments are adapted to the continuously changing conditions of urban development in a broad public discourse. The second is the project series for cities and urbanity, with its innovative, exemplary and partnership-based urban development projects. Open project announcements form the basis for this field of action. These announcements were met with over 500 statements of interest from municipalities, as well as civil-society organizations and associations, in the years 2007 and 2008. The Federal Ministry of Transport, Building and Urban Development (BMVBS) is currently supporting over 70 such projects. The content profile of Germany's national urban development policy is made up of six areas of action:

- the civil society – activating citizens for their cities
- the social city – creating opportunities and maintaining unity
- the innovative city – engine of economic development
- climate protection and global responsibility – building the city of tomorrow
- building culture – improving city design
- regionalization – the region is the future of the city.

Climate-friendly urban development

Climate-friendly urban development is a special focal point within the framework. The starting point is the assertion that cities are in a position to produce a considerable share of the energy they need themselves. In Germany, the share of energy from renewable resources was only 8.5 percent in 2007. Enlarging it will require new thinking on the part of the population, grid operators and suppliers. An increasingly decentral infrastructure would appear appropriate in this context to accommodate renewable energy from smallest-scale producers. A further focal point for action is energy savings in the building and transportation sectors.

The federal government has initiated programs for climate-friendly urban development within the context of good practices. The CO_2 building renovation program and the German Energy Conservation Ordinance (ENeV) are central elements of climate protection policy in the building sector. Since 2006, more than 865,000 residential units were newly built or comprehensively renovated with financing by the KfW development bank for energy-efficient building and renovation. This prevented the emission of nearly 2.6 million tons of CO_2, with the added benefit of saving nearly € 800 million in heating costs. Energy-conscious building and modernization work also creates and secures jobs, and this was a further incentive to increase the funding of the CO_2 building renovation program by € 580 million to around € 1.5 billion as part of Germany's first stimulus package, and to continue funding it at that level in 2010 and 2011.

Since 2008, cash-strapped municipalities have been able to benefit from the federal-Land-municipal investment pact for improving the energy efficiency of municipal social infrastructure. In 2009, the federal government is providing €300 million in the context of tripartite financing to help reduce the backlog of investment projects in social infrastructure facilities.

Climate-friendly urban development is not just a matter for the building sector, however. Mobility must also be organized in an environmentally friendly and city-compatible manner. Although city dwellers have shorter distances to cover on average, cities are heavily burdened by car traffic. The BMVBS supports the search for future-oriented mobility concepts by promoting a stronger focus on bicycle traffic with the national bicycle traffic plan and model projects related to innovative bicycle rental systems and e-mobility.

Integrated urban development as envisaged by the BMVBS within the context of national urban development policy certainly will not take off by itself. It will require a steady stream of ideas, dedication and discourse keep it fresh and lively. Ultimately, it can only succeed if national urban development policy is helpful on the ground – in municipal and regional planning. This can be realized by focusing urban development programs more tightly on problems and by stimulating greater public interest in environmental and climate protection.

PETER HETTLICH

Ecological Building Activity – Modern and Sustainable

Achieving sustainability in building means reconciling several factors: the condition of the building, the energy footprint of the construction project, inhabitant health and the recyclability of the building materials. The building sector accounts for one third of Germany's total energy consumption. But Germany is essentially completely built. Two thirds of its buildings are over 30 years old and fall far short of current energy standards. Building renovation focusing on energy conservation therefore holds the greater potential for mitigating energy consumption, yet the energy requirements of new buildings can also be reduced considerably by applying innovative and sustainable solutions and using ecologically sound building materials.

It will be essential to establish a holistic approach in the construction industry. Sustainability means more than improving the insulation of residential buildings to reduce their energy consumption – it must target the building's entire life cycle. The production of building materials must involve as little energy as possible and avoid the use of hazardous substances. The share of ecological, renewable building materials must be increased and the energy consumption of buildings in use – both existing and newly-constructed ones – must be cut significantly. The potential for re-use of building and insulation materials is also playing a bigger part. As the sealing of buildings improves, the indoor climate and concentration of harmful substances and microbes in indoor air is becoming problematic, making residential health an increasingly important factor. Beyond these current practical considerations, the green vision of tomorrow's building has already progressed to renewable and compostable houses.

Ecological building materials

Buildings whose technology is so advanced that they only use very little energy are the wave of the future. A closer look at the life cycle of a building shows that energy is not only consumed while the building is in use, but also in manufacturing building materials and recycling those materials when the building has exceeded its useful life. Natural materials such as wood, straw, hemp, etc. require significantly less energy to produce. Building a wooden house uses only around 30 percent of the primary energy of a comparable masonry design. The natural properties of ecological building materials also have a positive effect on energy consumption. Unlike concrete, wood is a warm material which also has good insulating properties, and this makes it much easier to erect an energy-efficient wood building than a concrete one.

Natural building materials also result in a much more pleasant indoor climate. While the ever-improving insulation and sealing of houses saves a great deal of energy, it can lead to hazardous substances being "locked in". This issue can be avoided by using selected and certified building materials. Here too, the use of natural materials is frequently the solution. Avoiding the growth of mold requires a sophisticated ventilation plan, however.

With the population decreasing and demolition rates on the rise, the recycling properties of building materials must also be taken into account when assessing overall sustainability. Whether demolishing a building or renovating it to improve its energy efficiency is the better solution must be decided on a case-by-case basis.

Renovation measures related to energy conservation

Renewable building materials can also be used to reduce energy consumption in renovation measures designed to improve energy efficiency. They are outstanding as insulation, for new windows, or for use as fuels.

Insulating the basement floor and roof can cut energy consumption roughly in half. Further measures such as replacing poorly sealing windows, insulating the entire building envelope, replacing the heating system and insulating pipes can reduce energy consumption from approx. 300 kWh/m^2 per year to around 50 kWh/m^2.

What to do?

Increased communication and public relations work on sustainable building is urgently needed at every level – among policymakers, the scientific community, experts and building clients. Only those who are aware of energy conservation options can also realize them. Sustainable building can only succeed if mandatory ecological building regulations are put in place. Certified building materials and life cycle assessments are helpful here. The energy certificate is an instrument that must therefore be expanded to include a sustainability assessment that takes the total energy footprint of a building into account.

The number of buildings being renovated must be increased significantly, and while this can be realized through financial assistance and other measures, it will be necessary to adjust the terms of credit. In addition to low-interest loans, the increased use of subsidy models would also be useful here. Energy-efficient building techniques and the use of ecological building materials must be covered in both university and apprenticeship curricula. Sustainability is a topic that must also become an integral part of the training of architects and tradesmen.

The Green Party calls for energy consumption standards of 60 kWh/m^2a for existing buildings. Special support must be provided for compliance with even more stringent energy standards. In the case of new buildings, this would mean erecting minimum-energy buildings with a consumption of 15 kWh/m^2a. Compliance with the Energy Conservation Ordinance – especially in projects using KfW development bank financing – must be subject to regular verification.

Energy certificates are only meaningful if they document a building's actual requirements. They can only serve as a decision-making aid for renting or purchasing property if they permit the energy consumption of different objects to be compared directly. As the current regulatory situation has shown, differently structured energy certificates are more a source of confusion than orientation.

The Renewable Energies Heat Act only governs the use of renewable energy sources for heating in new buildings. The Green Party calls for existing buildings to cover at least ten percent of their heating requirements with renewable energy following a renovation or heating system replacement.

They also propose the creation of an energy conservation fund of € 2 billion to be used primarily for renovation and electricity conservation measures in urban areas with a large share of low-income households.

The Market Incentive Program (MAP) must be streamlined and expanded to cover innovative new technologies, and contracting legally facilitated. The potential for energy savings here is substantial.

FRANZISKA EICHSTÄDT-BOHLIG

Germany: Seeking the Sustainable City

There are individual examples of sustainability in many German cities. There are cycle-friendly cities, projects for innovative mobility, and any number of initiatives for low-energy construction and use of regenerative energy sources. There are eco-estates and model projects for mixed-use and space-saving construction. But none of these are more than isolated building blocks: what Germany has not yet managed to create is a truly sustainable city. Trailblazing sustainability is not easy to find: it is rare in new construction, and just as rare in urban renewal projects. The most important pioneer project is this area is the district of Vauban in the southern German city of Freiburg. In Hamburg-Wilhelmsburg, too, the International Building Exhibition (IBA) is in the process of becoming a model of sustainable urban development. But unfortunately, Germany has no large-scale modern housing development that could serve as best-practice example, like the Hammarby Sjöstad model estate in Stockholm.

In my opinion, Germany's "city of the future" will not be found in newly constructed urban areas. 98 percent of our urban environment is already settled, and with population growth stagnating, Germany is not experiencing the growth pressure felt in other regions of the world. Moreover, many German cities have not fared well with housing areas planned as constructionally, functionally and socially homogeneous districts. In both East and West, most of these large-scale projects have become the problem children of urban developers.

Pilot project for the social and ecological renewal of built-up urban areas

As in the rest of Europe, the main task of urban planning in Germany must be to make existing urban areas sustainable for the future. This is why I hope that new model projects will finally be initiated for a comprehensive social and ecological renewal of built-up districts. We are definitely not talking only about solar panels or energy-efficient construction and innovations in transportation. For me, sustainability as a holistic approach means linking innovations in energy engineering and ecology with ideas to strengthen the local business community and to mobilize the resident population, and with forward-looking social and educational concepts. Our cities are presently facing a myriad of challenges ranging from climate change to jobs and the social and cultural integration of an increasingly diverse urban society. In facing these challenges, planners must look to ecological innovation and investment in climate protection as the key to strengthening their cities' economic and social fabric.

A good example: IBA Berlin

It's high time to stop talking and start acting. (West) Berlin did this once before with its cautious approach to urban renewal in the Kreuzberg SO36 district in the 1980s. Within the scope of an International Building Exhibition, the Kreuzberg project approached urban renewal with a large measure of social commitment, working towards renovating and modernizing an urban area by focusing on the expansion of facilities for children and educational institutions and by encouraging the active participation of the district's population. This restorative renewal approach became the yardstick for urban rehabilitation in many other cities, especially in eastern Germany. Our country needs a comparable design approach and a similar firmness of purpose for the tasks facing us today.

I would like northern Neukölln to become a model for the city of tomorrow – a project that will create an economically, socially and ecologically sustainable city. What I would like to see here is an international building exhibition supported by the federal government, a successor to the current IBA in Hamburg-Wilhelmsburg. At the moment, the Berlin Senate is hoping to host an IBA dedicated to climate change and an international horticultural exhibition for the area of the former Tempelhof airport, just west of northern Neukölln. This might showcase innovative engineering and design, but it will not provide answers to the social and ecological challenges facing our city and many others like it. But this is precisely the area where we need integrated solutions.

Northern Neukölln is a burning glass of today's urban problems. It is an ethnically colorful and mixed district fraught with high unemployment, low educational interest and rising juvenile violence. With the potential opened up by the area of the now decommissioned Tempelhof airport, the district offers a golden opportunity to generate a new atmosphere of urban development optimism.

Ideas for northern Neukölln

The model for northern Neukölln – and of course others like it – should integrate the following aspects:

- Modernization of public infrastructure from the point of view of building and energy technology, focusing on education, children and youth needs, intercultural diversity and sport. This needs to be linked with intensive participation on the part of the district's residents. Unemployed young people should be involved in the construction work.
- Connection of renovation work with an educational and youth policy that can mobilize and intensify the involvement of parents, teachers, the media, social workers and youth welfare workers, even the unemployment offices, in

order to revitalize the feeling of community responsibility for the raising and education of children and young people from families with low educational backgrounds.

- Development of concepts for a new kind of mobility focusing less on private cars and at the same time increasing residents' identification with public spaces and with the district itself – for instance by transforming the main shopping artery into a "shared space", by setting up a public bicycle rental system, etc. Here again, this type of project can work only if local residents, especially young people, are actively and constructively involved.
- Mobilization of private landlords to renovate and optimize their buildings' energy engineering, and financial incentives to encourage this type of investment in order to secure stable rents. Tenants should also be offered extensive counseling on how to save energy in the household and in their mobility patterns. This is particularly crucial, as we know that energy is increasingly becoming a social issue as a result of dramatic rises in the costs of heating, hot water and mobility.
- Active participation of the local business community in the renewal processes. The aim here is to create jobs locally, to strengthen local networks and to firmly establish the concept of technological and economic innovation in the area's companies. Another essential aspect of this point is to awaken a feeling of social and ecological responsibility for the district among local entrepreneurs.

As in Berlin-Kreuzberg's gentle urban renewal of the eighties, sustainable urban renewal should not be the sole objective in Northern Neukölln: what we want to achieve is a mobilization of residents' social responsibility and community feeling for their living and working space. And above all, this objective must be presented to young people in a manner that will convince them. Urban development must therefore be organized as an intensive social and cultural process. Ultimately, we will succeed in protecting our climate and our planet only if as many people as possible learn to feel responsible for it.

ULLA SCHREIBER

"Tübingen macht blau"

The university town's successful climate protection campaign

In early 2008, Tübingen lord mayor Boris Palmer initiated a municipal climate protection program named Tübingen macht blau, a clever but untranslatable play on words involving the color blue – the signature color of the publicity campaign supporting the program. Around one year after its launch, Tübingen macht blau has become a popular catchphrase throughout the university town in connection with climate protection and in other contexts. It is the first municipal campaign in Germany to use the tools of advertising and PR to launch a citizens' movement for improved climate protection. The campaign seeks partners among the town's networks and institutions and develops special offers for Tübingen's inhabitants. Municipal projects take on an exemplary character, while planning instruments are used to create a suitable framework and incentives for further climate protection measures. The campaign offers many opportunities for identification thanks to its powerful presence, both visually throughout the town and in the public's awareness.

Over 3,500 users of the local utility company's green power program are participating, as are increasing numbers of car sharers and users of public transportation. Blue is the predominant color on the thermal images of freshly insulated houses. Roofs are becoming blue with photovoltaic systems. Local retailers are decorating their shop windows with a Tübingen macht blau theme. Twelve local car dealers are participating in a special Tübingen "climate certificate" program.

The town's administration is also doing its share: schools are being renovated to improve their energy efficiency, municipal employees have attended courses in fuel-efficient driving, and City Hall has purchased switchable power strips and energy-saving lamps. Lord mayor Boris Palmer's – rarely used – official car is an economical Smart hybrid.

Activating the public

The campaign gives the town's inhabitants tips and incentives on how they can help keep the skies over Tübingen blue, cutting their CO_2 emissions and saving money while doing so. On the municipal side, the first year of the Tübingen macht blau campaign highlighted trial weeks at the local car-sharing program, courses in fuel-efficient driving, a “climate certificate” for cars, green power, building insulation and climate protection knowledge. A number of channels are being used to create a positive, healthy awareness of facts related to climate protection:

- weekly climate tips in the local newspaper
- numerous press releases
- PR events and information booths
- the www.tuebingen-macht-blau.de website: CO_2 calculators, campaign modules, climate protection tips, lists of participants, etc.
- posters, flyers, brochures
- 20 climate tips in a coupon booklet for new residents
- events at the Tübingen adult education center
- the “Energy and Climate” multivision show presented to around 3,000 students by Friends of the Earth Germany.

Example: green power

In the summer of 2007, the public administration of Tübingen switched completely to green power and promoted its use by other public bodies. For example, shopkeepers who use green power in their stores are eligible to put the campaign sticker in their shop windows: “Tübingen macht blau – we are taking part.” Further measures to promote green power include:

- The SWT local utility company advertises its green power at numerous information stands, in print ads, and in and on local busses in Tübingen.
- The Landestheater Tübingen developed a special admission ticket with a voluntary “blue euro” donation to help defray the additional costs for green power in the theater.
- Buyers of e-bikes or Pedelecs who switch to SWT green power receive a € 100 rebate.
- Recent arrivals in Tübingen who switch to SWT green power may use the town’s public transportation free of charge for one month.
- The lord mayor rarely misses a public speaking opportunity to promote green power.

The results to date: the number of SWT’s green power users has more than quadrupled since January 2007 and is now at around 3,500 customers.

Example: photovoltaic systems

The city and the GWG, a predominantly municipal local housing company, reviewed the suitability of their buildings for solar power systems. Ten public buildings – all schools – proved usable. SWT invested in the first larger photovoltaic systems, which were publicly put into operation. The following measures were realized to create further incentives to set up photovoltaic systems:

- The roofs of public buildings are provided to public-participation organizations free of charge to promote private climate-protection initiatives. There are currently more inquiries from potential public-participation organizations than suitable public-property roofs.
- Information panels showing the momentary output of the systems on the roofs provide an impressive demonstration of the potential of solar energy for students.
- The city operates a solar roof exchange website on which owners can put their roofs on offer for solar systems and operator companies can find suitable roofs.
- In direct contact, press releases, letters to companies and personal meetings, owners of roof space are encouraged to invest in photovoltaic systems or make their roof spaces available on the solar roof exchange website.
- The lord mayor personally encourages companies in Tübingen – when discussing building permits or property sales, for example – to include building-mounted photovoltaic systems in their plans from the outset.

The results to date: after two years of the climate protection campaign, the installed photovoltaic capacity has more than doubled from 1.2 to 2.8 MWp.

Example: teilAuto

teilAuto, the local car-sharing provider, is very successful in Tübingen. In terms of the ratio of users to inhabitants overall, it holds second place in Germany. The town's administration also uses the company's offerings. Promotion and support measures include:

- A brochure titled "Ecologically Mobile" advertises for teilAuto.
- The lord mayor has split his parking space at City Hall – one half for the lord mayor's official Smart, the other half for a car of the teilAuto fleet.
- Parking spaces have also been allocated to teilAuto elsewhere in the town.
- teilAuto waives its deposit and basic charge during trial weeks.
- teilAuto cars have clearly visible "Tübingen macht blau – we are taking part" bumper stickers.
- The TüBus service of the local public transportation company and teilAuto have recently joined forces: regular TüBus customers are granted a discount of 50 percent on teilAuto's basic charge.
- A central teilAuto station with seven vehicles will be established in a prominent location in front of Tübingen's main railway station to improve connections between teilAuto and TüBus.

The results to date: the number of teilAuto users has risen from 900 to over 1,200 since June 2007.

Outlook for 2010

New focal points for the campaign in 2009 and 2010 will be electric bicycles and intelligent heat pumps. The starting shot for the next phase was the recent climate fair at City Hall that attracted several thousand visitors. The local utility company has since received 50 specific inquiries related to its heat pump replacement program. The lord mayor will be giving up his official car altogether at the end of the year and will be traveling exclusively by e-bike in the future.

The city and its associated companies will continue to set examples for climate protection. Over 90 percent of the funds in the stimulus package have been earmarked for renovation measures related to energy conservation: the public housing company will be renovating around 100 apartments in 2009. The city will be replacing all obsolete heat pumps, and the local utility company will be investing heavily in modernizing the district heating network around the university and in the old city in the near future – just to name the most important projects. In total, the city and its associated companies will be investing € 25 million in measures to reduce carbon emissions in 2009.

Tübingen macht blau was recognized by the Federal Ministry of the Environment for reaching beyond the city and its institutions and inviting citizens to take part. No other city in Germany has put as broad and successful a climate protection program in place as Tübingen, the ministry explained. It especially praised the idea of a citizens' movement for climate protection and the wealth of options for individuals wishing to do their part. The prize money of € 20,000 is being used to make Tübingen even more "blue" by continuing the city's successful public-relations work in 2010.

AUTHORS

Ted Caplow holds a Ph.D. in environmental engineering. He is the founder of New York Sun Works, a company that designs architectural and technical concepts for urban agriculture. In 2004, Ted Caplow built his first project: the “Science Barge”, a multi-story greenhouse on a barge in the Hudson River. His design work also includes BrightFarm, a rooftop greenhouse system, as well as the Vertically Integrated Greenhouse, a system that integrates greenhouse elements into façades. During his earlier work as an energy consultant, Ted Caplow focused on energy efficiency and on CO_2 compensation projects for institutions such as the California Energy Commission and the US Department of Energy.

Stefan Denig is the head of the Siemens AG Corporate Communications Unit. In this function, he initiated and realized extensive international projects in the fields of urbanization, demographic change and climate protection, including the study Megacity Challenges – A Stakeholder Perspective, which was published in 2007 on occasion of the World Economic Forum. He is currently managing a research program on sustainable infrastructure and resource efficiency in cities and conurbations. Denig studied in Paris at the Sorbonne and the Institut d’Etudes Politiques (IEP). Before joining Siemens in 2006, we was active in the corporate communications sector for a variety of companies and held adjunct status at universities in Munich, Germany and Pittsburgh, PA, USA.

Sabine Drewes is the section head for municipal policy and urban development of the Heinrich Böll Foundation. Prior to that, she served as an editor of the Kommunalpolitische Infothek. After studying political sciences at Freie Universität Berlin, she worked as an independent journalist (Zitty, DeutschlandRadio, Deutsche Welle Fernsehen, Canadian Broadcasting Corporation) from 1994 to 1997. From 1997 to 2002, Drewes served as a consultant on journalism for the Green/Alternative Party in North Rhine-Westphalia (GAR-NRW). She also served as co-editor of Das neue Gesicht der Stadt. Strategien für die urbane Zukunft im 21. Jahrhundert (2006).

Peter Droege is a professor at the Institute for Architecture and Planning at Hochschule Liechtenstein. For more than two decades, he has been internationally active in the field of environmental issues and renewable energy in practical urban planning. In addition to his teaching work, Droege holds advisory positions in a number of organizations such as the World Council for Renewable Energy, the Urban Climate Change Research Network and the World Future Council's commission on cities and climate change. His urban planning designs have received numerous awards. Droege has helped create a broader awareness for his fields thanks to his work as an editor and author of publications such as The Renewable City – a comprehensive guide to an urban revolution (2007).

In addition to his work as a freelance architect, **Joachim Eble** is group leader of the German team of the European Union's ECOCITY research project. He has worked on various German and international ECOCITY projects, including the ECOCITY-Derendingen model district of Tübingen and the ecocity of Tainan in Taiwan. Joachim Eble is also active in research and teaching, currently at the University of Wismar's department for architecture and environment as well as at Rome's LUMSA University. He is also co-founder of B A U (Bund Architektur und Umwelt), consultant for large-scale international projects, member of competition juries, an active journalist and the developer of the GAIA International and econnis planners' networks.

Piet Eckert studied architecture at ETH Zurich and at Columbia University Graduate School of Architecture in New York. After completing his studies, he worked as project manager at Office for Metropolitan Architecture/OMA in Rotterdam. He then went freelance and in 2001, together with his brother Wim, founded E2A Eckert Eckert Architekten AG. Piet Eckert regularly holds lectures and workshops at various universities and institutes. He has been guest professor at the Delft University of Technology and part-time lecturer at ETH Zurich.

The architect and urban planner **Franziska Eichstädt-Bohlig** has been the floor leader and spokesperson for urban development of the Green Party in the Berlin House of Representatives since 2005. She has been an expert for sustainable urban development, the concerns of squatters, and cautious approaches to urban renewal in Berlin for nearly 40 years. At the time of the fall of the Wall, she served as the councilor responsible for construction in Berlin-Kreuzberg and worked to overcome the effects of the division in the inner-city districts. From 1994 to 2005, Eichstädt-Bohlig was a member of the Bundestag for the Green Party in Berlin. She is currently advocating future-oriented urban concepts for the decommissioned Tempelhof airport, the historical center of Berlin, and for a green Mediaspree riverside development.

Ulrich Hatzfeld is director of the urban development section of the German Federal Ministry of Transport, Building and Urban Development in Berlin. Prior to taking on this post, he spent ten years as team leader for urban development at the Ministry for Urban Planning and Housing, Culture and Sport of North Rhine-Westphalia. Ulrich Hatzfeld studied urban, regional and national planning at the University of Dortmund; for 15 years he ran the Hatzfeld-Junker, Stadtforschungs/Stadtplanung office.

Peter Hettlich is an agronomist and a member of the German Bundestag for Bündnis 90/Die Grünen, the German Green party. He is the parliamentary party's spokesperson for construction and deputy chair of the parliamentary committee for transport, construction and urban development. Before this, he worked for the district party group of Torgau-Oschatz, of which he has been spokesperson since 2000. Some of the issues that Peter Hettlich has fought for in the Bundestag as well as in his constituency offices in Pirna, Chemnitz and Oschatz have been the reconstruction of the eastern part of Germany, urban development, transport and environmental protection.

Andreas Hofer studied architecture at ETH Zurich. In 1993, after completing his degree, he and others founded a construction and housing cooperative called KraftWerk1, a sustainable, mixed-use land development project in Zurich which has since been successfully implementing ambitious social and ecological criteria. Since 2003, Andreas Hofer has been managing director of the umbrella organization of non-profit housing construction companies in the Zurich region as well as partner in archipel Planung und Innovation GmbH. He has published and taught extensively on the topic of housing and urban planning as well as on sustainability and architecture.

Architect **Sebastian Jehle** has been professor for construction and design at HFT Stuttgart since 2004. Since 2007 he has also been one of the founding members of Deutsche Gesellschaft für Nachhaltiges Bauen. In 2000, after completing his studies in Stuttgart and London, Sebastian Jehle founded Hascher, Jehle und Assoziierte GmbH in Berlin. He has won several architectural prizes and honors, for instance the first European Architecture Prize, Architecture + Technology Award, in 2003. He has published articles in professional publications and won several competitions. In 2006 he took part in the 10th International Architecture Exhibition of the Venice Biennale.

In addition to numerous teaching and research posts at various universities, architect **Michael Müller** is director of ACMS Planungsgesellschaft mbH and of mipshaus-Institut GmbH for ecologically sustainable construction. Together with Christian Schlüter, Michael Müller founded Architektur Contor Müller Schlüter in Wuppertal in 1998. Since 2004 he has been involved in research projects of the German Federal Ministry of Economics and Technology and DBU (Deutsche Bundesstiftung Umwelt). He is a founding member of Gesellschaft für Nachhaltiges Bauen e.V. (DGNB) as well as member of the "Ressourcen NB" special advisory board and of the "Bauen im Bestand" working group.

Since 2001, **Sabine Müller** has been running the SMAQ office of architecture, urban planning and research in Rotterdam together with Andreas Quednau. She completed a Master of Science degree in advanced architectural design at Columbia University and a degree at the New York Graduate School of Architecture, Planning and Preservation. Sabine Müller has participated in several international cooperation projects with offices such as Gerkan, Marg & Partner (Hamburg), West 8 (Rotterdam) and Asymptote (New York). She has taught at the Delft University of Technology (Netherlands), at the Karlsruhe State University for Design as well as at Darmstadt Technical University. She is currently research assistant at Karlsruhe Technical University.

Philipp Oswalt is managing director of the Bauhaus Foundation in Dessau. From 2006 to 2009 he held the chair for architectural theory and design at the University of Kassel. Prior to assuming this post, he worked in architecture, journalism and research. He spent several years as editor of the Arch+ journal of architecture. He was the initiator and director of the European research project "Urban Catalysts", co-initiator and artistic co-director of the project for the interim use of the "Palast der Republik" in Berlin prior to and during its demolition, and director of "Shrinking Cities", an international research and exhibition project organized by the Cultural Foundation of the German federal government. He has worked as an architect for the Office for Metropolitan Architecture/Rem Koolhaas in Rotterdam and, together with Klaus Overmeyer, as a freelance architect. Some of his publications are: Wohltemperierte Architektur (1994); Berlin: Stadt ohne Form (2000); Schrumpfende Städte (Vol. 1 2004, Vol. 2 2005, Atlas 2006).

Walter Prigge is a journalist and urban researcher. He apprenticed and studied in Frankfurt am Main, where he also completed a post-doctoral habilitation thesis. Since 1996 he has been working for the Bauhaus Dessau Foundation on projects involving city, space and architecture. He has also been co-curator of the "Shrinking Cities" project. He is currently working on a project entitled "Die Wohnung für das Existenzminimum – von heute". He is the author of several publications for Edition Bauhaus.

Together with Sabine Müller, **Andreas Quednau** founded the SMAQ office in Rotterdam in 2001. Before this, he had worked with international firms of architects including KCAP Kees Christiaanse Architects & Planers (Rotterdam), Diller+Scofidio and Michael Sorkin (both in New York) as well as Arata Isozaki & Associates (Berlin). Andreas Quednau has also held guest professorships in Stuttgart (Germany), Delft (Netherlands) and Puebla (Mexico).

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Simona Weisleder is an urban planner and architect. As an architect, she has worked in numerous offices in Hamburg, Dresden and Montevideo and served as a research assistant for building technology at the HTK Academy of Design in Hamburg. Since April 2008, she has been a project coordinator for IBA Hamburg in the "City in a Changing Climate" key theme, realizing projects such as the Energiebunker and Energieberg and the "Renewable Wilhelmsburg" climate protection concept. She is participating on behalf of HafenCity University Hamburg in the Forschungslabor Raum international Ph.D. program on renewable sources of energy in urban spaces (Hamburg – Vienna – Zurich).

Cities are home to half of humanity. Cities are strongholds of our culture, powerhouses of our economy and test beds for new ways of life. Yet they are also responsible for the bulk of our greenhouse gas emissions. Urban centers are driving climate change and will feel its consequences in no uncertain terms – despite, and because of the technologies at our disposal. Together with traffic and industrial production, building-related energy consumption is one of the major sources of urban carbon emissions. Dealing with climate change will mean taking a critical look at our building work, and it is no coincidence that "greening the city" is the new trend. The experts contributing to this volume give insight into the answers that future-oriented urban planning and architecture must deliver.

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