Elements of sustainability

Ecological building in Berlin

Elements of sustainability

Ecological building in Berlin

Senatsverwaltung
für Stadtentwicklung

Table of contents

Foreword

Cities are largely responsible for climate change. Due to their massive energy use, urban areas emit around 80 % of climate-relevant greenhouse gases, particularly CO_2, even though they cover just 0.4 % of the earth's surface. If we wish to maintain and promote cities as places worth living in, then we must continue down this path in order to achieve more use and sustainability with less energy. One important instrument in this endeavour is ecological building. Today we are particularly eager to find out how we can use this topic for economic innovation and how we can reduce our dependence on the international energy markets. We want to use ecological building techniques in order to promote modernisation, technological development and competitiveness and, not least, to maintain and enhance property values.

Ecological building has many facets. We are not merely focused on creating a zero-energy house. What we need in our cities is nothing less than the ecological retrofitting of complete urban areas. Public buildings, commercially used structures and large housing stocks play a particularly important role when it comes to significantly reducing CO_2 emissions.

Berlin is a city that has long concerned itself with the issue of ecological building. For many years it has contributed to the development of ecological and sustainable construction with a large number of projects. This applies to the use of regenerative energies, geothermal and solar energy, energy-efficient building and heat-insulating techniques, innovative water technologies and alternative waste concepts.

Berlin is a pioneer in new climate protection policies. With technologies for resource efficiency in the construction of buildings and infrastructure, building renovation and sustainable urban development, Berlin provides a model for future-looking climate protection.

This brochure provides a look into the various issues of ecological building. It presents projects that can serve as examples for innovative construction techniques.

Ecological building is one of the core issues of an urban development concept that can face up to the challenge of climate change. This brochure offers important suggestions and presents realistic examples that can show us the way forward.

Ingeborg Junge-Reyer
Senator for Urban Development

Ecological building in Berlin

Reducing CO_2 in Berlin
The city of Berlin has already achieved the goal of reducing CO_2 emissions 25 % ahead of schedule. As a next major step, by 2020 the State is aiming at reducing emissions by 40 % from 1990 as a base year. One path that can take us closer to this goal involves so-called contracting models. The energy saving partnerships that have been showing success since 1996 demonstrate this. In this way the city has succeeded in forming twenty-three pools encompassing more than five hundred properties. The result: some 65 million Euros of private investment in public buildings, state budget savings of some 3 million Euros per year and reduction of CO_2 emissions of currently 64,000 tonnes per year.

'Contracting' means that a private contractor assumes responsibility for city-owned buildings for a set period of time and invests in their energy modernisation. In this way, energy consumption declines along with operating costs. The savings accrued in this way then refinance the investments; the surplus is divided annually between Berlin and the contractor as profit according to a predetermined rate.

Since 2002 the Federal Government has been using the Energyeinsparverordnung ***EnEV (Regulation on Energy Saving)*** to determine which standards existing buildings or construction projects must fulfil in regard to energy consumption. The EnEV is a component of building law. It was updated in 2007. Further updates have been added in mid-2009 and will again be added in 2012, continuously tightening its specifications.

For many years, the central guidelines of government action in Berlin have included the principles of sustainability. The Berlin Senate has defined these objectives in a variety of programmes and in numerous state laws and has thus codified them in an understandable way.

This brochure presents the field of activity of ecological building, which is of great significance for the city of Berlin. It describes sustainable building as a comprehensive ecological concept that is based on the elements of energy, water, building materials, greenery and waste, and illustrates the topic using selected examples.

Framework

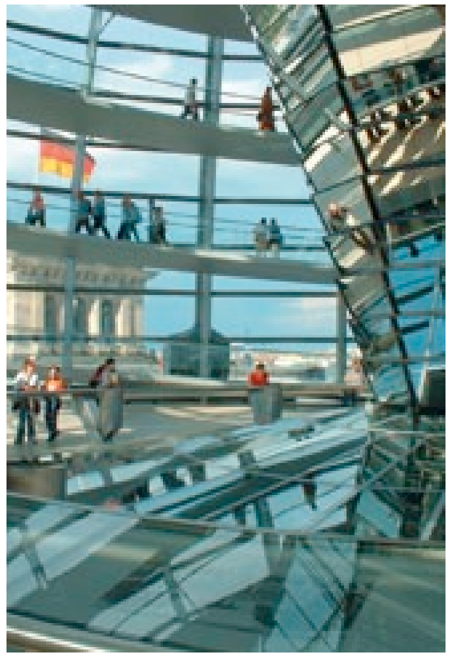
Ever since the mid-1990s, Berlin's urban development policy has focused on creating a compact, spatially complex, polycentric and multi-functional city. This entails a focus on traditional urban centres. Such an approach minimises space consumption, reduces traffic and thus saves energy resources. The city's social planning also observes the principle of sustainability and creates the framework for a stable and secure urban society that is worth living in. Other examples of sustainable energy-policy action are visible in the steady reduction of CO_2 emissions and the way the roofs of public buildings are being utilised for solar energy. The city of Berlin foresees a further approach in the form of voluntary commitments by industry and private companies. In the autumn of 2008 the Senate concluded a climate alliance with twelve initial signatories that will soon be joined by further responsibly-minded and responsibly-acting companies.

Building ecologically

With its roots in urban development and energy policy, ecological building is a central element of sustainable policy in Berlin. The framework conditions for private builders are regulated by federal laws and EU directives. As a Federal State, Berlin can actively work for more sustainability in building. In this way, it enjoys the opportunity to explore and develop models and parameters, as it has been doing since the late 1980s. The city of Berlin can also establish clear regulations for its own public and publicly financed construction projects.

The public sector as a model

Against this background, schools, universities, kindergartens, theatres, museums and other cultural buildings – along with hospitals, sports and court buildings – provide optimal conditions under which we can now realise the holistic approach of ecological building.



The principles of sustainability begin with the selection of a location and continue on to the actual building, its use and its operation, all the way to the building's future dismantling. However, such a comprehensive approach, which actually encompasses a building's entire life cycle, cannot be prescribed to private builder. It can only be taught by example.

High energy standards for public buildings

Energy standards for public buildings are subject to clear regulations. Even today, all new buildings in Berlin that are subsidised by public funds need to be planned and constructed in such a way that their primary energy needs fall thirty percent below the caps set by the 2007 EnEV. The Senat is currently developing further concrete and stringent regulations. Thanks to these new rules, the city is on course to achieve results that fall well below nationwide limits, such as those of the 2007 EnEV – even after the tightened restrictions of 2009. This 'Berlin Standard' will become the new target when existing public buildings undergo renovation.

In 2008 the Senate Department of Urban Development and Berliner Immobilienmanagement GmbH tested a large portion of their building stock and investigated possible CO_2 savings. This potential will be explored over the next ten years by means of a master plan for the renovation of all public buildings.

Regulations for building materials

A further example for sustainable policy concerns regulations regarding the use of building materials. Already in the early 1990s the Senate issued its first regulations for public building projects, requiring that they use

←← For the reconstruction of the Reichstag, the planning staff under the direction of Lord Norman Foster developed exemplary solutions designed to minimise energy needs. For example, the cone in the dome ventilates the Chamber using natural thermal processes. A system of mirrors introduces diffuse light into the Chamber. Energy is supplied by a block heating station powered by vegetable oils. Heat from energy generation covers nearly all the heating and cooling needs of the seat of parliament. Two water-bearing soil layers serve as a heating and cooling reservoir.

← The greened southern façade is the most noticeable component of the comprehensive ecological concept for the Lise-Meitner-Haus on Humboldt University's Adlershof campus. This building, which houses the physics institute, was built between 1999 and 2003 according to plans by the firm of Augustin Frank Architekten. Rainwater is collected in cisterns and is then used to irrigate the green façade and to create evaporation chill for the cooling system. Surpluses are temporarily stored in a pond located in the central courtyard and are thus locally evaporated and trickled away.

sustainable materials. Today, for example, only low-polluting paints and quickly biodegradable lubricants and hydraulic fluids may be used. The use of formaldehyde-free or at least low-formaldehyde plywood and composite board is mandatory.

Examples of prohibited materials include chrome-primed aluminium components, PVC flooring and components containing fully or partially halogenated chlorofluorocarbons. Tropical wood, which was also banned in 1997, was made legal once more in 2004 under the stipulation that the wood be certified according to the standards of the Forest Stewardship Council (FSC) or a similar body.

All of these detailed regulations concern both construction and civil engineering and apply not only to all building materials and components but also to auxiliary materials and construction by-products.

Tools for building projects and competitions

In 1994 the Senate established principles that made sustainability mandatory for public building projects. These principles were intended to lead the city 'from an ecological experiment to standardised regulations, from the individual eco-house to ecological, environmentally suitable urban planning'. This 'Berlin Standard for Ecological Building' became a nation-wide model. One well-known example was the set of construction projects slated for the IBA International Building Exhibition at Emscherpark.

In the shape of the 'Guideline for Ecological Building', these standards have been updated regularly. The guideline serves as a tool for the preparation of all public and publicly financed building projects in Berlin. Divided up among the various phases of a building project, and highlighting the entire trajectory of a building's life cycle, it shows which aspects must be considered in order to build sustainably and ecologically. This starts in the early phase of need identification, i.e. the basic idea. It continues on to use appraisal, preliminary and draft planning. It moves on to execution planning, execution and actual use, and ultimately includes the dismantling or demolition of the building.

Architects who participate in competitions for public Berlin buildings by submitting a draft proposal must also fulfil these ecological standards. The 'Ecological Criteria for Building Competitions' that have been published for this purpose define what criteria must be observed when conducting such competitions. In this way Berlin is ensuring that the concerns of ecological building are already included in the project definition itself.

The ***Forest Stewardship Council (FSC)*** is a non-profit organisation that has developed criteria for the certification of forestry operations. According to these criteria, organisations accredited by the FSC certify companies. These firms may then label their wood with the FSC seal of approval, thus proving that it comes from a sustainable forestry operation.

Decades of experience and concentrated competence

The Senate has developed the foundations of ecological building in Berlin in the form of various model projects over the past twenty years. This policy first took root in residential housing construction. Today, these principles have also advanced into other areas of construction. Many project approaches have developed from experiments into standards.

Ecological building was essentially jump-started by the 1987 IBA. The International Building Exhibition (IBA) explored the possibilities for ecological building approaches in a series of model projects. Examples include the Kreuzberg block 103 in Oranienstrasse and block 6 in Bernburger Strasse. At the same time, the 'Twelve Principles of Cautious Urban Renewal' included the idea of maintaining a structure's building fabric as its core objective.

↑ Today the double high rise (built in 1974) at Schulze-Boysen-Strasse 35/37 in Hohenschönhausen with 296 flats is regarded as Germany's largest low-energy building. The HOWOGE building society renovated the building in 2006 for 8 million Euros and achieved energy savings of 50 %. This exemplary project received the Berlin Klima-SchutzPartner environmental prize in 2007 and the environmental prize of BUND in 2008.

→ The low energy building in Marzahn was one of the projects included in the state programme for 'Urban Ecological Model Projects'. Its convex, wide-open southern façade takes advantage of the low-hanging sun in winter. Narrow, continuous balconies protect the building from the nearly vertical rays of the sun in summer.

After the fall of the Berlin Wall, private owner-builders, investors and the Federal Republic adopted these ideas and implemented them in their own projects. This can be seen in the Daimler property on Potsdamer Platz and in the new parliamentary and government district. Particularly in regard to government buildings, the German Bundestag and the German Federal Government have set energy-oriented and environmentally responsible goals.

Renovating housing stock

Berlin can point to great success in the field of energy-saving renovation of residential buildings. With its programmes for heating modernisation, retrofitting prefabricated slab-style complexes, social urban renewal and eliminating vacancies, the Senate as early as 1990 aimed to improve building shells and heating, particularly by eliminating inefficient single-combustion heaters and moving away from electric and coal heating. The targeted expansion of district heating networks, efficient local heating solutions with natural gas and the utilisation of renewable energies have considerably improved the energy efficiency of Berlin's housing stock within the framework of these renovation measures. Between 1991 and 2001 alone, the State invested 8 billion Euros in these programmes, some 20 to 25 % of which – i.e. up to 2 billion Euros – went toward energy-saving measures.

The environmental benefits accrued in this way should not be underestimated. These modernisation and reconditioning programmes have been applied to more than half of the 273,000 flats in pre-fab residential complexes and more than a third of the entire Berlin housing stock.

The Berlin real estate industry, particularly the municipal building societies, has made intensive use of the various subsidy programmes. It has willingly adopted its ideas and is today pursuing sustainable urban renewal of its own accord. Not least, it is important to note that this has occurred against the background of rising energy prices with all the economic consequences this entails. In addition, other measures on the Federal level have taken effect since the start of the millennium. These include the 'Investitionszulagengesetz' (InvZulG –capital investment subsidy law) and the 'Energieeinsparverordnung' (EnEV – Regulation on Energy-Saving). In this way Berlin was able to concentrate the limited funds from its own subsidy programmes on particularly problematic housing stock.

This collected expertise has developed into an export item that is in particular demand in Eastern Europe and Asia. Thus, within the framework of the Baltic Energy Efficiency Network for Building Stock (Been), the Senate has developed a handbook with eleven concrete recommendations on the energy-saving renovation of pre-fab slab-constructed housing complexes and also introduced this handbook at the Green Building Conference in Beijing in the spring of 2008.

Ecological model projects

Berlin owes a large portion of its competence and its head start in relevant knowledge regarding sustainable building to the state programme for 'urban ecological model projects'. Ever since 1989, this programme has been providing information on the factors and components of sustainable housing and urban planning and is underpinned by practical applications in concrete building projects.

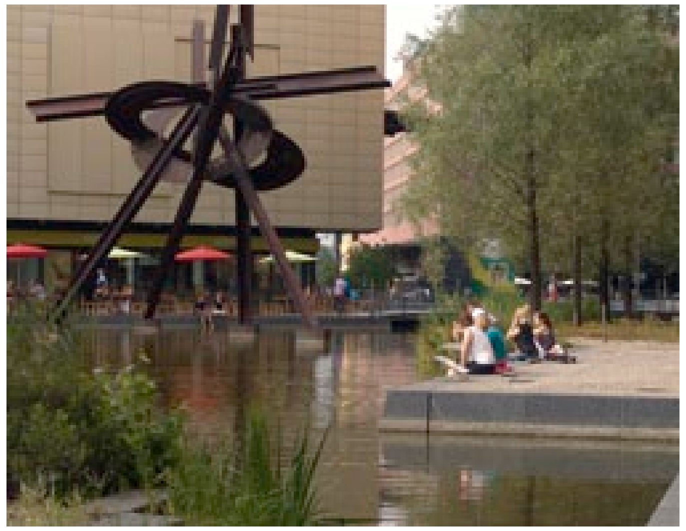
These projects were not primarily meant to be directly transferable to other building projects. Instead, they represent working models on the basis of which experts continue to explore and test new approaches and methods. As 'built research', these projects were principally developed and implemented within the framework of cooperative and integrative planning procedures. They were then scientifically supervised, evaluated, optimised where necessary and finally documented over a long period of time.

The city of Berlin promoted three types of projects:

- Building projects that tried out innovative measures pertaining to at least one of the five ecological elements: energy, water, building materials, greenery and waste.
- Building projects developed on the basis of an overall ecological concept
- Cross-section analyses, tools, data sheets and project documentation that made the information gathered this way available to the public

The prerequisite for support was the presence of public interest in the testing and further development of new approaches. In concrete terms, this meant that the projects dealt with typical urban building tasks and that they could subsequently be implemented on a broad scale. The projects promoted in this way included planning optimisation aimed at an overall ecological concept or portions thereof, the testing of new techniques and new building materials, additional costs for ecological measures and project monitoring.

Overall, some fifty model projects have been realised. These include the renovation of the 'Weiberwirtschaft' commercial complex in the district of Mitte, a Wilhelmine-era school in Prenzlauer Berg and a standardised, slab-constructed school building in Lichtenberg. One thematic focal point has concerned renovation work in prefabricated residential complexes. This included the installation of drinking water-saving facilities along with the ecological renovation of a large-scale housing estate in Hellersdorf. Since the mid-1990s new building projects in the field of low energy standards have been moving to the centre of attention. Examples include the Heinrich-Böll-Siedlung in Pankow with 330 flats, the housing estate at Berliner Strasse 88 in Zehlendorf with 173 flats and the low energy house in Marzahn with 56 flats.



← The approximately 1.2 ha artificial lake at Potsdamer Platz is an oasis of peace in the central city, combining aesthetic urban design and ecology. The lake is part of the Daimler property's rainwater management system. It is supplied by five cisterns that temporarily store precipitation flowing from the roofs of the nineteen-building complex.

↑ From 1994 to 1996 the WoGeHe building society renovated 196 flats at Suhler Baufeld in Hellersdorf. The city of Berlin subsidised the project as an ecological model project. This renovation projected halved energy consumption in the buildings of this prefabricated housing complex.

Building on a sustainable basis

The term ***sustainability*** originally came from the forestry. It appeared in the 19th century and describes the objective of managing forests on a permanent basis by avoiding clear-cutting and harvesting only as much wood as can grow back.
In 1987 the UN's World Commission on Environment and Development adopted the term as a central concept in its concluding report 'Our Common Future'. This report, which is often called the Brundlandt Report after the commission's chairwoman, stated that 'Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.' Thus the core of sustainability is ensuring the preservation of future generations' freedom of action.

Even if these terms might seem intechangeable today, ecological building and sustainable building are not the same thing. In its original, narrow definition, ecological building was primarily aimed at ecological aspects. It was focussed on primary energy needs and consumption, the use of renewable raw materials and avoidance of fossil and other scarce resources, the protection of soil, water and air, reducing spatial use and soil sealing whenever possible, the elimination of pollutants, the reduction of emissions (particularly in regard to the greenhouse effect, ozone destruction and climate change) and the notion of closed circuits.

Ecological buildings should optimally fulfil the needs of their users without leaving behind unnecessary and irreversible burdens on nature and the environment for future generations to deal with.

When we speak of sustainability, however, the tasks are defined in a much stricter way. Ecological building, as it is understood in Berlin today, is aimed at bringing economic and socio-cultural aspects into harmony with ecological issues and ensuring a sustainable balance of all three factors. This not only leads to an expanded perspective but also underscores the fact that the principles of ecological building are dynamic and are subject to change. Once one of the three areas in the 'sustainable triad' is altered, the ideas and principles must also be adapted and updated.

In this respect ecological building is comparable to a continuous deliberation process in which competing goals need to be evaluated and appropriately considered against the background of current developments and continuous intensification.

Ecological factors

The unmistakable process of climate change has noticeably shifted the emphasis of ecological goals. The question of whether or not we can succeed in saving energy, preserving fossil resources and particularly in reducing CO_2 emissions has become the decisive criterion for our society's ability to face the future. The world community has been addressing this goal since the 1997 Kyoto Protocol at the latest. Both before and after that event, the Senate has continually underscored Berlin's willingness to make an above average contribution to achieving this goal by implementing responsible municipal policies. The Berlin Energy Savings Law, the 2006-2010 state energy programme and current government actions demonstrate this commitment.

That is why ecological building today is focusing more closely on the energy consumption issue than it did in the early 1990s. The energy efficiency of new buildings and of renovated buildings can be drastically increased through complex and environmentally-appropriate planning. Despite the immense significance of this task and the vast ecological potentials such efforts unleash, it is essential not to detach this emphasis but rather to observe it in its interactions with further elements and issues.

Economic factors

Any analysis of the economic components of sustainable building brings a building's cost-effectiveness into focus. Alongside pure investment costs we also must look at added expenses for operation, cleaning, upkeep, repairs and maintenance. These parameters are subject to change: For example, the price rise for fossil fuels in recent years has noticeably pushed operating costs upward. This has serious significance even for landlords who pass these costs on to their tenants. This 'second rent' reduces rentability and increases vacancy problems. By contrast, energy-saving renovation measures lower operating costs, thus offsetting the general rental relationship and opening up a whole new scope of action for building owners when it comes to basic rents. In this way the economic perspective currently generates impulses that move the element of energy into the centre of ecological building.

Life cycle of a building

Socio-cultural factors

Barrier-free access, security, accessibility and the creation of healthy surroundings conducive to living are only a few of the socio-political objectives that form the foundation of sustainability. Sustainable building also means including social developments such as demographic change in one's deliberations, paying attention to historical preservation aspects and much much more.

Here it is important to focus on aesthetic, functional and other expectations on the part of users. In order to ensure a healthy living and working environment, it is not enough just to construct ecological buildings according to the latest technology. The users' behaviour has a critical impact on a building's ecological bottom line. That is why sustainable building also includes measures and mechanisms that inspire people to adopt environmentally-appropriate behaviours – for example, by making one's consumption of energy, electricity and water transparent.

Sustainable life cycles

It is particularly important to observe the sustainability triad described here in regard to all processes connected with the construction and operation of a building. This extends from raw material extraction to the construction itself, and from the building's use to its dismantling and the recycling of the resulting waste materials. Even in early planning phases decisions are made that decisively inform a building's ecological characteristics. It is only possible to fulfil the demand for sustainability if we start here at the beginning.

Overall concept and elements

Sustainable building is not just a laundry list of individual ecological measures that are simply grafted onto a conventional blueprint. That is why an integrated planning approach is vital. Architects, building services planners and energy planners need to work together from day one in order to coordinate their activities. Jointly developed measures should be 'coherent within the framework of the overall plan and be meaningful and effective in their interaction' and be 'in harmony with an urban planning and architecturally effective concept'. Overall ecological concepts have proven successful tools for securing that harmony by considering as well as evaluating conflicting objectives. Ideally, such a concept should be broken down into five elements: energy, water, building materials, greenery and waste. This modular system ensures that even in times when the climate issue has top priority ecological building is not reduced to the element of energy. Each of these elements is first observed on its own and then monitored in its interactions with the other elements – and thus adequately evaluated. This also ensures the deliberation process that stands at the centre of the notion of sustainability.

Triad of sustainability

Elements

- Energy
- Water
- Building materials
- Greenery
- Waste

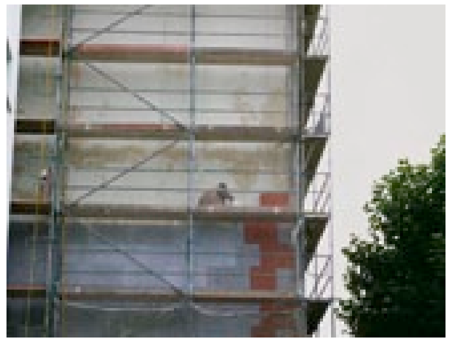
The element of energy

Increasing energy efficiency in buildings is the most pressing task in sustainable building today. Resource and climate protection (ecological factors), economical and socio-cultural considerations all demand greater efforts in this direction.

Reducing energy consumption is a task that cuts across all organisational lines. That is why this is not solely a concern of the various departments of the Berlin Senate. There are also regulations on the EU and Federal levels that reflect this issue's importance for society as a whole. The Energyeinsparverordnung (EnEV - Regulation on Energy Saving) is one notable example. The Berlin Energy Programme for 2006-10, which lays out the principles and objectives of the city's climate protection and energy policy, is another.

When it comes to building, this policy is mainly focused on improved heat insulation and efficient heating systems. It is aimed at designing new and modernised buildings in such a way as to permanently ensure the lowest possible energy needs. From the point of view of ecological building, this perspective is widened to encompass a project's overall efficiency – which also includes the energy consumed during the construction process itself. For this reason alone, the use of existing buildings tends to be more sustainable than building a new structure.

↓ District heating pipeline in Berlin



→ Since July 2002 the photovoltaic system on the roof of Berlin Central Station has been feeding more than 150,000 kWh of power into Berlin's electricity grid. The 1,870 m² system has a nominal output of 189 kWp.

→→ During the energy efficient renovation of the 'Märkisches Viertel' housing complexes a thermal insulation composite system was installed on the outer walls.

Significance of the structure

A structure's design helps determine its users' energy consumption. If the structure is compact, this reduces energy losses. The shape of the building, and the design, geometry and location of the structure, as well as its position in regard to the sun and the local wind direction, can minimise energy losses and noticeably impact ventilation, electricity consumption for lighting, and also expenses for cooling and air conditioning. One familiar example is the Reichstag building, where the Federal Government utilised and implemented these aspects in the building's conversion and restoration.

Minimising losses

Approximately one third of the energy utilised in Germany is consumed in buildings. According to the Federal Ministry of Building, around 85 % of this is used in private households for heating and warm water. The heat supply in buildings thus represents the area with the largest potential savings. Much of this potential is easy and economical to tap.

There are two main approaches to this goal. On the one hand, heat insulation for facades, basement ceilings, roofs and/or upper floor ceilings minimises energy losses. On the other, efficient heating systems and modern control and building services technology can help reduce energy consumption.

Just how important energy consumption really is was recently underscored by the Federal Government's introduction of energy performance certificates. Today, whoever sells, leases or rents a residential building must first present such an energy performance certificate. This requirement for residential buildings constructed before 1965 has already been in place since July of 2008. It has been mandatory for newer residential buildings since the beginning of 2009. As of July 2009, this requirement has also been extended to non-residential buildings. The only exceptions to this regulation are smaller buildings with less than 50 m² of useable space as well as listed buildings. According to EnEV 2007, publicly used buildings with over 1,000 m² of useable space and with public access must display this certificate at a clearly visible location. The information contained in the energy performance certificates for new and renovated buildings is based on energy needs. Only existing buildings, under certain circumstances, may use a certificate based on climate-adjusted energy consumption.

Consumption behaviour

The energy performance certificate not only represents an instrument for calculating a building's energy needs. It also provides information regarding measures to be taken to enhance energy efficiency. It thus serves as the basis for planning energy efficient building renovation. But more than anything else, it provides transparency for everyone who wishes to rent or purchase a house or flat. Thanks to the energy performance certificate, these people can also receive detailed information on the energy efficiency characteristics of older buildings. At the same time, the certificate directs users' attention to their own energy consumption. This is an important step in advancing the idea of sustainable building beyond mere construction guidelines. It positively influences the important factor of 'user behaviour'.

Utilising renewable energy sources

By 2020 the share of renewable energy in heating is to be raised from the current level of 6 % to 14 %, and the proportion of renewable electricity generation from 14 to between 25 and 30 %. This increase is mandated by two laws: the 'Gesetz für den Vorrang Erneuerbarer Energien (EEG – Law on the Priority of Renewable Energies) and the 'Gesetz zur Förderung Erneuerbarer Energien im Wärmebereich (EEWärmeG – Law on the Promotion of Renewable Energies in Heating). These objectives call for the proportional use of renewable energies in all new building projects in Berlin. They also require that the use of renewable energy be examined and documented for building conversions and modernisations.

However, not all renewable energy sources are appropriate for Berlin. There are no rivers that flow quickly enough to provide economically feasible hydropower. Wind energy systems are too loud, at least in residential areas. They also require a great deal of space and may unreasonably burden the city's wild life. Facilities for geothermal energy can only be constructed at great expense in the densely built-up city and are thus uneconomical. On the edge of the city, such plans are problematic due to their impact on the groundwater. After all, 25 % of Berlin's area is made up of water conservation areas.

Energy generation from biomass is only justifiable in individual cases, since the benefit from the renewability of the energy source is nullified by the resulting negative (environmental) costs. In the inner city in particular, wood pellet heating is impractical due to high respirable dust emissions and the large amount of space required for storage. Biogas facilities are also inappropriate in the city. That is why the energy supplier GASAG intends to build some fifteen such facilities beyond the city's boundaries by 2015. The first of these has gone into operation in the town of Rathenow in Brandenburg in September 2009. Part of the methane gas produced there will be fed into the Berlin natural gas grid. The rest will be used to generate electricity in cogenerated heat and power stations.

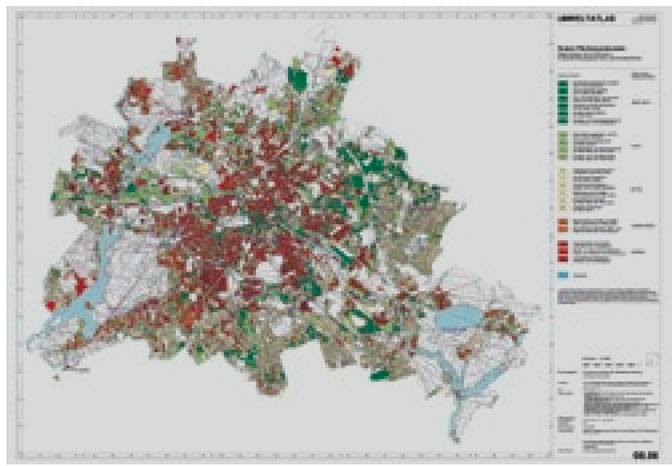
Solar energy in focus

Despite the city's geographical location in northern Germany, solar energy systems have proven themselves in Berlin. Solar energy – whether in the form of solarthermal or photovoltaic (PV) energy – is the most urban-friendly of all new energies. Berlin's solar registry, which was begun as an ecological model project, as of December 2008 listed 5,864 solarthermal and 1,976 photovoltaic facilities, as well as around 2,000 PV island systems. The total installed area of the solarthermal facilities today amounts to nearly 62,000 m², while all registered PV systems have a total output of around 14,400 kWp. The cost-effectiveness of solar energy is likely to improve noticeably in the near future, thanks to the introduction of new technologies. Berlin is leading the way nationally, particularly in the development of low-cost thin-film modules (cf. the solar wall project on pp. 22/23).

Warmth from residual heat

Another form of renewable energy that has proven to be particularly valuable in Berlin is the targeted utilisation of otherwise wasted residual heat. Energy from ***cogenerated heat and power*** comes either in the form of district heating from the power plants of the local energy supplier, or is generated in decentralised district heating plants. A similar principle can be used within the building's own cycle, employing facilities to recover heat from exhaust and waste water.

Cogeneration means that the residual heat from power plants is not allowed to escape into the environment but is targeted for use as district heat for building heating purposes. Cogeneration plants of this kind thus generate both electricity and heat.



← The 'solar surface potential' map included in Berlin's Environmental Atlas documents the results of a survey evaluating the potential of Berlin's building stock for the deployment of solar systems on roofs and facades. The entire map with its detailed legend can be downloaded via the Environmental Atlas on the website of the Senate Department for Urban Development.

What is essential in all of these approaches towards improved energy efficiency is to ensure that the structure, heat insulation, heating systems, building services technologies and the utilisation of renewable energies are developed on a coordinated basis.

Berlin is one of the few large cities that are able to guarantee their water supply on their own territory. For more than one hundred years the city has been drawing its drinking water from the groundwater and its bank filtrate. That is why the Senate's fundamental goal is to ensure a balanced water management. In the process, the idea of an internal urban water cycle is replacing the concepts of consumption and disposal.

The Senate's various departments are working hand in hand to achieve this goal. The Senate Department for the Environment is responsible for water and waterway management. The Senate Department for Urban Development is involved with the water issue in connection with construction planning. This concerns the installation of water, sewage, and fire extinguishing systems including tanks and cisterns as well as both the drainage and utilisation of rainwater.

↑ The Senate initiated a programme to protect shoreline reed beds in the 1980s. Over the course of many kilometres, reed-covered shorelines have been partially replanted and protected with palisades to shield them from the waves caused by ship traffic. Today, reed bed protection is anchored in the 'Berliner Naturschutzgesetz (Nature Conservation Act). This procedure also directly protects the city's water supply, which draws a portion of its drinking water from bank filtration.

Irrigation and seepage

The high degree of soil sealing in Berlin's urban areas impacts on the consistent replenishment of ground water. Allowing water flowing from roofs and paved surfaces to seep into the soil on a local basis and use it to irrigate green areas and greened façades is thus the most sustainable method of reinforcing Berlin's water cycle.

This is provided for in the 'Berliner Wassergesetz' (Berlin Water Act), which defines the rules together with the 'Niederschlagswasserfreistellungsverordnung' (Rainwater Exemption Ordinance). Throughout Berlin, water collected from rainfall is permitted to seep into the groundwater. However, properties in water protection zones and properties whose soils are burdened with past pollution, or where this is suspected to be the case, represent an exception. Restrictions on seepage are also placed on properties in areas with high groundwater levels where water damage threatens buildings and vegetation.

Seeped rainwater must not be used or contaminated, nor may it be mixed with waste water or water-harming substances. It must originate from non-metallic roofing surfaces, paths and courtyard surfaces, bicycle paths or car parks in residential areas. Rainwater from street surfaces in purely residential areas is also permitted to seep as long as the maximum traffic density does not exceed 500 motor vehicles per day.

In the case of water from busy roads, and also water from roofs with a high proportion of metals such as zinc, copper and lead, the filtering capacity of the soil is not sufficient. In these cases it makes more sense to channel the water into wastewater sewers in order to ensure ecologically responsible reprocessing.

Seepage procedures

There are five methods for facilitating rainwater seepage. The more sustainable they are intended to be, the greater the space requirements. The correct procedure to be followed must always be chosen on a case by case basis. Ideally, the water should seep over a broad area across the greened topsoil, which functions like a natural filter. Trough seepage can handle large quantities of water in a small area since the permanently greened hollows function as short-term intermediate storage basins. Infiltration ditch systems expand this procedure using a layer of gravel beneath the topsoil, from which the filtered water drains and is channelled into the groundwater through a shaft. Simple infiltration ditch or pipe seepage is only advisable in exceptional cases due to the absence of a topsoil to act as a filter. In particularly precarious space situations it is only possible to channel the seepage through a shaft.

The Berliner Wasserbetriebe utility company rewards load relief on its sewers as a result of seepage by issuing exemptions from the rainwater fee. This fee for rainwater removal is calculated according to the built and paved surfaces from which rainwater enters the public wastewater disposal system.

Intermediate storage

Rainwater does not fall evenly. Since heavy rainfalls may occur repeatedly within a short period, it makes sense to install a retention system as a buffer so that the water does not drain above ground or through the sewer system and thus contaminate the watercourses. Open storage facilities on the outskirts can be designed in the form of wetlands and ponds, or can be combined with the same. This creates habitats for plants and animals and also utilises the filtering characteristics of reeds and water plants. In areas where space conditions do not allow this, rainwater cisterns may be used. When placed in exposed locations they can also serve as a fire water supply. At the Haus der Deutschen Wirtschaft on Mühlendamm, for example, rainwater is collected to form a reserve of fire water and for use in toilet facilities.

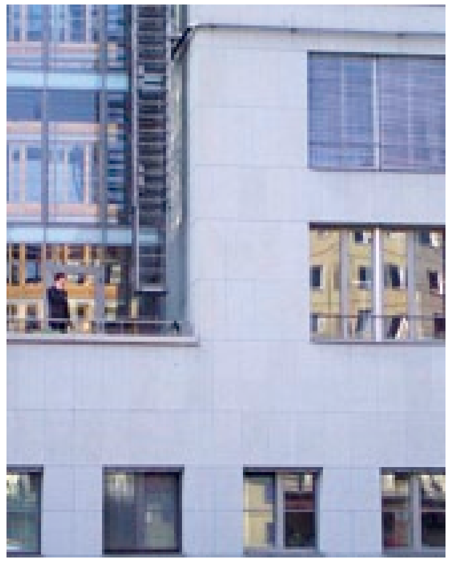
Drinking water and service water

The goal of ecological building is to reduce the consumption of drinking water. This is particularly served by the installation of water-saving faucets and household appliances. However, the Senate also became interested in the use of service water at an early stage. Water of drinking quality is not necessary to wash laundry or to flush a toilet. It can be replaced by recycled grey water or rainwater. Thus in 1989 the first successful system for grey water recycling went into operation in Kreuzberg's Block 103 and was optimised in the period up to 1998 within the framework of a comprehensive urban ecological model plan. In Germany, there are no binding requirements for the quality and monitoring of service water used in buildings. However, Berlin has formulated concrete quality targets, which have attracted international attention as the so-called "Berlin values". The Senate Department for Urban Development has made the knowledge developed available to interested builders, planners and operators worldwide in two brochures published in 1995 and 2003.

In Berlin itself, however, the use of grey and rainwater as service water calls for careful consideration. Neither the rainwater nor the groundwater situation in Berlin lends itself to an increased utilisation of service water. In addition, the necessary installation of a second pipe network with a perfectly hygienic separation between the networks would require a high level of investment along with equally high operating costs for monitoring, maintenance and repairs. In most cases, facilitating the seepage of rainwater and channelling grey water through the sewer network for targeted reprocessing in treatment facilities makes better ecological sense.

Sewer systems

A 9,400 km long network of underground wastewater, rainwater and mixed water sewers extends across Berlin. Only the city centre is still dominated by the old and ecologically less efficient mixed water sewer system. Three quarters of the sewered areas are already drained according to the separation process, by which rainwater and wastewater are channelled separately. Where this is the case, rainwater and wastewater must also be channelled separately inside building facilities. This guarantees that the rainwater reenters the natural cycle via seepage basins, intermediate sewage basins and retention soil filters or by channelling into the watercourses.



← The Haus der Deutschen Wirtschaft on Mühlendamm, completed in 1999, collects rainwater as a fire water supply and for toilet flushing.

↑ This storage basin for rainwater is located south of the private residential housing area of Habichtshorst in Biesdorf-Süd. It has been incorporated into the 'Schmetterlingswiesen' neighbourhood park. During dry periods it serves as a playground and benefits plants and animals as a natural meadow. During heavy rainfalls, the basin serves as a receiving stream and seepage trough to relieve the nearby stream.

The element of building materials

The selection of materials, components and products has a decisive impact on a building's ecological quality. The objective is to preserve the health and environmental compatibility of these materials throughout their entire life cycle. The foundation for this is established in preliminary conceptual considerations.

As a matter of principle, renewable raw materials and raw materials made from recycled materials should always have priority. The location and type of raw material extraction also impacts the ecological bottom line: materials that can be created without elaborate conversion and refining processes and in as few manufacturing steps as possible ensure low energy consumption and generally also low emission rates during their manufacture. Providing building materials of local origin is also beneficial due to short transport routes.

The question of which building materials lend themselves to which application should be examined in regard to their health-compatibility and air pollution control in the building's interior. In the process, it is also necessary to pay attention to processes on the building site and, for example, to allow for sufficient drying periods for paints and adhesives.

Long lifespan and easy maintenance

From an ecological point of view, building materials with a long lifespan and low maintenance costs are always preferable. For example, the maintenance and cleaning of the outer skin and the interiors should be easy and involve a low consumption of detergents. This is good for the environment and lowers operating costs. That is why more often than not smooth outer surfaces make more sense than open or rough ones.

Exchanging and replacing defective components must be simplified in order to extend the building's life cycle. Not only the materials used but also their cut and the processing methods used are decisive here. For example, screwed or inserted joints are easier to remove than glued joints and thus make it possible to replace them at any given time. In addition, materials joined in this way are easier to separate when they are later dismantled. This makes it easier to continue using them, or to reuse them for other purposes. Degradable and compostable construction materials ensure a particularly inexpensive disposal.

Construction product evaluations

Since the early days of ecological building, a number of alternative materials and methods have been tested, ranging from rammed clay walls to heat insulation using reeds. However, the considerable progress currently being made in the field of classic construction material production is of great significance when it comes to wide-scale use. For example, multiple glazing employing new heat and solar insulating glass and glass compound systems succeeds in lowering the heat transfer coefficients (U values) of windows and glass surfaces to between 0.7 W/m²K and 0.5 W/m²K.

The ordinances and regulations of the chemical, hazardous materials and labour protection laws also regulate the management of health and environmentally relevant substances for the manufacture and processing of building products. The states' building regulations determine which products can be used in buildings and in what ways. Berlin's building and construction material regulations not only pertain to materials and components but also to pre-fabricated systems such as heat pumps, which are also treated as building products. In these cases, the evaluation of their energy efficiency is a major precondition for their use.

↓ Building Group Project e3 was developed on Esmarchstrasse in Prenzlauer Berg based on a design by Kladen + Klingbeil Architekten between 2007 and 2008. What looks like an ordinary new building on the outside is in reality Germany's highest wooden building: The house was erected using balloon framing with solid wooden walls and thus explores the potential for using wood as a renewable building material in multi-storey metropolitan residential buildings.

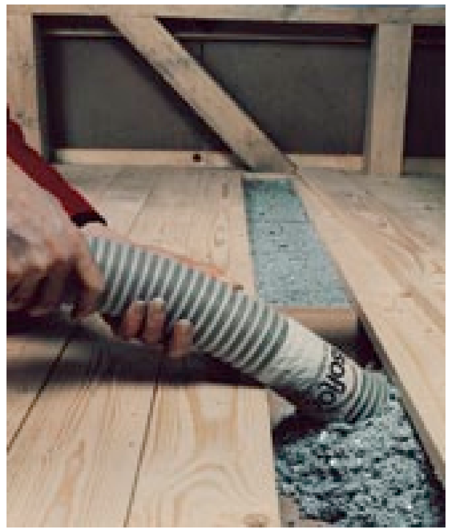
→ Salvaged and cleaned bricks collected during the cautious dismantling of buildings represent a valuable material, particularly when it comes to building additions onto historical structures. Even debris from bricks can be used sustainably – for example, as a source of granulated material for greening flat roofs.

The Deutsches Institut für Bautechnik (German Institute for Building Technology) evaluates the health and environmental compatibility of individual building product groups in the context of a general building permit based on the building regulations of the individual states. A voluntary contribution to product-related health and environmental protection is provided by privately organised certification systems. In the case of wood products for example, they can ensure environmental and health benefits that extend beyond the requirements provided for in existing building regulations.

Recycled construction materials in road-building

Berlin respects these principles in its own building projects – not only in structural engineering but also in road-building and other engineering projects. Whenever possible, pavements are constructed from and maintained with existing materials. A typical paved surface in Berlin – particularly in the city centre – is made of cobbled outer and inner strips such as mosaic paving, particularly Bernburg mosaic, and central paths of paving slabs or large granite slabs. The seams are usually filled with sand using a cement-free method. Alongside an attractive, historical design in tune with the urban landscape, this system has the added benefit of being open for seepage.

The Senate Department for Urban Development monitors the quality of road-building materials from reprocessed rubble, certifies them and publishes details of both the certified building materials and the companies that manufacture them once a year in the city's official journal 'Berliner Amtsblatt'.

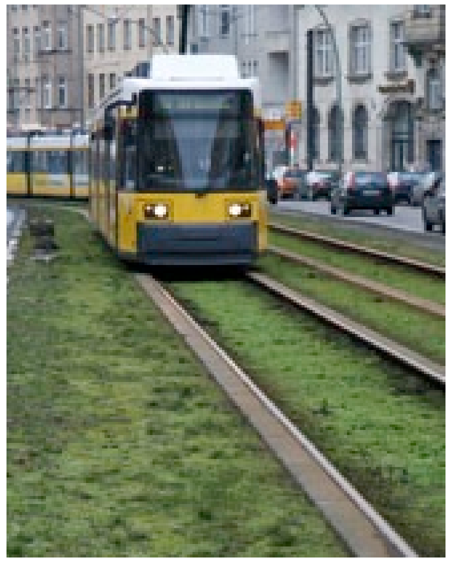


← With injected insulation materials made of cellulose, hollow spaces can be heat-insulated (even retroactively) all the way into the furthest corner.

↑ Paving work on a typical pavement in Berlin's city centre. Mosaic paving laid using a cement-free method frames paths made of larger paving slabs.

The element of greenery

Berlin is rightly viewed as a green metropolis. More than 42 % of the urban area consists of green and water areas – more than in any other large city in Germany. This enhances the quality of life not only for Berlin's human residents. In fact, today cities are regarded as hotspots of biodiversity since they offer a vast spectrum of habitats for animals and plants in a small area. That is why the Senate is taking countless measures to secure the valuable system of free spaces. This ranges from the protection of especially sensitive habitats to the high-quality design and maintenance of parks, squares and gardens, all the way to support for private initiatives that care for green areas on road land or cultivate temporary green spaces on unused plots.



↑ Since 1995 Berlin has greened more than 20 km of tram tracks. Along with grass, heat-resistant varieties such as sedum and other succulents have also been used. The city has benefited simultaneously on a variety of fronts: the plants reduce noise, filter pollutants, improve the microclimate through evaporation, cool the air and also protect the tracks and sleepers from erosion and deterioration.

Ecological building is aimed at protecting existing vegetation and integrating it into building projects, increasing the proportion of green spaces (particularly in inner-city areas), minimising soil sealing and taking steps to ensure that this valuable greening can be maintained on a sustainable basis.

Protecting vegetation and nature

The position and design of a structure should not just be determined on the basis of energy efficiency and economic considerations. The protection of existing vegetation, particularly old tree populations, should be thought through carefully. The root zones of trees are not appropriate for traffic and storage areas, and they should also be avoided when planning supply conduits.

When it comes to plant use, the selection of varieties appropriate to a specific location is key. Native shrubs and bushes serve as a bee pasture and provide food for birds. They represent a good choice since they are better adapted to existing ecosystems than neophytes. However, this selection must always be considered on a case-by-case basis. For ex-ample, especially pollution-resistant tree varieties might make better sense along streets with a high volume of traffic. Heat and drought-resistant varieties, especially in ex-posed locations, can help reduce maintenance and care requirements over the long term.

The urban habitat is characterised by the variety of its ecosystems and ecological niches. That is why the design of green spaces should strengthen the city's natural ecosytem and biodiversity. This goal is also served by measures to protect wild animals living in the city and to provide shelter to particularly threatened species.

Even allowing nature to take its course and encouraging spontaneous vegetation can play a role, as long as it does not compromise building safety or the use of open spaces. Studies have shown that even vegetation growing in the gaps between cement-free paved surfaces can noticeably improve the microclimate.

Increasing the proportion of green spaces

A greened courtyard impacts adjacent buildings by reducing temperatures in the summer and cooling the building's surroundings. In addition, the plants filter particulate matter from the air and provide habitats for many animal species. However, structural-physical, air pollution control and urban-ecological issues are not the only reasons to increase the proportion of green spaces. Increased green spaces also increase the users' identification with 'their' building.

In outdoor areas, it is preferable to structure space using hedges and shrubs rather than walls. The greening of roofs and façades also has a positive effect on the building and microclimate and creates new opportunities for ecological rainwater management.

These approaches should be considered during the planning of the building's outer skin. Trellises for twiners and climbers, suitable surfaces for self-climbers and appropriate planning for the façade's vertical stability are essential when it comes to planning targeted façade greening.

Roofs provide a further opportunity for increasing the proportion of green spaces. Extensive roof greening programmes using a thin layer of substrate and drought-resistant vegetation are, from an economic perspective, vastly superior to intensive greening efforts using high-quality soil. They result in significantly lower investment costs and do not require expensive care. That is why the Berlin Senate has officially prioritised extensive greening projects in its 'Ecological Criteria for Building Competitions'.

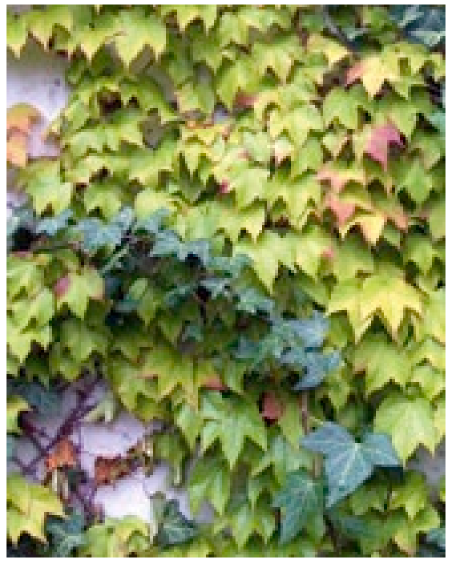
Avoiding soil sealing

From an ecological point of view it is desirable to reduce the overall proportion of sealed surfaces on a property when planning new buildings. The goal is to reverse the sealing of properties. At the very least, new sealing should be kept to an absolute minimum in building projects. Water-permeable, cement-free surfaces offer a broad spectrum of solutions. Wood and bark coverings, crushed aggregate lawns, honeycomb-type paving stones and pavements with large seams ensure relatively high water-permeability, even on traffic surfaces. The selection of the appropriate alternative must be oriented on future traffic demands. Ideally, the decisions should be made on the basis of a coherent, integrated landscape and greening concept that also describes the required degree of soil sealing and the intended rainwater management.

Ecological irrigation

A considered approach to the natural and cost-free resource of rainwater is a central component of sustainable lawn and garden maintenance. When irrigating open spaces and façades, it is preferable to use water from roofs. Wetlands, ponds and external reservoirs, as well as internal cisterns, make it possible to collect and store this water. The building itself should be designed in such a way that the water can flow onto the green areas or into intermediate basins as a result of natural gradients, without the need for pumps or any other energy-consuming lifting systems.

← Moss-covered pavement cracks improve the microclimate because the water stored in the moss gradually evaporates under hot conditions, thus cooling the surrounding area.



↑ The open concrete structure of this enclosure wall in the Federal Chancellery garden promotes the growth of self-climbing ivy and parthenocissus.

Ground water can be used in individual cases in order to avoid wasting drinking water for irrigation. However, an application for groundwater extraction must be submitted to the Senate's Environment Department as the responsible water authority. This authority will then decide whether water extraction for irrigation is possible and meaningful at a specific location.

The element of waste

The right approach to dealing with waste provides a decisive contribution to environmental relief. Closed flow cycles for materials reduce resource consumption, and recycling makes it possible to extract organic components that would otherwise burden the soil, water and air in the form of damaging emissions. This element is of critical and often underestimated significance when it comes to ecological building: around 80 % of all waste products generated in Berlin come from the building industry. In 2007 this amounted to nearly 5 million tonnes of waste.

Avoidance

Where no waste is produced, there is no waste to burden the environment. That is why the Kreislaufwirtschafts- und Abfallgesetz (Closed Substance Cycle Waste Management Act) is rightly aimed at avoiding building waste in the first place. The scope of action necessary for this is often present long before the waste actually materialises. The most effective measure that can be taken to avoid waste is to make use of existing buildings. It is equally important to extend buildings' life spans. That is why new buildings should be erected using long-lasting construction materials along with building methods that allow for future conversion. Intensive upkeep and predictive maintenance can also help prevent premature demolition.

↓ Asbestos removal during the dismantling of the Palace of the Republic.

→ Demolition rubble makes up four fifths of all waste in Berlin.

Soil and stones, which amount to more than 38 % of building waste, represent the largest share. As long as excavation spoil contains no dangerous substances, it can be used on the property for landscaping purposes and thus be reused via the shortest possible route.

Proper disposal

Nevertheless, every building measure and every building life cycle generates unavoidable waste. The idea of sustainability is based on a valuation and prioritisation of approaches to disposing of these waste materials. The principle of reuse (i.e. recycling or transformation into energy) before disposal is key. A waste concept can be helpful in developing considered and foresighted plans.

During construction

Optimised building site logistics allow builders to reduce waste production during the construction process. Building materials and components on the site should be protected in order to avoid damage and refuse. During this phase, need-driven material preparation can also help reduce waste. This includes the cutting of plasterboard and wooden sheets and the use of reusable and large-scale packaging. In this way, considerably less material packaging will require disposal.

During use

In order to ensure the intelligent disposal of waste during building use, separation systems need to be planned. This can start with the provision of appropriate storage spaces for yellow bins in the courtyard or in separate rubbish rooms. Biodegradable waste products, such as plant matter, can be composted directly on the property if conditions allow. Finally, during modernisation and renovation old and non-ecological systems can be eliminated. For example, the old rubbish chutes were removed during the modernisation of the Märkisches Viertel (cf. p. 32).

After dismantling

The reuse of building components after dismantling is made easier if appropriate measures are factored in during the initial building planning phase. That is why it makes sense (and is often more economical) to mandate low-waste solutions during the bidding process. The reuse of materials after dismantling can be prepared in advance by selecting appropriate building methods, reducing the variety of materials in order to simplify separation, using construction materials with high recycling potential (particularly through the use of biodegradable, compostable and pollutant-free building materials) and by avoiding composite materials and insoluble compounds.

Recycling building waste in Berlin

Ever since the late 1990s, Berlin has recycled nearly all of its building waste. For years this quota has reached percentages in the upper nineties. In 2007, for example, the city recycled more than 99 % of its waste. In doing so, Berlin has clearly surpassed the targets laid out in the 1999 Waste Management Plan for 2010 and even goes beyond the most recent EU regulations: The revised Waste Framework Directive (2008/98/EG) calls for a mere 70 % recycling quota for building and demolition waste.

Particular attention must be paid to the elimination of hazardous wastes containing substances that are harmful to human health and the environment. These include coal tar and coal tar-containing bitumen mixtures, asbestos-laden materials, materials containing mercury, PCB-contaminated sealants, PCB-contaminated flooring materials on a resin basis, along with paint, lacquer, glue and sealing compound waste containing organic solvents. All work using asbestos, PCB and PCP-laden construction materials and components is already subject to building and labour protection regulations designed to protect health. Beyond these regulations, the elimination of these hazardous wastes calls for due diligence, which is precisely regulated by law. For example, these materials may neither be mixed together with normal waste nor with each other. In Berlin, these hazardous wastes can only be disposed of by the specially created SBB Sonderabfallgesellschaft Brandenburg/Berlin (Hazardous Waste Company).

Using building waste in road construction

The state is leading by example when it comes to recycling building waste. Nowhere has it gone further in the use of recycled building materials than in public road construction. When building roads, used building waste is used in creating the frost-protection and substratum layers wherever possible. Soil and building rubble are crushed and separated in grinding and sorting facilities. The quality of the resulting building materials is explicitly mandated and painstakingly supervised. Depending on the required mixture, the deployment of up to 40 % asphalt granulate extracted from waste asphalt is proscribed for the asphalt binder course and substratum levels. Road construction also provides an ideal example of waste production: For years, virtually 100 % of removed materials have been recycled.

Step by step, the Palace of the Republic was disassembled between 2006 and 2008 – reversing the sequence in which it had been originally constructed. The central city location with its high level of visitors remained largely free of noise and dust while the disassembled materials – nearly 20,000 t of iron and steel, more than 56,000 t of concrete, 600 t of wood and bricks, and 500 t of glass – were more easily sorted for further use.

Exemplary Berlin projects

The basic ideas of ecological building are increasingly finding expression along a broad front of building projects. In Berlin countless projects implementing at least individual elements of sustainable building have been realised in recent years.

A selection of twelve particularly exemplary projects presents the vast range of solutions that architects and building-owners have developed. What most of these projects have in common is the manner in which they approach their task with a holistic approach that links together several elements of ecological building, thus creating additional synergies.

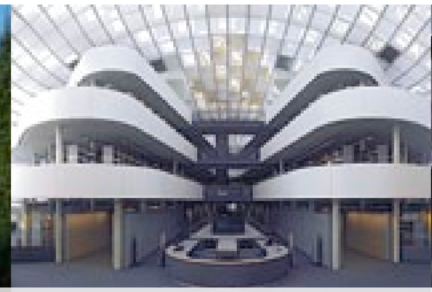
The spectrum encompasses innovative pilot applications of new energy sources, sustainable commercial buildings, office buildings, model training buildings, the sustainable retrofitting of entire large housing estates, energy-saving renovation of private homes, modular projects and special buildings such as a large tropical greenhouse in Berlin's Botanic Garden.

Elements
- Energy
- Water
- Building materials
- Greenery
- Waste

Solar wall – Ferdinand Braun Institute for High Frequency Technology

Training pavilion – Oberstufenzentrum TIEM

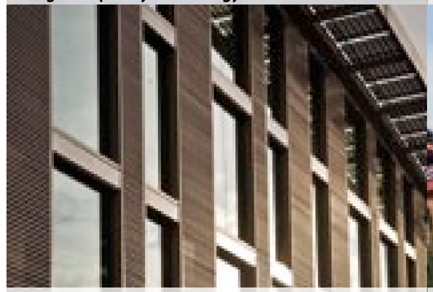
Breitunger Weg – Remodelling of a single-family house



Philological Library – Freie Universität Berlin

Annedore Leber Elementary School – New canteen and house for day care groups

Franciscan Monastery, Pankow – Remodelling and extension



Solon SE Headquarters – Corporate administration and production building

Lebens(t)raum Johannisthal – Trans-generational living

Märkisches Viertel – Energy efficient modernisation

Free Waldorf School Kreuzberg – Conversion of the former Children's Home

'Albert Schweitzer' House of Youth – Energy efficient remodelling

Fundamental reconstruction of the Main Tropical Greenhouse – Botanic Garden Berlin

'Ecological competence – advanced building'

Energy saving and the protection of natural resources are fundamental aspects of planning and building and important goals of a future-oriented urban development policy. Plans for buildings must be examined in terms of securing the quality of life and should be aimed at these goals. Ecological principles and energy-efficient concepts are becoming obligatory for all building projects.

The pilot projects for ecological building that have been developed in Berlin since the mid-1980s, considerable progress in energy-saving construction techniques, and many public and private projects undertaken in the city have provided Berlin with a wealth of experience that is now enabling us to make exacting demands on building projects and transform them into compulsory standards.

One important step in this process is to present the ecological demands on construction planning in Berlin within their own context and to invite everyone to implement these demands in order to transform ecological building from an exception to a rule.

For builders – both public and private – ecological and energy-efficient building has always been a financial issue, particularly in the short term. The assistance measures that the public authorities have allocated for energy-saving renovation provide financial incentives that represent an incentive for private builders, companies and also public building projects.

One does not have to be a prophet in order to predict that real estate sales will increasingly be determined by energy costs in the coming years. That is why we are seizing the opportunity to remain on the 'frontier' of technically advanced building and renovation. The following examples present a series of current projects in Berlin illustrating the advanced standards we are employing in the area of building techniques and methods.

Today, ecological and energy-efficient building is not just a topic of outstanding significance. It also requires new, network-based action on the part of public administrations.

That is why the Senate has codified all issues pertaining to this topic in a comprehensive 'Climate Political Work Programme' that is now being systematically implemented. Understanding energy as a valuable asset is a first step toward a climate-conscious future – a step that each of us must now take every single day. The second step is to focus these individual experiences within a common project – a project for sustainable municipal and social policies.

You will find examples of this path on the following pages.

Hella Dunger-Löper

Hella Dunger-Löper
Permanent Secretary for Building and Housing

Solar wall

Ferdinand Braun Institute
for High Frequency Technology

The distinctively curved hollow, in whose surface the sky is reflected on sunny days, shimmers anthracite grey. In technical terms, the façade, which makes a clear architectural statement at its location directly across from the Bessy II electron storage ring, is something of a small wonder. After all, it is the largest facility to date for the practical utilisation of second generation thin-film solar cells (CIS-2). It went into operation in early 2007. It took a total of five weeks to assemble. More than 700 of the innovative photovoltaic modules are mounted here using point anchoring on a substructure made of zinced steel sections.

The solar wall is the crowning glory of a reconstruction project that has provided the Ferdinand Braun Institute for High Frequency Technology (FBH) with a new face at its location in Adlershof. Ever since the 1990s, the FBH has been using a partially listed ensemble of buildings. These structures were refurbished between 2001 and 2005 and have also been complemented by a new laboratory building. This ensemble also includes a technology and production hall from the 1970s. It had previously been expanded and transformed several times on a purely technical basis. The new solar wall, which faces the road, now provides the building with a clear, uniform exterior. Behind the screen, which rests upon a wall made of light-coloured concrete, the FBH will be able to make future changes to the hall's actual cladding without impairing its external appearance.

At the same time, the Institute is clearly and visibly drawing attention to its declared intention to work on an environmentally-friendly basis. "The innovative solar system is showing today how people will build in the future," says Dr Nikolaus Meyer. Meyer is the director of Sulfurcell Solartechnik GmbH, which provided the state of the art photovoltaic modules. In 2006 Sulfurcell was awarded the Berlin-Brandenburg Innovation Prize for its contribution.

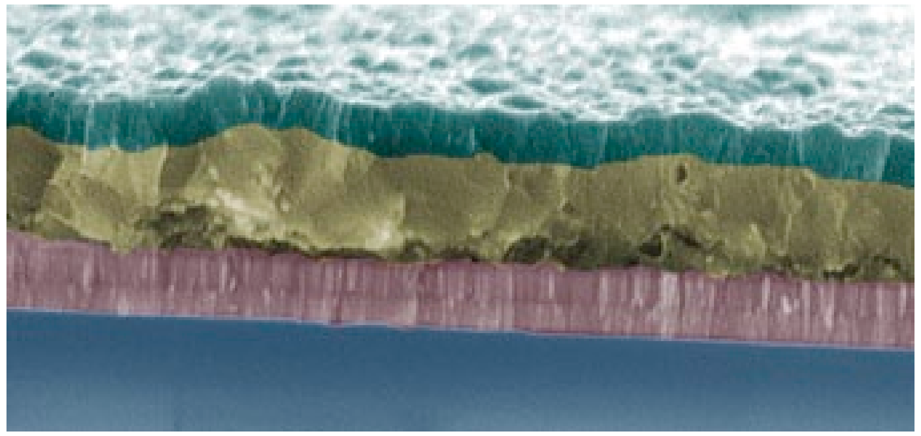
As daring as Meyer's assessment may sound, it is certain that the solar wall is launching a new era in photovoltaic applications. After all, thin-film solar cells not only expand the application spectrum but also reduce procurement costs for solar cells by up to 50 %. The new technology, in which Berlin has shown itself to be an international leader, is thus paving the way for the economical deployment of solar energy across the board.

The Helmholtz–Zentrum Berlin für Materialien und Energien in Adlershof grew out of the Hahn-Meitner Institute in 2008. It is this independent institute that stands at the centre of Berlin's solar cell research. Instead of silicium, compound semiconductors composed of elements such as copper, indium, gallium, sulfur and selenium are utilised as the base material for thin-film cells. They absorb sunlight in finer layers. The greatest potential for application on a broad, industrial basis is provided by copper indium sulphide ($CuInS_2$).

This is also the most environmentally-friendly version of the thin-film cell. First-generation CIS cells used copper indium selenide as an absorption material. When selenium is replaced with sulfur, cell production requires around two third less energy. The energy return time for the new cells – i.e. the time that passes before the cell has produced as much energy as has already been invested in its production – is a year or less. By comparison, the return time for conventional silicium cells amounts to between three and seven years.

As the first company in the world, Sulfurcell in Adlershof began with the production of these solar cells in 2006. The Senate subsidised the spin-off from the Hahn Meitner Institute with 7.23 million Euros within the framework of the Umweltentlastungsprogramm Berlin (UEP - Environmental Relief Programme) in 2003. The original shareholders were the Hahn-Meitner Institute, industrial shareholders and the Berlin Energy and Environmental Funds of Gaz de France and Vattenfall Europe Berlin. In the summer of 2008 a group of international investors under the direction of the equity capital financing company of the chip manufacturer Intel raised the share capital by eighty-five million Euros. This has allowed Sulfurcell to expand its production with an additional factory. It has been opened in October 2009.

← Manufacture of thin-film solar cells at Sulfurcell



← Structure of a thin-film solar cell

Location
Gustav-Kirchhoff-Strasse 4
12489 Berlin (Adlershof)

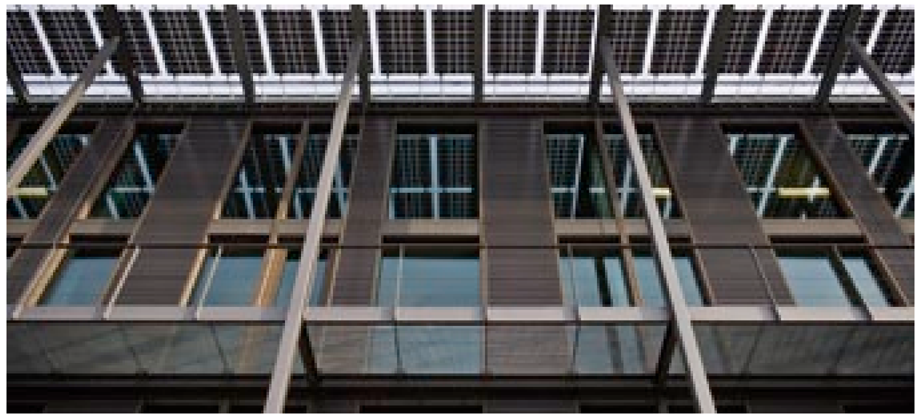
Element
Energy

Solar wall (photovoltaic facility)
Architecture
Christian Matzke / msp Gesellschaft für Bauplanung mbH, Dresden
Width
80 m
Height
8 m
Implementation
732 CIS-2 thin-film modules
(two inactive for facility-related reasons)
Manufacturer
Sulfurcell Solartechnik GmbH
Module size
129.6 x 65.6 cm
Module output
45-60 watts
Installed surface
640 m^2
Total output
39 kWp
Total costs
250,000 Euros
Start-up
January 2007

www.fbh-berlin.de
www.hmi.de
www.sulfurcell.de

Solon SE Headquarters

Corporate administration
and production building



More than a third of all German solar modules are already being produced in the Berlin-Brandenburg region. One of the manufacturers operating here is Solon SE. This TecDAX-listed company, which has gained international renown particularly due to its photovoltaic systems for large-scale solar power generating stations, also maintains subsidiaries in Austria, Italy, Switzerland and the United States. Solon was among the first signers of the Berlin Climate Alliance (see p. 4) and employs environmental management systems at all its locations in accordance with ISO 14001.

The holding company has taken up residence in a new headquarters building in Berlin-Adlershof. The new building complex combines administration and production facilities, creating space not just for an expansion of Solon's own production capacity. The company Global Solar Energy, in which Solon is a shareholder, also began serial production of thin-film solar cells on a copper indium gallium selenide basis (CIGS) at this same site back in November of 2008.

The energy concept used in these new buildings was coordinated and optimised as part of a comprehensive planning process. It relies on renewable energies, heat insulation extending far beyond current standards, a coordinated interaction of individual energy-relevant processes and an intelligent consumption management system. As a result of these efforts, the corporate headquarters' CO_2 output has been reduced to a quarter of the level produced by conventional new structures.

The open office levels can be subdivided as needed. This guarantees long-term flexible use. Atriums ensure natural illumination in the compact four-story administration building. The façade is made up of energy-efficient prefabricated wooden elements. Triple functionally-glazed windows ensure optimal heat insulation with minimal installation depth and work together with external shading elements to provide the needed sun protection. The average U value of this building shell is under 1 W/m²K.

A local cogeneration unit uses biomass to generate heat and electricity which is then fed into the grid. In addition, the complex draws from the district heating network of a local energy supplier. In this way, the entire heating energy is produced in combined heat and power facilities. The heat is distributed via convector heaters on the façade elements and the concrete core activation of the ceilings, which can be heated and cooled. The ventilation wings in the façade are equipped with contacts that shut off the heating system when the windows are open. During the heating period a mechanical ventilation system is used. It is linked with a highly effective heat recovery system.

Cooling needs are particularly high in the production hall. That is why an electrical compression cooling apparatus supports the cooling performance of wet cooling towers. In addition, the planted roof compensates temperature changes, utilising cooling from evaporation in the summer and providing insulation throughout the year. A cistern makes it possible to collect and utilise rainwater on-site.

Alongside the cogeneration unit, a photovoltaic facility integrated into the house generates electricity. Each desk is battery-buffered and can store up to 1 kWh of electricity which it can then return via an installed 'mobile power socket'. This makes it possible to decouple periods of electricity consumption and generation.

An additional significant component of this energy concept is a wireless building automation system where linked sensors, actuators and appliances communicate via the Internet protocol. In this way, users can regulate ventilation, temperature and light in the rooms with any Internet-compatible device – from a PDA to a PC, all the way to the decentralised soft-touch panels installed in the rooms. This renders traditional light switches practically superfluous.

Location
Am Studio 16
12489 Berlin (Adlershof)

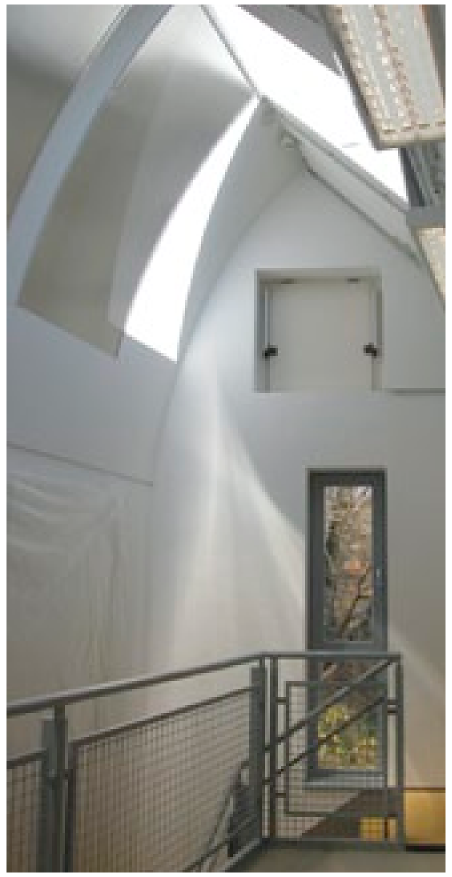
Elements
Energy, water, building materials, greenery

New building
Architecture
Schulte-Frohlinde Architekten
Energy concept and utilities management planning
EGS-plan GmbH
Utilities management and building automation
imtech Deutschland GmbH & Co KG
Floor space
23,000 m²
Construction period
2007–2008
Construction costs
Approx. 40 million Euros
Builder-owner
Solon SE

www.solon.com

Training pavilion

Oberstufenzentrum TIEM



The 'Oberstufenzentrum für Techniche Informatik, Industrie-Elektronik and Energie-Management' (OSZ TIEM – Secondary Education Centre for Computer Engineering, Industrial Electronics and Energy Management) is the only vocational school in the country offering students a three-year training programme to become 'certified assistants for regenerative energy and energy management'. Since there were still too few internship slots for this training programme, which was introduced in 2003, a pavilion was erected to serve as a teaching centre, practical workshop and educational aid all in one.

Its compact architecture ensures an energy-efficient ratio between the building's outer surface and its volume. Heat bridges have been reduced radically. The heat insulation of the façade also covers the window frame trims, which often represent weak points in otherwise well-insulated buildings. Penetration of the shell has been avoided as much as possible and construction-related heat bridges have been thermally separated. For example, all exterior and interior walls stand on supporting insulation layers in the bottom slab. Measurements have confirmed that the airtightness of the outer shell is well above average. Transmission losses are 43 % below the admissible limit. Annual primary energy needs are 38 % below the legal requirements.

The building is positioned in such a way that it receives direct sunlight despite the trees growing on the property. This location supports the active and passive use of solar energy. The roof is divided into a flat, accessible section and a sloped area. A variety of easily accessible solar cells and collectors are located on the lower section of the sloped part. Above them there are small windows whose light shines inside onto the concave north wall of a gallery and is then reflected onto the gallery and in the room below. Sun blinds prevent overheating of the rooms during the summer and simultaneously make it possible to apportion incident light as needed.

All interior and exterior technical systems are laid on top of the plaster. In this way, trainees can readily comprehend how they have been installed. In addition, the facilities can be adapted using state-of-the-art measures without impacting the building fabric. The deep seminar room on the ground floor can be furnished in a variety of ways: with classical rows of school desks, using learning bays or in a horseshoe shape. Forty centimetre-deep sunshade slats have been installed in front of the glass south-facing façade. They can be adjusted in such a way as to reflect light onto the ceiling of the seminar room, from where it is then distributed into the room as a whole. The electrical lighting reacts to the natural lighting conditions with an automatic dimming system. Motion detectors shut the lights off automatically whenever the room is not in use.

Stale air travels along the gently sloping ceiling of the seminar room into the gallery's air-space. From there it flows on to the ventilation flaps on the eastern and western gables. In this way, the building's geometry provides natural ventilation. In addition, a mechanical ventilation system supplies the seminar room with fresh air. This facility uses heat from the exhaust air to pre-warm the in-coming external air. A circulating air-cooling device installed beneath the gallery's ceiling, whose external portion is easily accessible on the flat roof, provides cooling.

Two photovoltaic systems provide an average of 2.4 kWh, which is fed into the public power grid. Warmth from the thermal solar collectors heats the building; the surplus is fed into the school's internal heating system. Metres measure how much energy is consumed for heating, cooling, ventilation, lighting and general electricity needs. A weather station additionally collects on-site climate data. All of this information is then fed into the building's digital heart: a building-management system that is administered from a master computer and manages all utility systems. Students can log onto this system from their notebooks via LON interfaces. This means that the management of heating, cooling, ventilation, lighting, sun protection and the building's own electricity generation systems can also be programmed on the student level.

90 % of this project was financed by funds provided by the Gemeinschaftsaufgabe 'Verbesserung der regionalen Wirtschaftsstruktur', a federal programme to strengthen local economy in structually weaker areas.

Location
Goldbeckweg 8–14
13599 Berlin (Spandau)

Element
Energy

New building
Architecture
sol-id-ar Architekten und Ingenieure
Technical building equipment
EST Ingenieure Ingenieurbüro Tesch
Project management
Schäfer Architekten- und Ingenieurgesellschaft mbH
Construction period
2007–2008
Construction costs
Approx. 1 million Euros
Builder-owner
Senate Department for Urban Development
Awards
KlimaSchutzPartner 2008
Deutscher Solarpreis 2008

www.osztiem.com

Lebens(t)raum Johannisthal

Trans-generational living

38 adults and 32 children are currently living their dream of sustainable, communal and trans-generational living in a new ecological settlement on the edge of the 65 ha Johannisthal Landscape Park. This communal project consists of 19 residential houses that were erected in several phases since 2004. This project with its high-density building style was inspired by the compact 'round villages' of the middle ages. The buildings are grouped in a horseshoe shape around a commonly used centre. No cars are permitted in the 'village' itself. Autos are left at a car park near the entrance. This creates near to nature gardens and common spaces in the interior that are especially suitable for children and the elderly.

The intensive heat insulation used in the wooden houses reduce energy needs. During construction, natural and traditional construction materials were used, including wood, loam rendering and masonry, compressed straw panels for the interior walls, linoleum for the floors and cellulose and hemp as insulation.

The builder-owners also rely on renewable raw materials for their energy supply. A local network provides the individual houses with heat and electricity along with warm, cold and service water from a shared technology cellar. A photovoltaic system with 23 kWp supports the electricity supply. A grey water system provides up to 2 m^3 of service water, which among other things is used to flush the toilets. This saves around 600 m^3 of drinking water annually.

Warmth is provided by a solar-thermal system with 50 kW total output and a biomass-fired boiler. In the winter of 2007/08 this wood pellet heating system was upgraded with an exhaust-gas heat exchanger to which a flue gas scrubber and a condensation heat exchanger have been attached. This system uses waste heat in order to prewarm the warm water in the settlement's drinking water network. This means that up to 15 % more heat remains in the system, now reaching the level of condensing boiler technology with a heating value of up to 103 %.

These measures also generated a further reduction in the already low respirable dust emissions. Dust emissions of 150 mg/m^3 flue gas are permissible. Before the refurbishment, the heating system emitted only 80 mg/m^3. Now, thanks to the new flue gas scrubbing system, this level has been reduced to just 30 mg/m^3. Thanks to this increase in efficiency, fewer wood pellets now need to be delivered by truck, which means the climate gas balance sheet has also been relieved in the upstream chain.

Alongside these construction measures, the residents have also changed their living and consumption habits and are attempting to create incentives to save energy, e.g. by exploring the issue of how operating costs are divided up amongst the users. In 2007 the project received an award for its ecological and civil society engagement and its concept of multi-generational living as part of the IKEA Foundation's 'Living in the Future' competition. The prize money helped residents to design the village centre as ecologically as possible and also to build a group house with a café and community rooms.

Location
Am Rundling 1–20
12487 Berlin (Joachimsthal)

Elements
Energy, water, building materials, greenery, waste

Ecological communal building project

Architecture
Planungsbüro BHZ/Harald Zenke

Project development
Hagen Neidel
Winfried Härtel

Residential buildings
19 single and two-family houses

Floor space
2,350 m^2

Construction period
2004–2006

Construction costs
Approx. 4.5 million Euros

Awards
Winner 'Wohnen in der Zukunft' (IKEA Foundation) 2007
KlimaSchutzPartner 2008

www.rundlinge.de

Breitunger Weg

Remodelling of a single-family house

Even old, non-insulated family homes can be upgraded from an energy standpoint through targeted intervention, as proven by the example of this private house on the boundary between the quarters of Buckow and Britz. The single-family home with an in-law flat was built in the 1960s. Two single-storey extensions expand the compact two-storey structure on its lateral sides. The floor plans were left almost unchanged during the conversion. The external shape also remained largely as before. However, the bulky balcony facing the street was removed in order to avoid constructional heat bridges. Roof overhangs and the chimney were also taken off for the same reason. The roof hatch was closed and the non-insulated roller shutter casings were removed. Two new wooden constructions were installed in place of the previous solid entrance landings, which also drew heat from the inside.

The exterior walls of plastered masonry received an insulation layer made of renewable raw materials. It encloses the building like a thick coat. Wood fibre panels on a ladder-like substructure form an inner wind-proof layer. 28 cm wide wooden ladders define the depth of the shell, into which cellulose has been injected. The outer layer of the building's two-storey sections is composed of larch wood cladding. The extensions were finished with an air-hardening lime rendering over a reed structure. While this curtain-wall construction increases the building's volume, it also drastically lowers the U value of the exterior walls to 0.12 W/m^2K. New, triple-glazed wood-frame windows with a U value of 1.0 W/m^2K (including frames) also provide noticeable energy improvements.

An inaccessible, wedge-shaped hollow space is located between the low-pitched lean-to roof and the suspended ceiling of rendered reed mats. This space has an average height of 40 cm. It was previously isolated with a mere layer of rock wool and a layer of polystyrene insulation material. Today, the cellulose that has been additionally injected into the hollow space raises the roof's U value to 0.06 W/m^2K. On the ground floor a new floor structure with a 6 cm layer of matting provides the necessary insulation. In the cellared area the ceiling was also insulated from below.

The builder-owners completely renewed the building's technical equipment. A brine/water heating pump with a 90 m deep geothermal probe uses geothermic energy. The heat is distributed using an underfloor heating system on both storeys. The living rooms are ventilated via a central ventilation and exhaust system with a heat recovery system that provides an efficiency level of 90 %.

Thanks to all of these measures, the house's calculated primary energy needs since the conversion now amount to a mere 37.7 kWh/m^2a, thus fulfilling the stringent 'EnEV New Building minus 50 %' renovation standard. This was the precondition for being allowed to take part in dena's 'Low Energy Existing House' competition. Since 2003, dena has surveyed and tested the potential for energy efficient renovation among more than 250 buildings within the framework of these national model projects. In 2007 the initial 'EnEV New Building minus 30 %' renovation standard provided the basis for wide scale incentives via the CO_2 building renovation programme of the KfW Förderbank. Since then, the higher target value has applied to the model projects. In addition to the basic incentives from the CO_2 building renovation programme, participants also receive additional incentive funds.

Location
Breitunger Weg 22
12349 Berlin (Buckow)

Elements
Energy, building materials

Existing structure
Built
1965/1966
Floor space
Main residence 177 m^2
In-law flat 49 m^2
Remodelling
Architecture
Roswag & Jankowski Architekten
Consultancy for utility management
Planungsteam Energie und Bauen
Construction period
2008
Construction costs
220,000 Euros
Builder-owner
Private

Märkisches Viertel

Energy efficient modernisation

Since 2008, more than 13,000 flats in the Märkisches Viertel are being modernised on an energy-efficient basis. This project is currently the largest such conversion project in the German housing industry. What is happening in the north of Berlin serves as a model for the sustainable conversion of large-scale housing estates throughout Germany.

A series of coordinated measures is enhancing energy-efficiency and environmental compatibility in these blocks of flats, which were built in the 1960s and early 1970s. The most important aspect of this project is the installation of new, low-loss conduit and distribution systems for the heating supply along with the installation of new radiators. Many buildings still contain outdated single-conduit systems. These will now be replaced by double-conduit systems. In order to reduce heat losses through the building shell the façades will be fitted with a thermal insulation composite system. The roofs (and/or the ceilings on the upper floors) and the basement ceilings are also being thermally insulated and all windows are being replaced. Depending on the building, these measures can cut heating costs by more than half. Overall, builder-owner GESOBAU AG expects to be able to reduce its CO_2 emissions by 20,000 t annually following the completion of these measures.

In the future, new radio-based and remotely readable censors will precisely gauge heat, warm water and – for the first time – cold water consumption. This will not only permit flat-specific and exact billing but also allows tenants to monitor their own consumption habits.

Since all wall conduits needed to be renewed, the builder-owner also took advantage of this opportunity to completely modernise the bathrooms and to install new, water-saving faucets and appliances. The outdated and unhygienic rubbish chutes were closed and replaced with an environmentally-friendly separation system with modern waste bin facilities. In addition, surfaces in the buildings' access areas were unsealed and transformed into green areas.

New entrance areas were also constructed as part of the modernisation programme. They are thermally insulated and have been glazed accordingly. The guidance and orientation systems have been improved and new intercom and doorbell systems have been installed. Intensive information efforts aimed at the tenants' energy-saving behaviour round off this package of measures. In an effort to cushion encumbrances and stress for the tenants, GESOBAU has initiated a comprehensive help and support network involving a number of social partners. It is particularly aimed at older tenants. This is important since the renovation is occurring in occupied buildings and older people and pregnant women are particularly affected. Tenants with special needs can even be supplied with a substitute flat for their families while their own flats are being renovated.

The project as a whole is particularly innovative in regard to financing. The housing company is taking advantage of the opportunities opened up by the expected drop in operating costs. For example, it can recoup a portion of the modernisation costs via higher rents (not including utilities) without the tenants experiencing a noticeable increase in their overall monthly costs. Overall, this modernisation can occur without increasing expenses for the tenants. In addition, the project takes advantage of low-interest financing from the KfW's residential modernisation and CO_2 building renovation programme. In early 2009 the Senate classified the Märkisches Viertel as the sixth area of the 'Stadtumbau West' programme. In this way, some 13.5 million Euros in subsidies will flow from the state, the Federal Government and the EU into the quarter's renovation by 2013.

The final component of this energy efficient transformation has yet to be decided on.

From the beginning, the Märkisches Viertel has been supplied via a district heating network. Heat is generated in a specially built, natural gas-powered district heating plant from the 1960s. It is operated by a subsidiary of Vattenfall Europe. The energy provider is currently considering a shift to cogenerated heat and power and/or renewable biomass fuel. GESOBAU director Jörg Frenzen says: 'Together with our energy efficient modernisation, the energy supply for the Märkisches Viertel would then be CO_2-neutral.'

Regarding the electricity supply, a decision has already been made. In October 2008 the company extended its contract with Vattenfall, which calls for the GESOBAU flats to be supplied exclusively with green electricity from Scandinavian hydropower plants. According to the housing association, this will result in CO_2 savings of an additional 7,500 t annually.

Location
13435 und 13439 Berlin (Reinickendorf)

Elements
Energy, greenery, waste

Existing structures

Constructed
1963–1974

Urban planning
Werner Düttmann, Georg Heinrichs, Hans Müller

Architecture
Werner Düttmann, Karl Fleig, René Gagès, Ernst Gisel, Georg Heinrichs, Chen Kuen Lee, Ludwig Leo, Hans Müller, Peter Pfankuch, Planungsabteilung DeGeWo, Hansrudolf Plarre, Pysall Stahrenberg & Partner, Stefan Scholz, Heinz Schudnagies, Herbert Stranz, Volker Theißen, Oswald M. Ungers, Werner Weber, Shadrach Woods, Astra Zarina, Jo Zimmermann

Energy efficient modernisation
More than 13,000 flats

Planning
Building division of GESOBAU AG

Pilot project
2007–2008

Construction period
2008–2018

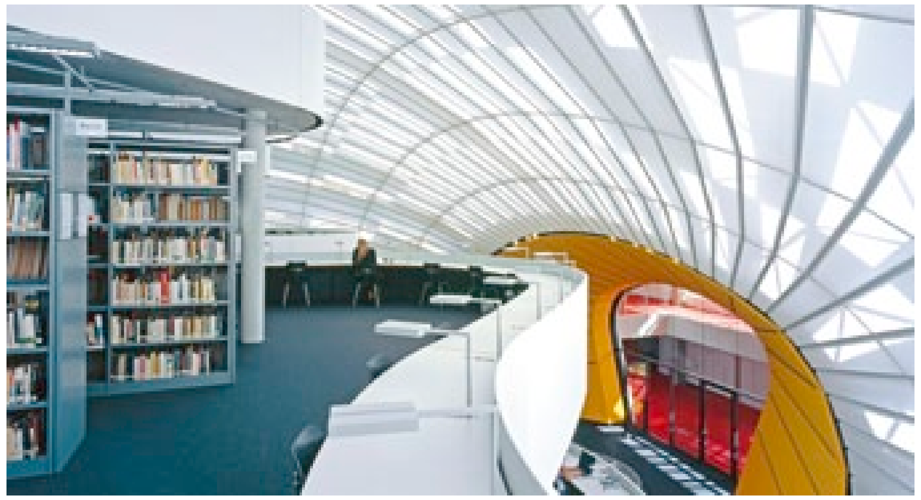
Construction costs
Approx. 440 Millionen Euros

Builder-owner
GESOBAU AG

www.gesobau.de
www.mein-märkisches-viertel.de

Philological Library

Freie Universität Berlin



Even before its grand opening in 2005, the new Philological Library of the Freie Universität Berlin already had an informal name: The Berlin Brain. It not only describes the building's significance, but also the admiration the structure regularly inspires among users and architecture fans alike. Lord Norman Foster provided the blueprints. Although Foster inserted this reference library into the existing architectural structure of the 'Rostlaube', he conceived of it as an autonomous building that would only be linked to the university complex's internal path system on two sides. The drop-shaped structure conforms to the style language of 'blob architecture' and the sustainable principle of creating the largest possible interior space with the least possible external surface.

This edifice is a reinforced concrete structure. Designed like an étagère, five storeys, each smaller than the last, are stacked upward around two supply cores. The bookshelves are arrayed around the cores. Long, flowing galleries form the outer boundaries of each level, whose serpentine design provides space for almost 640 workstations.

A self-supporting, double building shell surrounds the structural skeleton. The outer sphere consists of aluminium panels, ventilation elements and double-glazed windows. A steel frame, geometric radial structure supports the edifice. The inner shell consists of an opaque glass fibre membrane that is interrupted by windows in a few places. This membrane evenly filters and distributes incoming sunlight in the form of reading light.

The double shell is primarily responsible for the building's ecological qualities. Alongside natural lighting, it also optimises weather, heat and sun protection. It also helps the students to keep a cool head. The building skilfully utilises thermal-physical processes in order to keep the interior ventilated: The sun heats up the air between the shell layers. The warm air rises, escapes through a flap system at the apex of the dome and pulls the stale air from the building's interior along with it. This creates a natural circulation process directly powered by the sun. Fresh air rises upwards along two paths: via ground-level ventilation elements in the shell and through ventilation shafts in the elevated false floor, under which outside air is also fed into the library.

The prevailing wind flow at this location is responsible for a second natural ventilation effect. The building is positioned in such a way that, by virtue of the wind pressure alone, fresh air streams into the building via ventilation elements in the shell of the building's west side, exiting again on the east side thanks to the pressure differential. Additional ventilators are only needed on unusually hot and windless days. In wintertime, ventilation occurs through a central heat recovery system.

On cold days the building is heated via concrete panels and cores. Water-bearing rubber hoses inside the concrete building components make it possible to use the walls and floors as a kind of large-scale radiator that stores heat and then distributes it evenly (concrete core activation). The cooling system functions according to the same principle in summertime. Overall, these measures help save 35 % of operating costs compared with a conventional building.

This new building was part of the comprehensive modernisation of the 'Rostlaube' campus complex, during which the rusted Patinax steel façade elements were replaced with more durable bronze panels. During the renovation 6,000 m³ of asbestos-laden material were also removed employing a negative pressure procedure and 10,000 m² of roof surface were redeveloped and extensively greened.

Location
Habelschwerdter Allee 45
14195 Berlin (Dahlem)

Elements
Energy, greenery, waste

Existing structure (Rostlaube)
Constructed
1967–1973
Architecture
Georges Candilis, Alexis Josic, Shadrach Woods, Manfred Schiedhelm

Renovation
Architecture
Lord Norman Foster & Partners
Construction period
1997–2007
Construction costs
Approx. 40.8 million Euros
Builder-owner
City of Berlin, represented by the Senate Department for Urban Development

New building (library)
Architecture
Lord Norman Foster & Partners
Utility management
Schmidt Reuter Partner
pin planende ingenieure
Main floor space
6,290 m²
Construction period
2001–2005
Construction costs
Approx. 18.5 million Euros
Builder-owner
City of Berlin, represented by the Senate Department for Urban Development
Awards
Architecture Prize of the BDA Berlin 2006
German Architecture Prize 2007

www.fu-berlin.de

Free Waldorf School Kreuzberg

Conversion of the former Central Children's Home

Location
Ritterstrasse 69
Alte Jakobstrasse 11–13
10969 Berlin (Kreuzberg)

Elements
Energy, water

Existing structure
Architecture
Max Taut
Fritz Bornemann
Constructed
1966–1969

Conversion
Architecture
Mohr + Winterer Gesellschaft von Architekten mbH
feddersenarchitekten
Utilities managment
Pichler Ingenieure GmbH
Ingenieurbüro Zander
Construction period
2005–2007
Construction costs
Approx. 16 million Euros
Builder-owner
Freie Waldorfschule Kreuzberg e.V.

www.waldorfschule-kreuzberg.de

It was the great architect's last project: In 1963 Max Taut, who was by this time seventy-eight years old, won the competition to build Berlin's new central children's home on the south side of the Friedrichstadt district. However, he died in early 1967 before the start of construction. Fritz Bornemann went on to develop the plans and the centre was opened in 1969. Today, this listed complex consists of a bar-shaped main building along Ritterstrasse, behind which is located a garden with five pavilions.

The children's home was closed in 1974 following riots amongst its residents. The building was later used by various social welfare institutions. Remodelling of the first sections for the Free Waldorf School Kreuzberg began in 2005. This is a comprehensive, public general education school in private ownership.

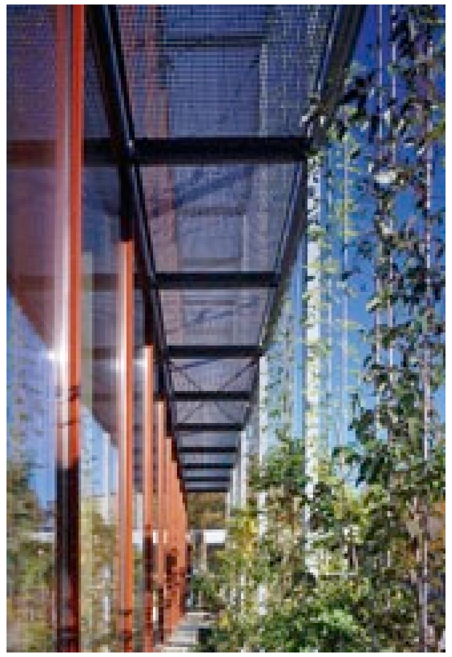
The complex's extended architectural structure, its lack of thermal insulation and utilities that were still on the level of 40 years ago combined to make an energy efficient conversion essential. The Senate has provided around 619,000 Euros from the Umweltentlastungsprogramm (UEP - environmental relief programme) half of which stem from EU funds. The money promoted a series of measures which succeeded in reducing energy consumption to the level of a comparable new building and at the same time to fulfil all the demands of historic preservation.

The entire building shell was comprehensively insulated and the heating systems were modernised in all the building's sections. Energy-saving ventilation technology is used in the classrooms to recover exhaust heat. Rainwater is used to flush toilets and also to irrigate the extensive open spaces.

Overall, these measures have created savings of 272 MWh of primary energy annually. This corresponds to a 55 % reduction of energy consumption and thus also of CO_2 emissions. At the same time, renovation of the existing buildings has provided space to expand the school by another section. Further building measures, including the extension of a new canteen building and internal construction, have been financed by funds from the Berlin Lotto Foundation.

Annedore Leber Elementary School

New canteen and house for day care groups



Since 2006, a canteen building and a house providing rooms for day care groups have complemented the architectural ensemble of the Annedore Leber Elementary School in Lichtenrade. The two new buildings have provided the space needed for an open all-day school. The school complex had previously consisted of the main building from 1955 and several extensions. These included a 'mobile school' inaugurated in 1968. The elementary school shared these rooms with the nearby Theodor Haubach School, a combined secondary general and intermediate secondary school.

The two new buildings carefully complement the school complex's open urban structure and optimise its internal processes as an all-day facility. The single-storey canteen on Halker Zeile provides space for 200 students. A blue-cladded passage with portholes connects it with the school foyer. The detached house for day care groups fills a vacant lot on Grimmstrasse. Both buildings were erected using timber panel construction techniques. The wall, ceiling and roof elements were prefabricated and delivered to the construction site where they were then installed. The closed façade sections of both buildings are covered with fibre cement cladding.

In the canteen a steel structure above the dining hall complements the wooden structure, providing the required stability for the hall's immense height and width. An outside wooden terrace, whose shape is adapted to the location of two old oak trees, opens the building southward onto a tree-filled courtyard previously unused by the students.

The two-story house for day-care groups with its eight classrooms and group rooms is accessed via a building-high stairwell foyer and a gallery. A wall which, for cost and fire protection reasons, was built of exposed concrete, separates the foyer from the class and supervision rooms. This concrete element also makes sense from an eco-architectural point of view: the south side of the foyer, which faces the school courtyard, is glazed over a wide area and is greened by a trellis situated directly in front of it. This allows the new building to make passive use of solar energy. In the wintertime, when the sun is low in the sky, the concrete wall stores heat. In the summertime the climbing vines provide shade and prevent the building from overheating.

The new buildings were financed via the Investitionsprogramm Zukunft, Bildung und Betreuung (IZBB - Investment Programme for the Future, Education and Care). Within the framework of this programme the Federal Ministry for Education and Research has made financial assistance available to the states, allowing them to provide all-day schools with a modern infrastructure. The city of Berlin contributes ten percent to the subsidies granted.

Location
Halker Zeile 147
12305 Berlin (Lichtenrade)

Elements
Energy, water, building materials, greenery

New building
Architecture
Rozynski_Sturm Architekten
Utilities management
Ingenieurbüro eins.a
Gross floor space
House for day care groups 840 m^2
Canteen 402 m^2
Construction period
2005–2006
Construction costs
Approx. 1.35 million Euros
Builder-owner
District Office of Tempelhof-Schöneberg

www.algs.de

'Albert Schweitzer' House of Youth

Energy efficient remodelling

Between the Steglitz city park and the Teltow Canal stands the 'Albert Schweitzer' House of Youth, a youth facility sponsored by the district. The house is a central contact point for children and young people who spend their leisure time here. Group and computer rooms, workshops, sports areas, a kitchen and an event room accomodating 200 persons are available. The one to two-storey flat-roof complex was opened in 1958. A gymnasium was added in 1979. As far as energy efficiency is concerned, post-war buildings such as this one left much to be desired: the complex's energy consumption surpassed the average level for youth centres by 23 %.

In 2005 the ensemble was one of 69 properties included in the 19th pool of Berlin's energy contracting. Contractors Vattenfall Europe Berlin and Siemens Building Technologies thus made a commitment to optimise the energy efficiency of the building's heating facilities.

At the same time, a building energy consultation by Berliner Energieagentur (Berlin energy agency) provided the basis for the building's energy efficient conversion. This project was commissioned by the district and financed by funds from the Umweltentlastungsprogramm (UEP – environmental relief programme). It was completed in June 2008.

The old building's exterior walls and flat roof are now insulated with a 12 cm thick thermal insulation composite system. The old wooden and steel doors were replaced by thermally insulated doors. The original glass brick walls disappeared and were replaced by security and thermal-insulated glazing. The old windows and French doors have made way for energy efficient, higher grade windows. And a paintjob in bright and conspicuous colours sets off the complex's individual sections. With measures like these, the remodelling project has provided the building with a distinctive new look.

The skilful utilisation of the available budget ultimately made it possible to install a local rainwater management system. Now that the district's nature conservation and gardens department has unsealed and redesigned the forecourt and yard surfaces, rainfall can seep directly into the grounds.

Structural thermal insulation has lowered primary energy use by around 112 MWh annually, thus reducing the previous energy needs by more than half. CO_2 emissions have been reduced by around 30 t per year as a result. In conjunction with the contractor's modernisation of the heating system, specific primary energy needs will amount to a mere 16.66 kWh/m²a, which is 35 % below the minimal standards required of new buildings today.

Location
Am Eichgarten 14
12167 Berlin (Steglitz)

Elements
Energy, water, greenery

Existing structure
Constructed
1957–1958, 1979

Renovation
Architecture
Hagemann + Liss
Construction period
2007–2008
Construction costs
Approx. 486,000 Euros
Builder-owner
District Office of Steglitz-Zehlendorf

www.hausderjugend-steglitz.de

Franciscan Monastery, Pankow

Remodelling and extension

What started out as a small project in 1991 has since grown to become a very large presence in the lives of many homeless persons. Hundreds of people come to the soup kitchen of the Franciscan Monastery in Pankow every day. In order to provide them with the care they need, the Order decided to remodel two listed former residential buildings for the mission's headquarters and extend them with a new building for the soup kitchen. 1.35 million Euros and thus half of the construction costs were contributed by Berlin's Umweltentlastungsprogramm (UEP – environmental relief programme). 75 % of these subsidies were co-financed by the EU. The Order financed the rest with its own funds and donations.

The architects and utility management planners consistently worked hand in hand from the design phase onward. This allowed them to develop a coordinated energy and water concept for the complex's sustainable operation. Since the management of the social welfare facilities is entirely financed by donations, the designers were particularly eager to keep operating costs as low as possible. In the end, the wide range of energy-saving measures has ensured that future operating costs will amount to some 15,000 Euros less than would have been the case with a conventional renovation.

The old buildings now undercut the requirements of the EnEV 2007 by around 60 %. This was made possible by thermally insulating the basement floors, roof and exterior walls. So as not to detract from the listed buildings visual qualities, the insulation was only applied to the outside of the firewalls, and in all other cases on the inside. The exteriors of the box-type windows were also preserved. However, the old interior windows were replaced with modern copies using insulating glass. Today the total U value of the double windows in the old buildings is an exemplary 1.1 W/m²K.

The steel and glass façade surrounding the new building on three sides also demonstrates the same U value. Its fourth side is designed as a semicircular brick wall and its roof is extensively greened. This extension was designed in such a way as not to disturb the existing trees. The transparent building rests upon a solid base. The light-flooded main room serves as a dining area. Beneath it are located showers and WCs for men and women, along with additional adjoining rooms.

The central idea behind the energy-technical approach was conversion to natural gas as an energy source. A new 160 kW gas condensing boiler is sufficient to heat the building in normal time. One of the two existing low-temperature boilers has been retained in order to cushion peak demands. It can be activated at short notice. The kitchen appliances and the laundry driers in the wash kitchen have also been converted to natural gas. This has significantly reduced primary energy consumption in the kitchen and hygienic facilities. A thermal solar energy system with 30 m² of collector surface provides a quarter of process water heating. Waste heat from the new cooling unit is also used to heat water.

Efficient lamps, washing and dishwashing machines all reduce electricity consumption. An induction hood in the soup kitchen reduces heating needs for supply air by around 40 %. In the dining hall, temperature and mixed gas sensors monitor air quality. Using this data, it is possible to automatically regulate the ventilation of the large hall with precision and thus save energy. Modern utility management technology ensures that the utility systems function economically and without disruption. In addition, the systems' energy and water consumption is evaluated and optimised using a master computer.

An innovative water concept represents the final ecological component. Water-saving faucets and appliances reduce consumption. Rainwater from the roofs of the old buildings and the monastery is filtered, collected and partially used for laundry purposes. The other portion flows together with the grey water from the hygienic facilities onto a ground filter located on the property. After it has been purified in this way, the water is disinfected with UV, mixed with drinking water and then used to water garden areas and for toilet flushing. The rainwater from the roof of the new building evaporates via its greened surface, and any excess seeps locally.

Location
Wollankstrasse 18–20
13187 Berlin (Pankow)

Elements
Energy, water, building materials, greenery

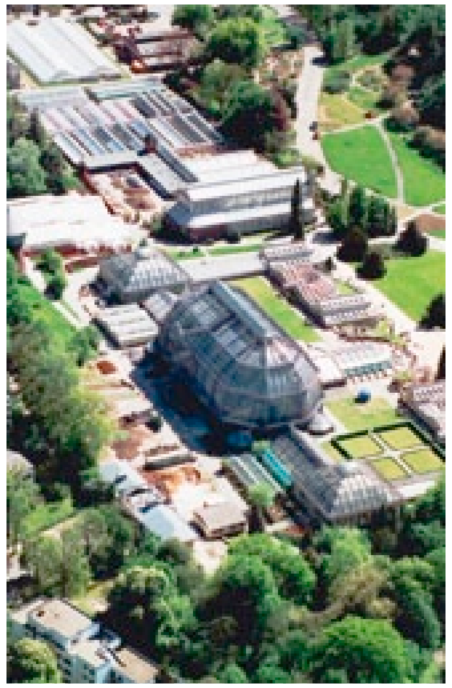
Existing structure
Constructed
1876–1900

Conversion and new building
Architecture
kampmann + partner Architekten
und Ingenieure
Energy and utility management planning
AKUT Umweltschutz Ingenieure
Burkard und Partner
Floor space
Approx. 1,800 m²
Construction period
2003–2004
Construction costs
Approx. 2.8 million Euros
Builder-owner
Provinzialrat der sächsischen Franziskanerprovinz vom Heiligen Kreuz e. V.
Award
KlimaSchutzPartner 2007

www.franziskanerkloster-pankow.de

Fundamental reconstruction of the Main Tropical Greenhouse

Botanic Garden Berlin



When the Main Tropical Greenhouse was opened at the Botanic Garden in 1907, it was regarded as a technological masterpiece. Giant steel arches, in which the glass shell was hung, spanned a space, uninterrupted by columns, with a volume of almost 40,000 m^3. It remains one of the largest freestanding greenhouses in the world today. Beneath its deep plant beds, the royal architect, Alfred Körner, ordered the construction of a cellar from which the building was heated. The system included three circular pipelines in the glass roof.

The building's skeleton survived the Second World War almost undamaged. However, shockwaves from nearby bomb blasts shattered nearly all the panes of glass. During the building's reconstruction in the 1960s, the glass was replaced with acrylic glass. It allowed in more UV light, it was lighter and could be used in larger sections. However, this decision made a fundamental reconstruction necessary forty years later when hairline cracks were discovered across the non-durable acrylic, reducing light penetration. Large cracks and weathered seals allowed valuable heat to escape.

When the greenhouse opened its doors for the third time in the summer of 2009, this was not the only problem which has been resolved. An innovative heating and air conditioning system combined with a newly-constructed outer skin and modern building service technologies bring energy savings of up to 50 %. Energy costs have been reduced by around 100,000 Euros annually. Water costs will also drop since the tropical plants are primarily being watered using rainwater.

The building is heated with district heating. Heat is distributed throughout the space via three combined systems: a floor, façade and air heating system. A central component of this heating system is formed by seven climate ventilation devices in the catacombs beneath the hall. A considerably less efficient air circulation system had been installed during reconstruction in the 1960s. The new system draws cooled air from the greenhouse and blows the reheated air back inside. In this way, the ventilators also function as sorption devices: 5,5 t of quartz sand granules allow the system to trap the water in the air (adsorb) or release it (desorb). In coordination with a completely renewed humidification system, this enables a precise management of the air humidity. The heat energy released in the adsorption process is then used for heating.

Two 16 m high towers optimise air recirculation in the hall. On the outside they are disguised as rain forest trees. On the inside, giant propellers draw the warm air from above and blow it back down into the building. The most innovative aspect of these pipes are their latent heat storage systems. The in-coming air flows through a honeycomb structure made of Phase Change Material (PCM). This high tech material can store heat during the day and then selectively release it during the night when heating is needed. The PCM storage units have two benefits: they require considerably less space than a hot water storage system and they do not heat up themselves, due to the fact that they do not store energy in the form of heat. Instead, they utilise enthalpy, i.e. the transition from a solid to a liquid state. This storage system obeys a physical principle similar to that used on a smaller scale in rechargeable hand-warming pillows.

The building shell was completely reconstructed. First, the steel framework was sandblasted and resealed. Then a new grid was assembled out of 436 ladder-like façade elements. Its rods are hollow on the inside. In this way, the entire network serves as a giant radiator. It is divided into 26 different heating circuits that radiate heat into the interior and are thermally separated from the exterior. This ensures an even and low-loss distribution of heat, which prevents condensation and fogged glass. The close-meshed rungs also fulfil historical preservation requirements by once more returning the glass façade's overall look to the structure's original appearance.

A novel thermal insulation glazing system replaces the acrylic panes, reduces the thermal transmittance value by three quarters and improves growth conditions for the light-hungry tropical plants. The insulated glass in use here is particularly low in iron oxide and is covered with an anti-reflection film. This increases its UV transparency. A completely new intermediate material is used in the laminated sheet glass (LSG). Polyvinyl butyral (PVB) is normally used as an LSG foil in order to prevent glass fragments from falling in case of damage. However, PVB allows nearly no UV light to penetrate. The new, internationally unique construction used here has not yet been approved by the building authorities and could only be realised thanks to special permission from the state's supreme building authority.

The costs for the total project amount to around 16 million Euros. 8.38 million, i.e. more than half, come from Berlin's Umweltentlastungsprogramm (UEP – environmental relief programme). The remainder of the financing comes from the Federal Government's university building programme, Stiftung Deutsche Klassenlotterie Berlin, the Freie Unviersität Berlin as the builder-owner and the Botanic Garden itself.

Location
Königin-Luise-Strasse 6–8
14195 Berlin (Steglitz)

Elements
Energy, water, building materials, greenery

Existing structure
Constructed
1905–1907
Architecture
Alfred Körner
Floor space
Approx. 1,750 m^2

Fundamental reconstruction
Architecture
Haas Architekten
Engineering
CRP Ingenieurgesellschaft
Dittrich VBI
Herbert Fink GmbH
Project supervision/coordination
Technical Department, FU Berlin
Construction period
2006–2009
Construction costs
Approx. 16 Millionen Euro
Builder-owner
Freie Universität Berlin

www.bgbm.org

Putting it to the test

Checklists for ecological building

The regulations in place for public buildings in Berlin can be summarised in the form of lists of questions that can help private builder-owners to evaluate their projects in terms of sustainability and ecological building. Based on the life cycle approach, these questions are listed according to the respective planning phase. The column on the left indicates the applicable elements. These lists can be used as a preliminary and general orientation for almost any building project. However, they are no substitute for a comprehensive and coordinated ecological concept.

Project conception and urban planning

- Has a surface-minimising, need-driven spatial programme been prepared?
- Can the planned use and the necessary spatial needs be realised in existing buildings, which can be reused, remodelled or expanded?
- If a new building is necessary, does it utilise developed building space?
- Will the new building project lead to a net unsealing of surfaces?
- Does the choice of location obey the principle of internal development or must previously undeveloped areas be opened to development?
- Does the new building integrate existing building components?
- Does the orientation and arrangement of the structure take account of existing vegetation, natural spaces and habitats?
- Does the building project link existing natural spaces – e.g., by creating stepping stones for plants and animals?
- Does the planning pay heed to characteristic landscape elements at the location?
- Have climate conditions at the location been taken into consideration?
- Does the arrangement of the building take into account issues of lighting, sunlight and shading – depending on the trees and buildings present at the location?
- Does the positioning of buildings take into consideration the emissions situation at the location – e.g., by shielding sensitive areas from heavily travelled traffic routes?
- What impact will the project have on the urban climate? For example, will fresh air corridors be restricted?
- What impact will the future building emissions have on the air?
- Is past pollution present at the location, either in the existing building sections or in the soil, which will be removed in the course of the project?
- Does the location take advantage of existing infrastructure provision? Are connections for the technical infrastructure in place or firmly planned?
- Is the location near connections to the public transportation network so that individual motorised transportation can be minimised?
- Is an ecological master plan being developed for the project?

Building and open space planning

- Is the building's geometry optimised, is the structure as compact as possible?
- Are ceiling heights designed economically?
- Does the architecture ensure a measure of natural light and ventilation adequate for the intended use?
- Are room depth and windows designed in an optimal ratio?
- Does the architecture avoid internal (windowless) rooms?
- Does it obey the principle of compact, space and surface-saving construction?
- How has the structure been designed and located in regard to wind effects?
- Does the building's position and design permit passive solar energy use?
- Is overheating in the summer avoided by the structure's positioning and/or through sunblinds?
- Have basement storeys and the utility management, energy efficiency and construction expenses they entail been avoided – to the extent that use, technical demands and sealing requirements permit?
- Have all means of building planning been exhausted in order to render air conditioning and cooling systems powered by external energy supplies superfluous?
- Has thermal insulation been optimised to minimise energy losses? Are structures and materials with low heat conductivity being utilised for the external skin, namely for roofs, walls and glass surfaces?
- Are the storage capabilities of the building components being utilised for targeted heating and cooling management?
- Have heat bridges been avoided as much as possible?
- Does the structure permit a long period of use?
- Does it allow for future reuse?
- Do construction materials derived from renewable raw materials take priority?
- Have you given priority to construction materials that can be used without costly energy-intensive manufacturing and refinement processes?
- Have you given priority to regionally available construction materials?
- Are low-polluting and durable construction materials being used?
- Can the building's surfaces and rooms be cleaned and maintained at low expense?
- Can the construction materials in use be renewed at low expense?
- Are pollutants being removed from existing buildings as they are expanded or converted?
- Will soil pollution in available areas be disposed of during the course of new building?
- Can building components and construction materials be reused later?
- Does the project avoid the use of indissoluble composite materials and processing methods?
- Is a project-specific waste disposal concept in place?
- Are separation systems planned for waste disposable, e.g. appropriate waste bin sites in the courtyard or in special interior rooms?
- Is the property suitable for the on-site composting of biodegradable waste products?
- Is excavation spoil being used for on-site landscaping?
- Are roofs and/or façades being greened?
- Has the necessary care work been optimised?
- Has façade greening been prepared through appropriately designed vertical load capacity, surface conditions and/or scaffolding and trellises?
- Are hedges and bushes (rather than walls) being used to structure outdoor spaces?
- Is existing vegetation being included in green space design?
- Is the selection of plants appropriate to the location?
- Has priority been given to the planting of native shrubs and bushes?
- Are external protection measures for wild animals in place – e.g. nesting opportunities for building nesters?
- Have you given priority to greened or water-permeable coverings for external and road surfaces?
- Are ponds and wetlands planned?
- Is there a project-specific open area and greening concept?
- Will the groundwater and soil remain protected during the construction, operation and later dismantling?
- Have all possibilities been exhausted to increase the share of clean rainwater that can naturally return to the water cycle through seepage or evaporation?
- Is the targeted drainage of rainwater into the separate sewage system guaranteed?
- Is the noise protection, both internal and external, guaranteed?
- Will a favourable gross floor space to usable floor space ratio be achieved?

Planning technical building equipment

- Will high-efficiency energy supply systems be used?
- Is a need-driven heat recovery system planned?
- Can the rooms be freely and naturally ventilated – to the extent that this is not prohibited by regulations or major energy savings?
- Will at least a portion of energy needs be covered by regenerative energies, e.g. by solarthermal or photovoltaic systems?
- Has the cost-effectiveness of such systems been checked?
- Will electricity and heating be at least partially supplied by cogeneration plants?
- Has illumination with sunlight been given priority in the inner rooms?
- Are high-efficiency lamps being used?
- Are daytime and presence-dependent lighting control systems planned?
- Are energy losses being minimised by the use of new and energy-efficient systems and appliances?
- Do the supply lines avoid the root zones of existing trees and bushes?
- Have you chosen water-saving faucets and – if pre-installed – water-saving household appliances?
- Is rainwater being given priority in the irrigation of green and garden areas?
- Can rainwater reach the surfaces to be irrigated via natural inclines, i.e. without pumps or lifting systems?
- Are temporary storage basins planned for rainwater, e.g. in the form of ponds, wetlands or cisterns?
- Where drinking water quality is not essential, has substitution with service water from rainwater or grey water recycling systems been examined?
- Have the size and extent of technical areas been restricted on a need-driven basis and their locations optimised?

Execution

- Have building site logistics been optimised?
- Are construction materials and products being stored on the building site in a protected manner?
- Are construction materials and components being prepared and cut on a need-driven basis and with limited wastage?
- Are reusable and large-scale containers with a low packaging content being used to deliver construction materials?

Legal foundations

The most important laws, regulations and guidelines pertaining to the individual elements of ecological building in Berlin are cited here along with their acronyms. EU directives that only attain legal authority after being implemented in the form of federal laws have been included for the sake of completeness.

Current versions are available on line:

- Federal laws under www.gesetze-im-internet.de
- Regulations of the city of Berlin in the areas of building, green spaces and vegetation, and nature at www.stadtentwicklung.berlin.de → Service → Rechtsvorschriften
- Regulations of the city of Berlin in the areas of water, waste and soil conservation at www.berlin.de/sen/umwelt/ → Rechtsvorschriften

EU

2002/91/EC – Energy Performance of Buildings Directive
2004/8/EC – Promotion of Cogeneration Directive
2005/32/EC – Ecodesign requirements for energy-using products
2000/60/EC – Water Framework Directive (WFD)
89/106/EEC – Construction Products Directive
2008/98/EG – Waste Framework Directive

Germany

Energieeinsparungsgesetz (EnEG – Energy Savings Act)
Energieeinsparverordnung (EnEV – Regulation on Energy Saving)
Erneuerbare-Energien-Gesetz (EEG – Renewable Energy Act)
Erneuerbare-Energien-Wärme-Gesetz (EEWärmeG – Renewable Energy Heating Act)
Kraft-Wärme-Kopplungs-Gesetz (KWKG – Cogeneration Act)
Wasserhaushaltsgesetz (WHG – Federal Water Act)
Abwasserverordnung (AbwV – Waste Water Ordinance)
Trinkwasserverordnung (TrinkwV – Drinking Water Ordinance)
Bauproduktegesetz (BauPG – Construction Products Act)
Bundesnaturschutzgesetz (BNatschG – Federal Nature Conservation Act)
Bundes-Bodenschutzgesetz (BBodSchG – Federal Soil Conservation Act)
Kreislaufwirtschaft- und Abfallgesetz (KrW-/AbfG – Closed Substance Cycle Waste Management Act)
Nachweisverordnung (NachwV – Ordinance on Waste Recovery and Disposal)
Transportgenehmigungsverordnung (TgV – Ordinance on Transport Licenses)
Entsorgungsfachbetriebeverordnung (EfbV – Ordinance on Specialised Waste Management Companies)
Abfallverzeichnis-Verordnung (AVV – Ordinance on the European Waste Catalogue)
Verpackungsverordnung (VerpackV – German Packaging Regulation)

Berlin

Berliner Energiespargesetz (BEnSparG – Berlin Energy Saving Act)
Verordnung zur Durchführung der Energieeinsparverordnung in Berlin (EnEV-DVO Bln – Ordinance on the Implementation of the Energy Saving Act in Berlin)
Berliner Wassergesetz (BWG – Berlin Water Act)
Niederschlagswasserfreistellungsverordnung (NWFreiV – Rainwater Exemption Ordinance)
Indirekteinleiterverordnung (IndV – Ordinance on Indirect Dischargers)
Richtlinie über Grundwasserförderungen bei Baumaßnahmen und Eigenwasserversorgungsanlagen im Land Berlin (Directive on Groundwater Extraction during Building Measures and Independent Water Supply Facilities in Berlin)
Waserrahmenrichtlinie-Umsetzungs-Verordnung (WRRLUmV – Water Framework Directive Implementation Ordinance)
Verordnung über Anlagen zum Umgang mit wassergefährdenden Stoffen und über Fachbetriebe (VawS – Directive for Facilities Handling Water-Endangering Substances and Certified Companies)
Bauordnung für Berlin (BauO Bln – Berlin Building Code)
Bauprodukte- und Bauarten-Verordnung (BauPAVO – Construction Products and Construction Types Ordinance)
Berliner Grünanlagengesetz (GrünanlG – Berlin Park Act)
Baumschutzverordnung (BaumSchVO –Tree Protection Ordinance)
Berliner Bodenschutzgesetz (Bln BodSchG – Berlin Soil Conservation Act)
Kreislaufwirtschafts- und Abfallgesetz Berlin (KrW-/AbfG Bln – Closed Substance Cycle Waste Management Act)
Bekanntmachung zur Drittbeauftragung von Bauabfallentsorgungsanlagen zur Entsorgung von nicht gefährlichen Bauabfällen zur Beseitigung (Announcement of Third-Party Commissioning of Construction Waste Disposal Facilities for the Disposal of Non-Hazardous Construction Waste)
Entgeltordnung für die Entsorgung von nicht gefährlichen Bauabfällen zur Beseitigung durch Drittbeauftragte (Fee Schedule for the Disposal of Non-Hazardous Construction Waste for Elimination by Commissioned Third Parties)
Sonderabfallentsorgungsverordnung (SoAbfEV – Hazardous Waste Disposal Ordinance)

Support programmes

The EU, the German Federal Government and the city of Berlin are subsidising ecological building through a number of programmes. In the area of energy alone, there are some 900 support programmes for private, public and commercial builder-owners. An overview is available from the Federal Ministry of Economics and Technology at www.foerderdatenbank.de and the Federal Ministry for Environment, Nature Conservation and Nuclear Safety at www.bmu.de.

Most programme funds are being administered by the KfW Bank Group (e.g. the funds from the CO_2 building renovation programme, the 'Ecological Building' programme and the 'Generate Solar Power' programme). As a rule, they must be applied for through the applicant's bank. This bank is thus the first contact point for interested builder-owners.

Support by the IBB
The Investitionsbank Berlin (IBB) is the central development bank for Berlin. It is currently supporting energy efficient building renovation via an additional interest reduction on the already low-interest loans from the federal CO_2 building renovation programme.

The owners of rental buildings completed before 1984 and containing at least three flats can additionally receive a one-time construction costs subsidy for construction measures through the IBB for the improvement of outer-wall insulation. This subsidy amounts to 30 Euros per square metre of insulated surface. In order to receive these funds, the construction measure must be combined with the qualification and employment of unemployed persons in the construction industry. The Senate provides around 3 million Euros annually for the Qualification and Employment Promotion Programme (QUAB). The IBB supervises the application procedure in cooperation with KEBAB gGmbH. Information on IBB support funds is available at www.ibb.de

Umweltentlastungsprogramm
(UEP – Environmental Relief Programme)
The Berlin Environmental Relief Programme is being continued from 2008 to 2013. Building on UEP I, which was completed in 2007, the Senate has launched UEP II within the framework of the EU structural funds. It supports a wide range of activities to relieve Berlin's environment. It places particular emphasis on the link between conservation and technical innovation and on issues of climate protection. Above all, the support is intended to benefit public and non-profit institutions. However, even private companies can receive subsidies of up to 50 % of their project costs. What is decisive for the level of funding is the environmental relief targeted and the value of the project for Berlin's sustainable development. The Berlin Senate has commissioned B.&S.U. Beratungs- und Service-Gesellschaft Umwelt mbH as the programme's management agency. Information is available at www.uep-berlin.de

Orientation guides

The principles developed by the Senate regarding public building in Berlin and the documentation of the results from ecological model projects provide useful references for all builder-owners who are striving for sustainable solutions. The information is available in PDF form at the website of the Senate Department for Urban Development: www.stadtentwicklung.berlin.de.

in English:
- Ecological Construction – Requirements for Construction Projects (Guidelines), 2007
- Ecological Criteria for Construction Projects/Competitions, as of July 2006

in German:
- Leitfaden für Wirtschaftlichkeitsuntersuchungen (Guideline for cost-effectiveness studies), 2007
- Rundschreiben BauWohnV VI Nr. 19/1998 'Verwendungsverbote und Verwendungsbeschränkungen von Baustoffen' (use bans and use restrictions on construction materials)
- Rundschreiben SenStadt VI A Nr. 14/2004, 9 June 2004 'Verwendungsverbote und Verwendungsbeschränkungen von Baustoffen' (use bans and use restrictions on construction materials)
- Rundschreiben SenStadt VI C Nr.1/ 2003 'Grundsätze für die Betriebswassernutzung' (principles of service water use)
- Maßnahmenkatalog zur Reduzierung der Wasserkosten im öffentlichen Bereich (catalogue of measures to reduce water costs in public areas)

Additional information (in English)

www.bmvbs.de
The Federal Ministry of Transport, Building and Urban Development provides detailed information on the energy certificate on its website under → Building → Climate change and energy efficiency.

www.dibt.de
In an effort to ensure the uniform application of the EnEV, the special commission on 'building technology' has established a task force. This group answers all questions of general interest raised in the states and publishes the approved interpretations on the website of the German Institute for Building Technology under → What's new → Energy Conservation Regulation (Website in English, PDF-documents in German only!)

www.dena.de
Information on the EnEV is available from the German Energy Agency (dena).

www.erneuerbare-energien.de
This website operated by the Federal Ministry for Environment, Nature Conservation and Nuclear Safety provides basic information on renewable energy sources.

www.bine.info
This extensive website sponsored by the information service of the FIZ Karlsruhe provides thematic material and project sheets.

Senatsverwaltung
für Stadtentwicklung

Publisher
Senate Department for Urban Development
www.stadtentwicklung.berlin.de

Content and preparation
Senate Department for Urban Development
Directorate VI – Ministerial Building Affairs
Ecological Building, VI B1

Editing
Louis Back
www.louisback.com

Picture research
Jörg Küster

Layout
Fürcho GmbH
www.fuercho-gmbh.de

Printing
Sauer Druck & Werbung

Price EUR 5.00

Berlin, December 2009

Cover photo:
Louis Back

Interior photos and illustrations:

Page 3	Archiv SenStadt
Page 4	Björn Laczay / Wikicommons
Page 5	Louis Back
Page 6	HOWOGE/Peter Oehlmann (left), WBG Marzahn/Klaus Dombrowsky (right)
Page 7	Louis Back
Page 8	clockwise: Przykuta/Wikicommons; Archiv SenStadt; Pavel Losevsky/fotolia; Luke Roberts/Wikicommons; Endostock/fotolia; Bausparkasse Schwäbisch Hall AG/F. Thomas; Wolfgang Jargstorff/fotolia; Lekcets/fotolia
Page 9	Louis Back (3), Mattbuck/Wikicommons (bottom)
Page 10	Vattenfall Europe (left), DB AG/Paul Langrock (middle), GESOBAU AG (right)
Page 11	SenStadt/Umweltatlas Berlin
Page 12/13	Louis Back
Page 14	Holzabsatzfonds/Bernd Borchardt (left), Tarja/Wikicommons (right)
Page 15	Archiv SenStadt (top), isofloc Wärmedämmtechnik (left), Louis Back (right)
Page 16	Jörg Küster (left); Erik Jan Ouwerkerk (right)
Page 17	Louis Back
Page 18	Armin Kübelbeck/Wikicommons (left), Louis Back (right)
Page 19	Archiv SenStadt
Pages 20/21	left to right: FBH/schurian.com; Günther Ludewig/sol•id•ar Architekten und Ingenieure; Roswag & Jankowski Architekten; Freie Universität Berlin/Philipp von Recklinghausen; Werner Huthmacher; Christian Gahl; SOLON/Norbert Michalke; Louis Back; GESOBAU AG/Klaus Dombrowsky; Jörg Küster;Peter Schrage-Aden; Haas Architekten
Page 21	Archiv SenStadt (bottom)
Page 22	FBH/schurian.com
Page 23	Wiedel/WISTA MG (top), Helmholtz-Zentrum Berlin für Materialien und Energie (bottom)
Page 24/25	SOLON/Norbert Michalke
Page 26/27	Günther Ludewig/sol•id•ar Architekten und Ingenieure
Page 28	Louis Back
Page 29	planbar3 (top), Louis Back (2)
Page 30/31	Roswag & Jankowski Architekten
Page 32	GESOBAU AG/Klaus Dombrowsky
Page 33	GESOBAU AG
Page 34	Freie Universität Berlin/Philipp von Recklinghausen
Page 35	Freie Universität Berlin/Reinhard Görner (top); Freie Universität Berlin/Technische Abteilung (bottom)
Page 36	Jörg Küster (2); Freie Waldorfschule Kreuzberg (bottom)
Page 37	Werner Huthmacher
Page 38	Peter Schrage-Aden
Page 39	Hagemann + Liss Architekten
Page 40/41	Christian Gahl
Page 42	Haas Architekten
Page 43	Freie Universität Berlin (left); Freie Universität Berlin/Ingo Haas (right)

Berlin

Senatsverwaltung
für Stadtentwicklung