

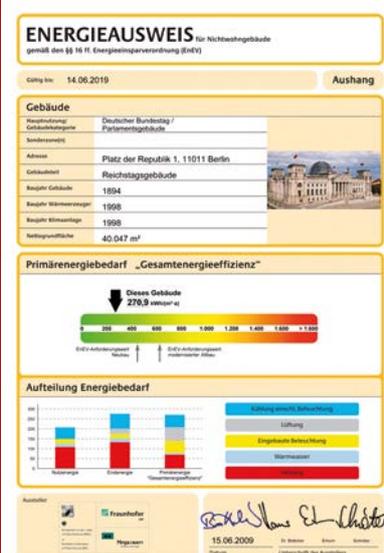
HEAT TECHNOLOGY



OUR MISSION

IN COLLABORATION WITH OUR VISIONARY PARTNERS FROM
INDUSTRY AND PUBLIC INSTITUTIONS,
WE DEVELOP FOSSIL ENERGY-FREE BUILDINGS AND COMPLEXES
OF PREMIUM AMBIENCE.





RESEARCH, DEVELOPMENT AND DEMONSTRATION FROM THESE WORKING GROUPS

- ENERGY CONCEPTS
- BUILDING SYSTEMS
- LIGHTING TECHNOLOGY
- PLANNING INSTRUMENTS

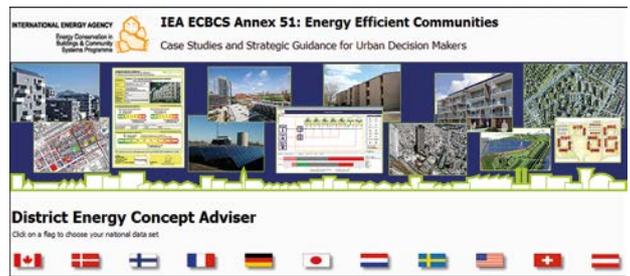
The Department of Heat Technology conducts research and development in the area of energy-efficient buildings and construction for home living and the workplace. Our scientists develop, supervise and evaluate nearly-zero energy, zero-emission and energy-surplus buildings. These developments incorporate all energy-related technologies pertaining to construction, heating, cooling, ventilation, air conditioning, lighting and materials-handling technology. In addition, the department creates energy-efficient concepts with a range of applications, from small communities to entire cities. The researchers elaborate energy-efficient retrofitting concepts for existing buildings and transform them into feasible construction solutions. Furthermore, the department deals with issues in urban climatology, avoiding so-called “heat islands” within densely developed building topologies, and the adequacy of daylight and fresh air supply in the urban street canyons, as well as street lighting.

For these purposes, the working groups primarily develop and research building systems and façade systems, as well as heating, ventilation, cooling, lighting, solar, hybrid, storage and energy supply systems. The department additionally prepares system analyses of buildings and heat supply systems, and analyzes and evaluates energy potential in new constructions and in existing buildings. The focus also extends to air flows in

spaces and large halls, and temperature patterns in buildings during the summer. Last but not least, as part of its energy retrofitting projects, the department also deals with studies predicting the risk of mold growth in renovated buildings.

The department’s scientists develop software tools to simulate and evaluate the lighting situation in buildings. They also generate innovative lighting system solutions for interior and exterior spaces, and provide consultations and assessment reports. The department has a diversity of singular light engineering measurement and testing facilities.

The team in the heat technology department creates and maintains computer-assisted planning instruments and information systems for end users, and develops calculation routines (“kernels”) used by software companies. The heat technology department also coordinates national and international demonstration and standardization projects as well as guideline committees. Its employees design and supervise national and international studies and transfer projects for the International Energy Agency (IEA), the European Union (EU), for the German government, the German *Länder* and communities as well as industry. Continuing education seminars round out the portfolio.



ENERGY CONCEPTS WORKING GROUP

More than 40 percent of energy consumption in Germany and Europe is caused by buildings. Innovations in current construction and systems engineering allow for building concepts to be realized that feature a nearly-zero energy demand, and that may even produce an energy surplus. The buildings of the future could become micro power plants. As this trend evolves, special attention should be paid to the building conglomerations in urban settlements and city sectors, in order to facilitate an economically feasible utilization of surpluses in heating, cold and power. The working group develops, supervises and evaluates energy concepts for high-efficiency individual buildings and settlements by private and public developers, prefabricated building manufacturers, systems manufacturers and energy providers.

Building concepts

In collaboration with architects and possibly with other parties involved in planning, the working group conceives energy concepts for trend-setting buildings, in both residential and non-residential sectors. In doing so, they prepare in-depth concepts and measures involving such criteria as primary energy demand, investment costs and economic feasibility.

Settlement concepts

Whether an individual development or an entire city sector, a new district or a redesigned district: the energy consumption of the total space can be optimized by individual concepts – both for new construction and for redevelopment of existing settlements. In this respect, consideration is given both to district and local heating concepts, waste heat utilization and in particular the use of domestic and renewable energy sources.

Strategic studies and systems analyses

Researchers are conducting studies on the reduction of energy consumption in the buildings sector – for developers, housing associations, prefabricated building manufacturers, and entire cities, *Länder* and federal ministries of German government and the EU Commission. In doing so, they analyze the specific energy conditions to highlight possible optimization potential. Among other things, the Energy Concepts group develops energy efficiency specifications for cities that extend beyond the national energy requirements.

International projects

The working group acts as coordinator or as the German representative in various international projects. The projects primarily focus on energy-efficient construction in Europe and all over the world, and comprise both demonstration projects, energy assessment of buildings, and the exchange of knowledge with other countries.

Software development

The Energy Concepts group develops software tools to evaluate various energy concepts of individual buildings and city districts. The tools can be tailored to decision makers and expert-level staff alike. Besides applications for the German market, the group also develops international software.

Selected projects

- EnEff:Stadt: Support research project on the German Government's research focus, "Energy-Efficient Communities"
- Research accompanying the BMVBS funding programme "Efficiency House Plus"
- Comparison of net zero energy concepts for a commercial building
- SEE: Energy balance and energy roadmap for state capital Stuttgart
- EnerKey: Energy efficiency concept for megacity region Gauteng, South Africa
- Concerted Action: EU 27 Cooperative and Information Exchange Project on EU Energy Performance Building Directive Issues
- School of the Future: EU Demonstration Project
- Energy Surplus School, Stuttgart
- Software tool "District Energy Concept Adviser"
- IT Toolkit: Assessment tools for energy-efficient public and government buildings
- BUILD UP: EU information platform for energy efficiency in buildings



BUILDING SYSTEMS WORKING GROUP

The Building Systems working group essentially focuses on increasing the energy efficiency of existing building structures. This objective depends both on the building as well as the systems and regulation technology installed – and on building users themselves. The focal points of the working group's work are validation measurements, in addition to consulting and demonstrations. They also focus on quality control systems, without which planning for high-efficiency buildings should not be carried out. By applying the methods and tools that failure analysis offers, both planner and developer can avoid the causes and pitfalls of undesirable developments.

Consulting and training

A building is a product with a comparatively long lifespan. Design flaws in their planning are frequently irreparable. With the right computer programs that the working group provides, the building and systems concept can be properly crafted and assessed. With the aid of a multidimensional heat flux tool the thermal bridges in the building envelope are minimized. By calculating and evaluating the air flow in large halls and atria in the planning phase, designers can predict undesirable air flows, and thus prevent these from occurring. Since the air tightness of buildings is gaining increasing significance, the working group also creates air tightness design concepts.

Demonstrations

Investors must be bold if they want to forge new paths in the construction of new buildings and the renovation of existing ones. Building and systems planners tend to prefer relying on the familiar, tried and true. Prototype buildings illustrate new solutions; they germinate into energy-saving building technology. They demonstrate feasibility, and inspire emulation. The working group develops and executes demonstration projects with a specific objective: to integrate the collaborative input of the general contractor, the architect and planners.

Validation measurements

Even buildings and systems concepts that were well-conceived at the planning stage may yield results other than the preliminary cost estimate would lead one to expect: for instance, if users, building construction and service systems technology do not interact as they should. Through a validation measurement – which also incorporates indoor-air temperatures, air volume flows, etc. in addition to energy consumption – the causes come to light.

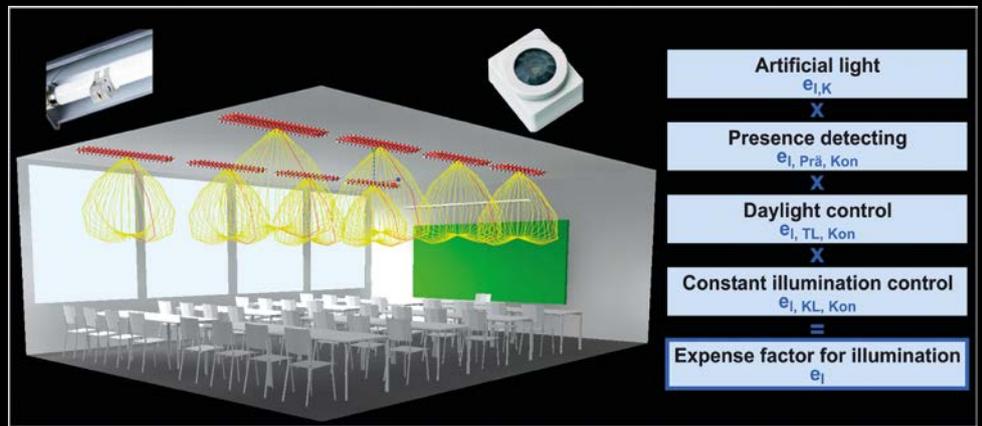
Quality assurance and damage analysis

When preparing buildings with a high standard of energy efficiency, quality assurance becomes indispensable. Even during the building construction phase, it is possible to measure the air tightness of the building shell by means

of blower door measurement, locating any leakage sites. Thermography is used to assess the seamless insulation of the building envelope components. The working group has a diversity of diagnostic options at its disposal.

Selected projects

- EnEff:Schule: Support research project on the German Government's research focus, "Energy-Efficient Schools"
- Development of a school building in Memmingen according to energy efficiency standard "KfW 55"
- Energy-optimized construction: Low-energy retrofitting of Kunsthalle Mannheim
- CO₂-neutral energy supply of a renovated residential complex in Munich
- German Museum of Technology in Berlin as low-energy building with optimal daylight measurement program and validation
- Model renovation of a retirement nursing home in Stuttgart: measurement program and validation
- Investigation of the causes for the excessive heat consumption and thermal discomfort in the manufacturing hall of an industrial building



LIGHTING TECHNOLOGY WORKING GROUP

The human being perceives approximately 80 to 90 percent of information visually. Great significance is assigned to the configuration and planning of the visual environment that suits this requirement. At the same time, lighting engineering solutions are gaining primacy in energy efficiency. With approximately 10 percent total electricity consumption in Europe used for lighting purposes, efficient lighting solutions can make a substantial contribution to conservative resource utilization and achieving the goals of climate policy. Against this background, the Lighting Technology working group develops projects for the general lighting needs of buildings and for street lighting. In this respect, the focus is placed on evaluation methods and software development, technology development, validation studies, consulting and in knowledge transfer – as well as in the area of measurement and testing.

Software and evaluation methods development

The development of diverse tools for specialists and practitioners: numerical simulation procedures for calculation of natural and artificial lighting conditions in buildings, particularly for façade lighting evaluation and for energy evaluation of lighting solutions.

Simplified evaluation and optimization procedures in the area of low-energy retrofitting of lighting systems.

Technology development

Development of technical solutions to increase the energy efficiency of lighting systems, and for providing comfortable and performance-boosting visual environments. Development of new light management procedures. Design and development of light engineering measurement and test facilities.

Validation studies

The complex fenestration systems have a manifold effect on the artificial lighting needs of indoor spaces. Frequently, the automatic control systems currently available are capable of utilizing the good daylight supply only to a limited extent – both in terms of energy and light – through façade systems that are improved by light technology. The validation and optimization of industrial developments is thus a work focus of the Lighting Technology working group.

Consulting and knowledge transfer

Consultations and expert opinions on natural and artificial lighting conditions in buildings, in particular on the design and configuration of façades as well as the coordination of light technology with other technical disciplines in integrated planning approaches.

Measurement and testing

The following measurement facilities – to some extent one-of-a-kind – are available for evaluating the light conditions in buildings and the light technology of façades and street lighting:

Evaluation and testing of daylight and artificial light scenarios:

- model studies in artificial sky
- model studies in artificial sun

Rating the light technology of façades:

- directionally resolved and integrated light transmission and reflection with goniophotometer
- VERU: Test facility for façade systems in building conglomeration
- outdoor testing facilities

Evaluation of street lighting systems:

- in situ determination of surface key indicators using street reflectometry
- assessment of street lighting (per DIN EN 13201)
- test environment for demand-responsive (adaptive) LED lighting systems

Selected projects:

- Operating Agent of IEA Annex 50: Advanced Lighting Solutions for Retrofitting Buildings
- Optimization of ergonomic and energy-efficient new lighting systems
- Demand-responsive, zonal and daylight-dependent lighting systems
- Photometric characteristics of road surfaces

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PLANNING INSTRUMENTS WORKING GROUP

In the field of energy and light technology evaluation of buildings and settlements, great demand for computer tools has arisen due to energy efficiency requirements and recently introduced national and international evaluation procedures. The department's Planning Instruments working group has accompanied this process for years, with the development and maintenance of a comprehensive set of various computer-supported tools. The tools can be applied both in daily planning use as well as in the evaluation of specialized energy and light technology issues. The focal points lie in the area of solutions to DIN V 18599 (the advanced German holistic energy assessment methodology), the creation of consulting and informational tools for planners and decision makers, and the development of simulation tools. The program systems are configured on a component-oriented basis, so that – through this modular principle – new application programs can be swiftly created at moderate cost in response to specific customer requirements.

The IBP:18599 product family

The majority of DIN V 18599-based energy performance certificates are issued in Germany with the aid of the calculation engine developed by the working group, the IBP18599kernel.

Most leading software manufacturers in Germany use this tool as an equation solver. It is maintained continuously and adapted to changes in the evaluation process. Based on this calculation engine, the working group creates and develops an array of application programs with the aid of its own user interface framework. They may be broad in scope such as the complete evaluation of residential and non-residential buildings in a national and international context (IBP:18599), or be for individual, highly specific issues – such as the overall energy evaluation of systems to provide protection from the sun.

Consulting and information tools

The energy quality of buildings and complexes evolves during the planning phase. Nonetheless, it is essential – in the pre-planning phase already – to set the basic agenda with regard to energy positioning of construction measures. Because only minimum resources exist in this phase for detailed analyses, on the one hand, and on the other, only limited knowledge exists on detailed execution, it is important to provide simple and readily applicable planning instruments that indicate the proper direction of planning. Besides these consulting tools, the working group also develops information tools for planners and decision makers that deliver an overview of energy-efficient technologies and new kinds of solution approaches in buildings, building shells and technical building equipment.

Focus: Simulation work tools

The development and implementation of physical models is essential to establishing fundamental research-based correlations, conducting detailed property evaluation and also to replacing connections previously established through measurements. For example, over the past few years detailed façade models were generated here that helped derive computationally simple links, of relevance to planning practice, between sun protection systems and the use of artificial light.

Selected software products

- IBP:18599 High-End and Standard
- IT Energy Assessment Toolkit (IEA Annex 46)
- Energy Concept Adviser (ECA)
- EnBW Lighting Expert
- ADELIN: Detailed daylight and artificial light planning and visualization software
- Talisy: Graphically and functionally interactive database of innovative light technology façade components
- Software tool "District energy concept adviser"



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