

International Energy Agency

Energy Efficient Communities: Case Studies and Strategic Guidance for Urban Decision Makers (Annex 51)

Project Summary Report

October 2014



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Edited by
Reinhard Jank

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Cover picture: Typical residential areas in Karlsruhe, Germany: Mixture of single/double family buildings and small multi-family buildings in the north and east, large multi-family buildings in the center and medium-sized multi-family buildings in the south of the area (at the bottom of the photograph). Source: Volkswohnung Karlsruhe GmbH.

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Project Summary

Project Objectives

The aim of the EBC project 'Annex 51: Energy Efficient Communities: Case Studies and Strategic Guidance for Urban Decision Makers' was to create an integrated approach to developing both 'municipal energy masterplans' and 'neighbourhood scale energy action plans', based on experiences gained from real case studies in the participating countries. Since implementation of such local energy plans (LEPs) in most towns and cities has typically only been moderately successful, it was the goal of this project to address the needs of municipal decision makers and urban planners. It has provided them with state-of-the-art information about urban energy planning methods and, in particular, given them recommendations for strategies and organizational structures that enhance the potential for successful implementation.

Approach

Due to the contrast between energy planning for neighbourhoods, usually labelled neighbourhood scale energy planning, and the creation of a long-term energy strategy for a whole town or city, a municipal energy masterplan, two different categories of case studies were initially evaluated. These included:

- neighbourhood energy planning projects, and
- for whole cities, ongoing efforts to derive and accomplish energy and greenhouse gas reduction strategies.

Knowledge gained from these case studies with respect to methods, tools used, barriers, and success factors was then evaluated as the basis for 'Case Studies and Guidelines for Energy Efficient Communities: A Guidebook on Successful Urban Local Energy Planning'. This can be used by municipal decision makers, project developers and urban planners as a 'manual' to conceive and implement their own neighbourhood or municipal energy action plans.

Deliverables

Considering conventional and advanced neighbourhood scale energy planning projects and long-term urban energy and climate change policies developed by 'frontrunner cities', and the case studies selected by the project participants, the existing state-of-the-art planning approaches were analyzed in evaluation reports. While these working reports were not intended for publication, the Guidebook on was jointly written by participants based on them as the main project deliverable. This Guidebook contains a detailed overview of motivations, boundary conditions, planning methods,

existing planning tools and implementation strategies available for local decision makers and urban planners.

Prior to the project, a planning tool to evaluate energy balances for integrated energy strategies for neighbourhoods (new developments or municipal revitalization projects) at an early phase of planning was not available. A tool called the 'District Energy Concept Adviser' (D-ECA) was therefore developed within the project that is capable of comparing various energy strategies for neighbourhoods (new or existing) in terms of annual energy balances, although not in terms of costs.

Achievements

The project has achieved its objectives in the following ways:

- Existing organisational models, implementation instruments and planning tools for local administrations and developers were assessed in a 'state-of-the-art' review.
- Case studies were produced on energy planning and implementation strategies for neighbourhoods, quarters and municipal areas. These include both refurbishment of existing building stock and planning and development for new 'green' settlements.
- Case studies were documented on the preparation of integrated energy and CO₂ abatement concepts for towns or cities and corresponding implementation strategies.
- Instruments for a successful community energy policy were explained, including

an overview of legal instruments at the level of urban planning found to be useful within the participating countries, as part of the means of implementing a policy.

Project duration

2009 - 2013 (completed)

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Germany, Japan, Sweden, Switzerland,
the Netherlands, USA

Further information

www.iea-ebc.org

Project Outcomes

Background

Currently available standards of individual buildings, residential or otherwise, such as 'green' buildings, 'zero energy' buildings, 'carbon (CO₂) neutral' buildings or similar, promise very large reductions in fossil energy consumption and greenhouse gas (GHG) emissions, ranging from 'factor 4' to 'factor 10'. Considering the whole existing building stock in neighbourhoods, municipal quarters or towns, the achievement of such ambitious targets is in some ways easier, while in others more difficult, than it is for individual demonstration buildings: Although at the neighbourhood scale there may be more technical and economic possibilities, it is much more challenging for the stakeholders involved to reach agreement about the best local energy plan and its implementation. Therefore, decision-making processes, organization and implementation strategies have much more weight compared to simple technological or planning issues encountered for individual buildings. Another important difference lies in the fact that, contrary to single demonstration buildings, the aim of neighbourhood scale energy plans must be to find an economically optimized solution for the whole neighbourhood rather than the latest technical solution for a few showcase buildings, otherwise comprehensive implementation would not be achievable.

Due to economies of scale, a number of technologies, such as cogeneration or combined heat and power, waste heat utilization, biomass, geothermal energy, solar heating (and cooling), and others, are more efficient – in technical and economic terms – when used in large installations instead of small ones. Taking advantage of these technologies, if locally available, the effective primary energy consumption achieved by an integrated system may fall even below best available standards for new buildings, but with lower cost and with the advantage of large scale feasibility. While for new or existing isolated buildings improving technical components and reducing their costs will be decisive to achieve the long-term energy goals, in high density built areas a centralized approach will generally offer better economic options. A successful urban energy and climate change policy will only be available if such options can be found and realized whenever possible; otherwise, the options will be too expensive.

The appropriate planning level to achieve this is at the neighbourhood or district level. Planning only for individual buildings often cannot realise the potential benefits offered by their local environments. Municipal energy planning generally only provides a theoretical framework for the whole city that cannot be implemented in a straightforward

manner, in contrast to a neighbourhood project.

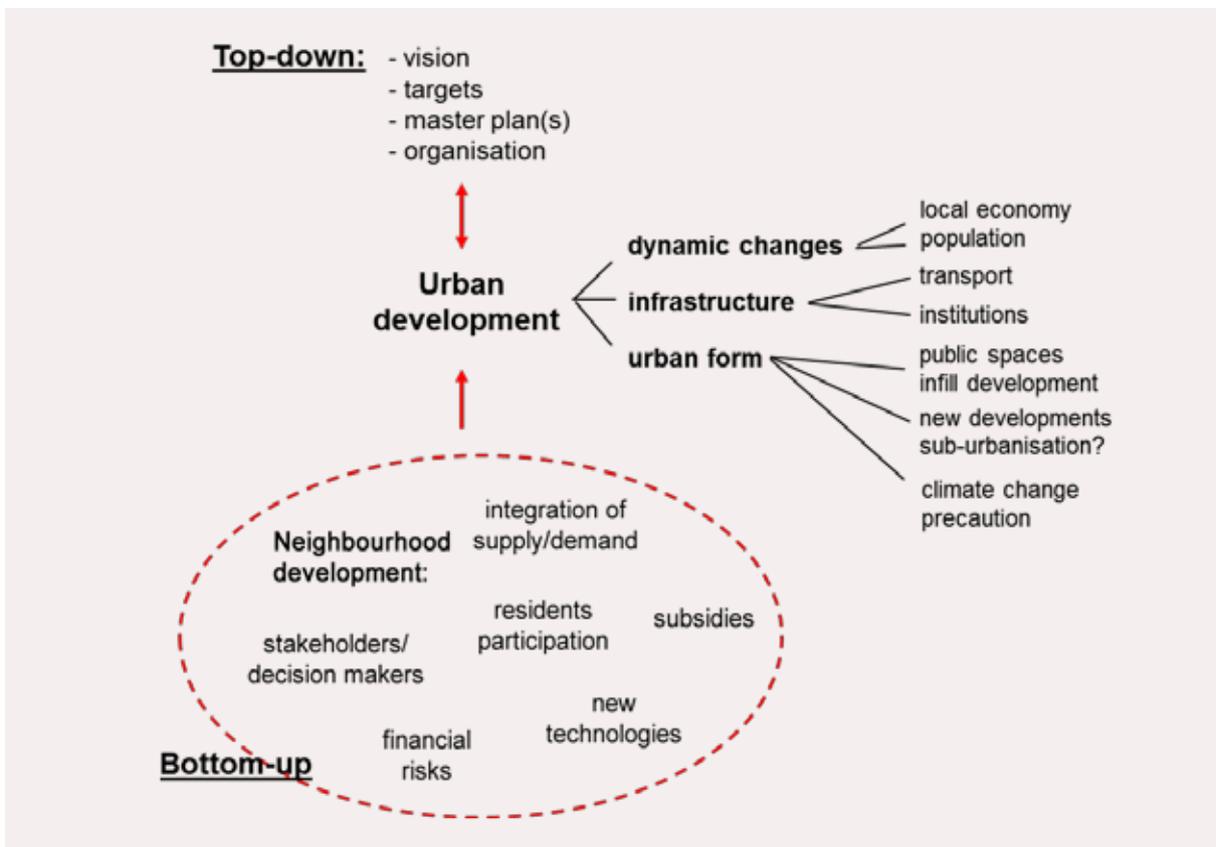
However, a city consists of several districts or neighbourhoods: Their local energy plans must be consistent with the overall municipal energy masterplan. Therefore, a parallel task is needed to optimise the neighbourhoods of a city in a bottom-up approach and to find an overarching plan for the future development of the whole city.

On this scale, energy issues are only a subset of many other topics that have to be considered adequately to achieve 'sustainable urban development'. This interaction of different levels of decision making and activity fields is shown below, illustrating the simultaneous actions required

at the 'strategic' level and at the 'operative' level that interact iteratively with general urban (economic) development over many years.

The resulting complexity would require a structured approach towards a holistic planning and implementation strategy to achieve the transition to a future energy efficient and low carbon city. As a consequence, to plan a 'future proof' energy system better than in the past, a systems approach is necessary, in which interactions of and feedback processes between different parts of the urban system must be adequately considered.

The aim of the EBC project 'Annex 51: Energy Efficient Communities: Case Studies



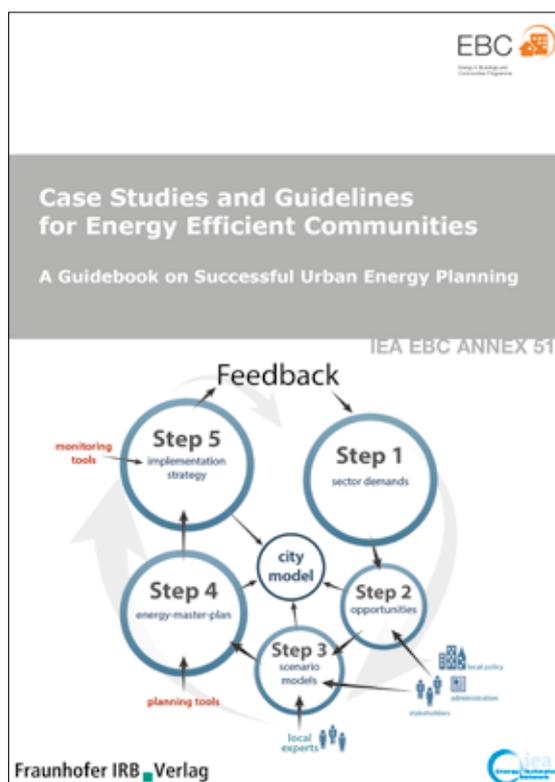
Urban energy planning requires both bottom-up and top-down approaches to be successful

and Strategic Guidance for Urban Decision Makers' was to analyse practical experiences with such integrated approaches and to draw conclusions from them that can directly be applied by the broader urban planning community.

Objectives and Activities

The project focused on strategies, decision processes, planning tools and implementation instruments, rather than research and development (R&D) activities for technological innovation. It has provided explanations of existing methods and instruments for the benefit of urban planners, decision makers and stakeholders to enable them to design building clusters, neighbourhoods, and urban districts and to achieve the goal of creating an energy efficient low carbon community. Such methods and approaches should be generally applicable by interested communities. It was the objective of the project to derive such principles of a holistic approach supported by methods and tools that can be used directly for community energy planning. With this general goal, the following tasks were carried out, which are described further below:

- Case study evaluations
- Summaries of national policy frameworks influencing local energy policies
- Municipal strategies and processes
- Overview of existing planning tools
- Creation of 'Case Studies and Guidelines for Energy Efficient Communities: A Guidebook on Successful Urban Local Energy Planning'



'Case Studies and Guidelines for Energy Efficient Communities: A Guidebook on Successful Urban Local Energy Planning'

- Creation of the 'District Energy Concept Adviser' computer tool

Case Study Evaluation

In the international co-operative framework provided by the project, practical experiences gained in more than 25 national case studies were evaluated with respect to the practicality of the approach, the methods used and the results achieved, revealing success factors, as well as barriers or reasons for failures. These included neighbourhood plans and municipal energy action plans for whole cities. The general question to be answered was what information could be extracted that could contribute to forming generalized conclusions local decision makers and urban

planners according to the issues described above. In the course of the project, case study evaluation working reports were produced on:

1. conventional neighbourhood scale LEP projects,
2. neighbourhood-oriented integrated planning projects involving innovative technologies and approaches, and
3. planning practices of municipal 'frontrunners' that have already had experience in implementing their municipal energy masterplans.

These case study reports served as key sources of information during preparation of the Guidebook. They were also of immediate benefit for decision makers and urban planners in their local energy planning projects.

Summaries of National Policy Frameworks Influencing Local Energy Policies

To assist understanding of the differences in the approaches found in the case studies from different countries, outline summaries were provided of the policy frameworks within those countries that influence local energy planning.

Municipal Strategies and Processes

It was clear from the project outset that it would be a complex management and organisational task to achieve the ambitious goal of municipal energy transition. Based on the practical experiences found in the case studies and primarily addressing municipal energy masterplanning, it was therefore

necessary to examine process steering and implementation strategy issues.

Overview of Existing Planning Tools

Due to the existing diversity on the one hand of more or less 'self-made' planning tools and of sophisticated energy system models used in academic circles on the other, an assessment was made of the current situation concerning available planning tools and development needs. Since an early stage decision support tool was not found to be already available to compare alternative energy strategies for neighbourhood energy plans, such a tool was developed within this project.

Guidebook on Urban and Local Energy Planning

The conclusions and lessons learned from the analysed case studies were outlined in the Guidebook to describe planning methods and existing planning tools. It also provides an overview of existing local data sources that can be used directly in municipal projects. To take into account the large differences between local energy planning at municipal and neighbourhood scales, the Guidebook evaluates the case studies from each perspective.

'District Energy Concept Adviser' tool

In parallel with the other activities, a computer support tool was developed within the project for use in the early phases of neighbourhood planning by deriving and comparing alternative plans. Using this tool, decision makers, or energy planners

working with them, are able to consider alternative strategies in terms of their energy characteristics.

Deliverables

The Guidebook to Successful Local Energy Planning

Based on the case study evaluations, the resulting conclusions for urban energy planners and urban decision makers are presented in 'Case Studies and Guidelines for Energy Efficient Communities: A Guidebook on Successful Urban Local Energy Planning', which is the core deliverable of the project. The existing state-of-the-art of LEP approaches are described in this to disseminate the knowledge

gathered by evaluating the case studies and to contribute to further development of these methods.

The most important topics considered in the Guidebook are:

- a systematic approach to creating municipal energy masterplans and their implementation strategies,
- methods for the assessment of the potential for local energy conservation, efficiency, and renewable supplies,
- a compilation of municipal energy inventories and energy scenarios,
- an overview of existing monitoring tools (municipal level) used within the participating countries,
- an overview of existing LEP software tools for urban energy planners



Terrace house with novel wood construction, Bad Aibling Case Study
Source: R. Jank

used in practice, and identification of development needs for such planning tools,

- methods to develop neighbourhood energy plans,
- steering and organizational principles to implement long-term municipal energy policy strategies,
- a large number of bibliographic and internet references relating to municipal energy planning literature that are useful for practising planners.

The Guidebook is aimed urban planners and also local decision makers. It provides a broad overview about frameworks, methods and existing tools for local energy planning for neighbourhoods and cities. In addition, the most significant messages and conclusions drawn from the Guidebook are concisely summarised in a stand alone section.

District Energy Concept Adviser

To complement the Guidebook, a computer tool was developed to calculate energy balances at neighbourhood scales for alternative potential energy conservation measures for buildings and local energy supplies, called the 'District Energy Concept Adviser' (D-ECA). The concept was to produce a tool allowing quick comparisons of options, whether for energy conservation or supply, which might be considered by developers or other local stakeholders. Using the D-ECA, end energy use, primary energy consumption and CO₂ emissions of the neighbourhood under consideration can be assessed. The freely downloadable

D-ECA is discussed further in Chapter 5 of the Guidebook and is available in both English and German versions (see www.iea-ebc.org/projects/completed-projects/ebc-annex-51).

Achievements

Neighbourhood Energy Planning

With respect to technologically advanced neighbourhood projects (e.g. solar thermal, biomass, heat pumps, cogeneration, low exergy systems, novel building embedded systems), in many cases new thermal energy supply technologies still proved to be too expensive compared to conventional systems and thus required subsidies for their implementation. However, there was consensus amongst the project participants that there exists unexploited potential for cost reductions, for example due to suboptimal planning because of the lack of experience of planners, investors and operators.

The most important barrier, however, was poor performance of the installed technologies, which often resulted from poor system integration of the various technologies employed in a specific project. Due to missing or insufficient control and monitoring equipment, active 'retro-com-missioning' and continuous optimization of system operation are difficult and require expert knowledge. Poor performance not only prevents achievement of project goals, whether economic or energy related, but will also seriously hinder the market penetration of new technologies. The lack of competent and experienced

planners and qualified manufacturers is another problem often encountered in advanced neighbourhood energy projects. Moreover, there is a need to better disseminate lessons learnt from practical experiences to local craftsmen and industries.

While both the technologies and the interest of potential investors exist, due to the increased system complexity the real problem to be solved is to find qualified planners and system operators. One solution to this problem would be to initiate structured co-operation between experts and experienced contractors, for instance to deliver integrated residential neighbourhood projects. This would improve the possibilities for finding optimized technical and

operational solutions and thus could be more cost effective.

To help to avoid technical and financial failures, energy regulations should emphasize contracting approaches in which the responsibility for the overall success of an integrated energy project remains with the contractor, in particular during the operating phase. For integrated neighbourhood energy planning, this would reduce the planning risks and implementation barriers significantly.

Municipal Energy Planning

At the outset of the project the following constraints were assumed that might form the decisive 'technical' barriers preventing communities from realising successful



Freiburg Case Study – Residential District Weingarten, integrated energy retrofit and CHP supply
Source: R. Jank

municipal energy and climate policies:

- insufficient know how on strategic planning,
- insufficient management ability during the implementation process, and
- insufficient availability of tools and instruments for decision making, planning and monitoring.

However, evaluation of the case studies focussing on municipal energy masterplanning revealed that the technical energy planning problems – at the municipal level – were not the decisive bottleneck. The management problem, in particular the problem of initiating and steering the necessary transition processes at all levels of local decision making, was the real problem faced by those responsible for implementation of municipal energy policies. While most of the investments necessary to guide development of local energy systems to achieve the future vision must be made by private investors at a neighbourhood level making use of adequate business models, a certain degree of coordination is necessary at the city level. With this in place, market participants can be enabled to make the right decisions at the right time to make the intended energy transition happen with the lowest transaction costs. This coordination task requires an overarching long-term local government strategy – the municipal energy masterplan, which every city should have in the first place.

To ensure successful implementation, adequate organizational structures must be established and maintained over the whole time needed for the transition process.

These should either exist within the city administration or should be delegated by it, for example in the form of a local energy agency. There are costs arising by the provision of such an organization, but they can be considered to be small compared to the decreased overall transaction costs of the municipal energy transition that can be achieved.

Thus, an important conclusion is that the most prominent barriers to achieving municipal energy goals are not formed by inadequate energy technologies or planning tools, rather these are:

- a lack of access to the relevant knowledge (energy systems analysis, process management),
- missing municipal management structures and supporting resources,
- missing consciousness within local governments about the importance of such structures, and
- a lack of sustained commitment on the part of the important local stakeholders.

To improve this situation, it is recommended that communication of IEA Technology Network research outcomes on topics relating to communities to stakeholders should be improved.

Estimates have been made from the case studies about the order of magnitude of costs to be expected for the energy transition process for whole cities, which amount to €10,000 per inhabitant. While this seems to be a very large investment, it must be compared with the substantial investments in infrastructure and the building sector of a community that regularly take place anyway.

The aim must be to align with these ongoing change processes to steer the urban development in the right direction.

Beyond reasons of climate change impacts, which are not yet fully understood by the general public, there are additional reasons to support such a policy, including:

- increased energy supply security by reducing dependence on imports from politically unstable regions;
- reduction of economic disruption caused by rising energy prices;
- cost savings for energy users by improving energy inefficient buildings or equipment;
- local economic advantages by capitalizing on local investments in energy conservation or renewables;
- modernization of local infrastructure;
- promotion of sustainable urban development in general.

These co-benefits of working towards energy and GHG emissions reduction targets should be emphasized in communication with stakeholders and the general public to increase awareness and acceptance of the consequences of local energy policies.

Computer-Based Planning Tools

Evaluation of the case studies and the practical experiences of the project participants have shown that:

- Simulation tools, both for buildings and for single energy system components, such as solar collector arrays, cogeneration plants or district heating networks, are available and widely in use by planners.

- Tools to compile energy and GHG inventories for whole municipalities have been developed and are currently also widely used by city administrations, and are increasingly assisted by federal or state offices for statistics to reduce the data collection burden.

Tools that support automatic energy mapping for neighbourhoods or communities by combining geographical information systems (GIS) data with airborne scanning data to provide 3D city models, including energy demand estimates of the neighbourhood's buildings, are still in their infancy. However, due to the ongoing development of powerful computer hardware and software it can be expected that such tools will be available and widely in use in the near future.

In contrast, energy system models describing the behaviour of 'integrated' energy systems (i.e. demand and supply), for instance at a neighbourhood scale, with sufficient time resolution and providing both simulation and optimization calculations, are still in general only used by academia. While such models are complex and difficult to use, in combination with GIS models, they could be a very powerful tool for LEP. It is concluded that this is still an area of basic research that should be fostered.

National Policy Frameworks

The overview of the existing policy frameworks in the participating countries that are relevant for LEP has disclosed a variety of legal, financial and organizational structures: National strategies vary considerably in design, complexity and

financial costs. Periodic fine-tuning and adapting regulations to specific needs result in more complex regulations that in themselves can cause barriers. A comprehensive appraisal of the effectiveness and cost / benefit ratio of the instruments found and their potential transferability to other countries is not available. After many years of experience, there would be value in enhanced knowledge exchange concerning the design of future energy and climate change policy instruments. A more comprehensive analysis of national energy policy approaches within IEA countries and more profound energy policy conclusions should be considered for future research.

Feed-in-Tariffs (FiTs) are used in several of the participating countries in various forms as a powerful instrument to promote electricity generation from renewable energy sources. This is in contrast to renewable thermal energy, where a comparable instrument has not been identified. In two countries, Denmark and Germany, the expansion of irregular power sources (wind energy, PV) has meanwhile reached such a degree as to cause challenges with system integration, backup and storage capacities. Changes to FiTs to provide more market orientation are therefore now necessary in these countries. The role of the building stock as active constituents of the future energy system (storage, small scale generation, demand-side management (DSM), smart buildings) must be more strongly emphasised and defined within suitable policy frameworks. It is this transition to 'smart cities' – in a very comprehensive sense – that will be the key

to success in the long term.

In several participating countries it is mandatory for municipal administrations to provide local energy or GHG action plans. The methods and quality of such plans vary from country to country. It would be helpful for every country to stipulate that such a basic planning instrument should be a mandatory constituent of urban development plans, because this would foster the necessary integration of energy issues into traditional urban planning procedures. At the same time, it would strengthen planning know how and capacity, if communities are expected to contribute their part to successful delivery of national energy policies.

Anticipated Impacts of Successful Local Energy Planning

The buildings sector (residential, commercial and public) is responsible for about 40% of energy consumption within industrialized countries, in which over 70% of buildings are located in towns or cities. If the potential energy conservation and efficiency improvements and widespread installation of renewable energy supplies can be implemented successfully, municipal primary energy consumption can be reduced by 60% or more over a time horizon of 30 to 40 years. The resulting impacts on the national energy balances of industrialized countries of successful implementation of municipal energy masterplans for all cities would be in the range of a 15% to 20% reduction in total primary energy consumption and even greater for GHG emissions.

Project Participants

Country	Organisation
Austria	Salzburger Institut für Raumordnung & Wohnen, SIR Austrian Institute of Technology, AIT
Canada	Natural Resources Canada
Denmark	Technical University of Denmark
France	European Institute for Energy Research
Finland	VTT Helsinki
Germany	Volkswohnung GmbH Fraunhofer Institute for Building Physics (IBP) Fraunhofer UMSICHT pro:21
Japan	Yokohama National University Tokyo Gas Co. Ltd. Nikken Sekkei Research Institute
Sweden	Linköping University
Switzerland	EPFL Switzerland
The Netherlands	Hogeschool Zuyd
United States	USACE

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EBC and the IEA

International Energy Agency

The International Energy Agency (IEA) was established in 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme. A basic aim of the IEA is to foster international co-operation among the 28 IEA participating countries and to increase energy security through energy research, development and demonstration in the fields of technologies for energy efficiency and renewable energy sources.

The EBC Programme

The IEA co-ordinates research and development in a number of areas related to energy. The mission of the Energy in Buildings and Communities (EBC) Programme is to develop and facilitate the integration of technologies and processes for energy efficiency and conservation into healthy, low emission, and sustainable buildings and communities, through innovation and research. (Until March 2013, the IEA-EBC Programme was known as the Energy in Buildings and Community Systems Programme, ECBCS.)

The research and development strategies of the IEA-EBC Programme are derived from research drivers, national programmes within IEA countries, and the IEA Future Buildings Forum Think Tank Workshops. The research and development (R&D) strategies of IEA-EBC aim to exploit technological opportunities to save energy in the buildings sector, and to remove technical obstacles to market penetration of new energy efficient technologies. The R&D strategies apply to residential, commercial, office buildings and community systems, and will impact the building industry in five focus areas for R&D activities:

- Integrated planning and building design
- Building energy systems
- Building envelope
- Community scale methods
- Real building energy use

The Executive Committee

Overall control of the IEA-EBC Programme is maintained by an Executive Committee, which not only monitors existing projects, but also identifies new strategic areas in which collaborative efforts may be beneficial. As the Programme is based on a contract with the IEA, the projects are legally established as Annexes to the IEA-EBC Implementing Agreement. At the present time,

the following projects have been initiated by the IEA-EBC Executive Committee, with completed projects identified by (*):

- Annex 1 Load Energy Determination of Buildings (*)
- Annex 2 Ekistics and Advanced Community Energy Systems (*)
- Annex 3 Energy Conservation in Residential Buildings (*)
- Annex 4 Glasgow Commercial Building Monitoring (*)
- Annex 6 Energy Systems and Design of Communities (*)
- Annex 7 Local Government Energy Planning (*)
- Annex 8 Inhabitants Behaviour with Regard to Ventilation (*)
- Annex 9 Minimum Ventilation Rates (*)
- Annex 10 Building HVAC System Simulation (*)
- Annex 11 Energy Auditing (*)
- Annex 12 Windows and Fenestration (*)
- Annex 13 Energy Management in Hospitals (*)
- Annex 14 Condensation and Energy (*)
- Annex 15 Energy Efficiency in Schools (*)
- Annex 16 BEMS 1 - User Interfaces and System Integration (*)
- Annex 17 BEMS 2 - Evaluation and Emulation Techniques (*)
- Annex 18 Demand Controlled Ventilation Systems (*)
- Annex 19 Low Slope Roof Systems (*)
- Annex 20 Air Flow Patterns within Buildings (*)
- Annex 21 Thermal Modelling (*)
- Annex 22 Energy Efficient Communities (*)
- Annex 23 Multi Zone Air Flow Modelling (COMIS) (*)
- Annex 24 Heat, Air and Moisture Transfer in Envelopes (*)
- Annex 25 Real time HVAC Simulation (*)
- Annex 26 Energy Efficient Ventilation of Large Enclosures (*)
- Annex 27 Evaluation and Demonstration of Domestic Ventilation Systems (*)
- Annex 28 Low Energy Cooling Systems (*)
- Annex 29 Daylight in Buildings (*)
- Annex 30 Bringing Simulation to Application (*)
- Annex 31 Energy-Related Environmental Impact of Buildings (*)
- Annex 32 Integral Building Envelope Performance Assessment (*)

- Annex 33 Advanced Local Energy Planning (*)
 - Annex 34 Computer-Aided Evaluation of HVAC System Performance (*)
 - Annex 35 Design of Energy Efficient Hybrid Ventilation (HYBVENT) (*)
 - Annex 36 Retrofitting of Educational Buildings (*)
 - Annex 37 Low Exergy Systems for Heating and Cooling of Buildings (LowEx) (*)
 - Annex 38 Solar Sustainable Housing (*)
 - Annex 39 High Performance Insulation Systems (*)
 - Annex 40 Building Commissioning to Improve Energy Performance (*)
 - Annex 41 Whole Building Heat, Air and Moisture Response (MOIST-ENG) (*)
 - Annex 42 The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems (*)
 - Annex 43 Testing and Validation of Building Energy Simulation Tools (*)
 - Annex 44 Integrating Environmentally Responsive Elements in Buildings (*)
 - Annex 45 Energy Efficient Electric Lighting for Buildings (*)
 - Annex 46 Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (*)
 - Annex 47 Cost-Effective Commissioning for Existing and Low Energy Buildings (*)
 - Annex 48 Heat Pumping and Reversible Air Conditioning (*)
 - Annex 49 Low Exergy Systems for High Performance Buildings and Communities (*)
 - Annex 50 Prefabricated Systems for Low Energy Renovation of Residential Buildings (*)
 - Annex 51 Energy Efficient Communities (*)
 - Annex 52 Towards Net Zero Energy Solar Buildings (*)
 - Annex 53 Total Energy Use in Buildings: Analysis and Evaluation Methods (*)
 - Annex 54 Integration of Micro-Generation and Related Energy Technologies in Buildings
 - Annex 55 Reliability of Energy Efficient Building Retrofitting Probability Assessment of Performance and Cost
 - Annex 56 Cost Effective Energy and CO₂ Emissions Optimization in Building Renovation
 - Annex 57 Evaluation of Embodied Energy and Greenhouse Gas Emissions for Building Construction
 - Annex 58 Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements
 - Annex 59 High Temperature Cooling and Low Temperature Heating in Buildings
 - Annex 60 New Generation Computational Tools for Building and Community Energy Systems
 - Annex 61 Business and Technical Concepts for Deep Energy Retrofit of Public Buildings
 - Annex 62 Ventilative Cooling
 - Annex 63 Implementation of Energy Strategies in Communities
 - Annex 64 LowEx Communities - Optimised Performance of Energy Supply Systems with Exergy Principles
 - Annex 65 Long-Term Performance of Super-Insulating Materials in Building Components and Systems
 - Annex 66 Definition and Simulation of Occupant Behavior in Buildings
 - Annex 67 Energy Flexible Buildings
- The programme has established the following working groups:
- Energy Efficiency in Educational Buildings (*)
 - Indicators of Energy Efficiency in Cold Climate Buildings (*)
 - The Energy Concept Adviser - Annex 36 Extension (*)

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