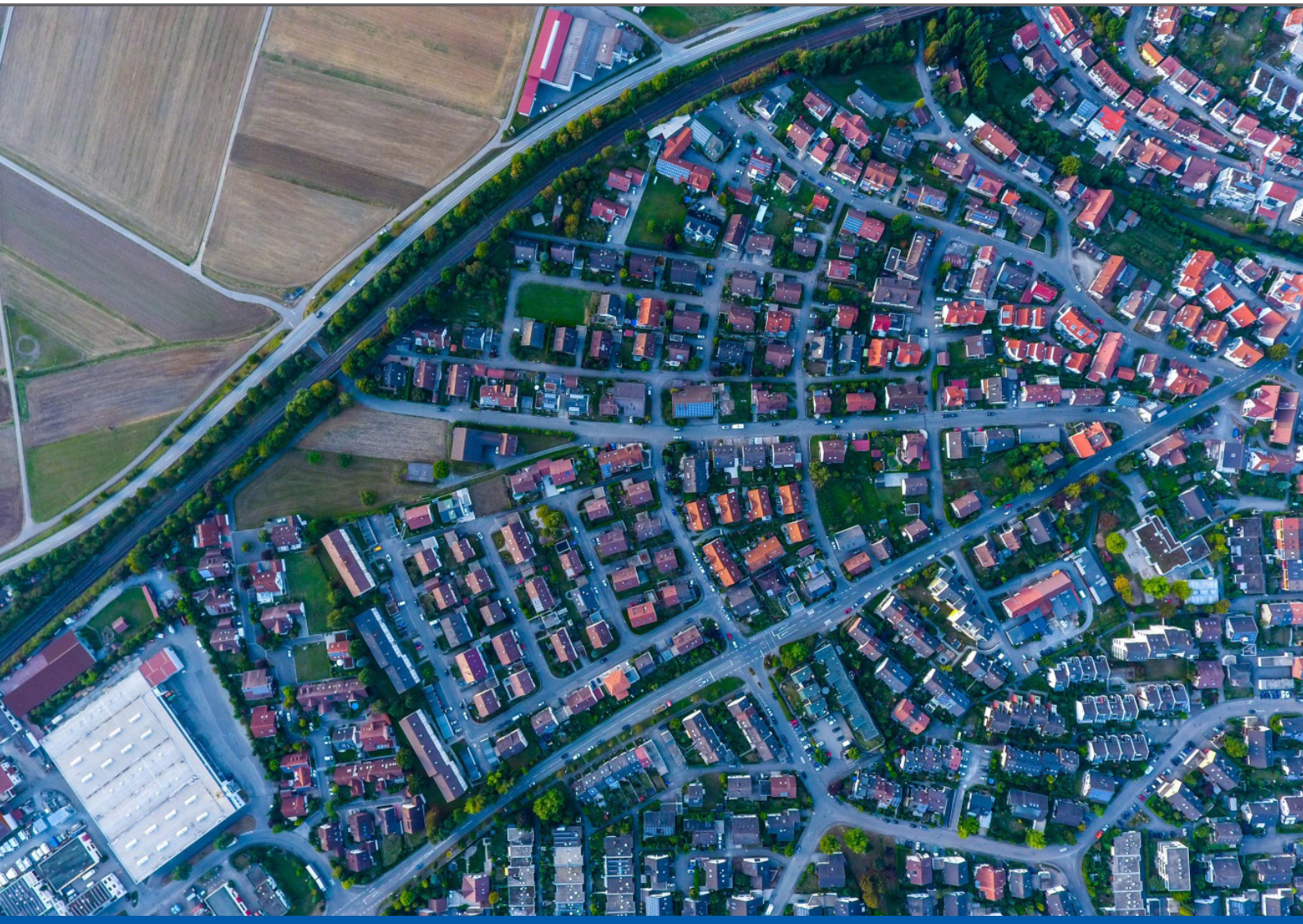
EBC

Energy in Buildings and Communities Programme

International Energy Agency

EBC Annex 63: Implementation of Energy Strategies in Communities

Project Summary Report



Technology Collaboration Programme
by IEA

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Energy in Buildings and Communities Programme

International Energy Agency

EBC Annex 63: Implementation of Energy Strategies in Communities

Project Summary Report

Edited by
Helmut Strasser

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Participating countries in EBC: Australia, Austria, Belgium, Brazil, Canada, P.R. China, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Republic of Korea, the Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, Turkey, United Kingdom and the United States of America

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Project Summary

The coordination of urban and energy planning processes at a local level is a central element for achieving goals for reducing greenhouse gases (GHG) emissions, and in particular those relating to energy-related carbon dioxide (CO_2) emissions. But, case studies from several countries have shown there is still a missing link between these processes that would enable the implementation of innovative technologies in large-scale projects. The previous EBC project, 'Energy Efficient Communities' (EBC Annex 51) has shown that the optimization of energy systems at community scale alone is not sufficient. Rather, a close linkage between energy planning and established urban planning processes is required. To address this, the EBC international research project, 'EBC Annex 63: Implementation of Energy Strategies in Communities', has closed this gap. It has collected and analysed experiences in the participating countries on a national scale. These analyses have shown that making changes to existing processes is very complex, because these must take into account the needs of different stakeholders (e.g. politicians, administrators, investors and planners) and the impacts of different topics (e.g. visions, goals, process flow, and organisation). Therefore, social skills and practical recommendations are necessary to initialize the change process.

A result is that an upscaling of building solutions to the level of settlements is not so easily achievable.

To optimise the energy supply for urban development projects, solutions at the individual building scale are necessary, but a broader framework is needed at an early planning stage. Therefore, it is important to include all relevant stakeholders early in the planning process and to understand their potential contributions. This can be done by restructuring existing urban planning processes and strengthening them with additional internal or external expertise. The well-implemented adaption of urban planning processes is likely to have a more significant impact on energy use and CO_2 emissions within a country compared to the optimisation of only the building stock.

So, the results of the project analyses have been further developed to create a set of nine strategic measures. These measures support the successful implementation of energy strategies in communities and include guidance on how they can be applied at a local scale. Finally, stakeholder support materials have been developed enabling the necessary change management process to be started.

The project has contributed to the implementation of the EBC Strategic Plans both for 2014-2019 and for 2019-2024. In

these plans, community scale methods for energy efficient communities are identified as a topic of high interest.

Additionally, as a project finding a requirement for further information exchange between researchers has been found for different technologies with relevance to the urban scale, as well as on technological and non-technological issues, such as urban planning processes. Thus, the EBC-led 'Working group on Cities and Communities' has created a forum for knowledge exchange on such 'urban issues' for the benefit of the IEA Technology Collaboration Programmes' research and other activities. The success of this project is largely determined by the close cooperation with more than 20 cities involved.

These experiences should continue to be introduced through close cooperation. For this reason, attempts are being made to integrate not only research institutions and experts, but also relevant city-related facilities. The following reports have been published by the project:

- Volume 0: Documentation of workshops and involvement of cities
- Volume 1: Inventory of measures
- Volume 2: Development of strategic measures
- Volume 3: Application of strategic measures
- Volume 4: Stakeholder support materials
- Volume 5: Recommendations

Project duration
2013 - 2018 (completed)

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Participating countries
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Further information
www.iea-ebc.org

Project Outcomes

Background

Organisation for Economic Co-operation and Development (OECD) research suggests that cities are major contributors to greenhouse gas (GHG) emissions. They consume a great majority – between 60% to 80% – of energy production worldwide across all sectors and account for a roughly equal share of global emissions. To avoid the full impacts of climate change, as well as energy and resources shortages, a drastic reduction of both energy and emissions is essential for the wide-scale development of more sustainable cities and communities (see also the United Nations Sustainable Development Goal 11 'Sustainable Cities and Communities'). In the past, research in the buildings sector has focused on technological innovation and improvements at the fragmented scale of the individual building. This has achieved partial success, but it is widely considered that to achieve the global climate and energy related goals more emphasis should be placed on the system wide reduction of energy demand and greenhouse gas emissions and implementing a higher share of renewable energy due to the integrated nature of our cities, including transportation and industry. Thus, the energy transition implies that a change of emphasis is needed from the optimization of building components via single buildings to optimized solutions for whole neighbourhoods and communities. In fact, first experiences in the development of net-zero energy communities have revealed not only challenges, but also significant opportunities supporting net-zero energy community concepts, including increased budgets for investments derived from energy savings, increased comfort and quality of life, and local production that boosts local economies. The frontrunners show that integrated approaches could be beneficial for all stakeholders, especially the end-users and to support the life-styles of citizens.

However, this is not obvious and clear for every stakeholder from the beginning. This often leads to situations in which everybody is in favour of such an approach, but not much happens, since the integrated responsibilities and initiatives are not organised in a structural way. A suitable mix of push and pull strategies is necessary to link the governance level and end users' level to stimulate initiatives leading to an integrated approach. This analysis leads to the thesis: 'Innovation is in the process, not in technology'.

The EBC project 'Annex 63: Implementation of Energy Strategies in Communities' focused on the integration of energy issues in urban development. Considering the whole system of a city and thus relevant

goals in communal policy in general, such as employment, living conditions, and so on, will work as a door-opener for implementing energy technologies and offers the chance of wide scale implementation of optimized energy technologies.

Objectives

The project focused on the following objectives:

- recommendations for the implementation of optimized energy strategies at the scale of communities;
- recommendations for effective translation of a cities energy / CO_2 goals to the community scale;
- recommendations for optimization of policy instruments for the integration of energy / CO_2 goals into common urban planning processes;
- new techniques for stakeholder cooperation along with holistic business models involving a wide range of stakeholders;
- the creation of methods for monitoring and evaluation;
- the involvement of cities / urban planners in order to integrate energy planning in urban planning procedures.

The project outcomes are summarised in the section below.

Outcomes

Involvement of cities

One central element of the project was on bringing together national and international knowledge on urban and energy planning. Therefore, within the framework of the project, 143 information exchange activities between 2,294 people were carried out. Central stakeholders were: the EBC Annex 63 participating cities, local stakeholder groups, the EBC Annex 63 project team, national and international networks, and IEA Technology Collaboration Programmes (TCPs).

Further information is provided in Volume 0.

National Measures

The first step in the project was the collection and description of national instruments in eleven countries (Austria, Canada, Denmark, France, Germany, Ireland, Japan, Netherlands, Norway, Switzerland and USA) in the areas of urban and energy planning. The project output includes a detailed list of 89 measures, with a short description of each measure, the entry point in urban and energy planning, the effectiveness (encourage, enable, or enforce), motivation (e.g. target setting, monitoring, integrated approach) and distribution (e.g. by organisation, law, open source). A measure is understood here as any action, program, policy or other activity that can demonstrate or influence a change in process.

Further information is provided in Volume 1.

Strategic measures

The collected national measures were developed further into nine strategic measures. These strategic measures can be used to develop individual implementation strategies on a local level for part of, or for the whole life cycle of an iniative (from

the first vision through to monitoring of the implemented solution). The strategic measures are as follows:

Set Vision and Targets: This measure focuses on how urban and project planning processes can be enriched with an overarching vision, as well as clear targets. Applying this measure will make planning more productive by orienting planning actions toward a common vision and set of targets. Building early and broad acceptance of visions and targets will increase their success.

Develop Renewable Energy Strategies: This measure focuses on developing strategies, ideally in alignment with vision and targets, to shift the existing energy supply mix to include a higher amount of renewable energy. Strategies informed by stakeholder engagement and that rely on the range of implementation tools are more likely to be successful.

Make Full Use of Legal Frameworks: This measure supports the analysis of existing legal frameworks to identify opportunities to integrate energy and urban planning, such as through memoranda of understanding, joint powers agreements, and shared decision making, governance, and funding structures.

Design of Urban Competition Processes: This measure offers recommendations as to when and how climate and energy-related issues can be incorporated into competitions (sometimes called requests for proposals, RFPs) to produce projects that have enhanced urban design quality, as well as features that advance climate and energy goals.

Make Use of Tools Supporting the Decision Making Process: This measure is focused on tools that can help to analyse and apply energy and other information in decision-making and planning processes. Tools can be helpful in integrating multiple data sources (e.g. energy, economic, social), conducting analyses across large data sets, and exploring potential scenarios.

Implement Monitoring of Energy Consumption and GHG Emissions: This measure highlights the importance of monitoring energy and GHG data at multiple scales, from the building to the community. Establishing an initial baseline and tracking data over time can be used to identify progress towards and updates to targets and renewable energy strategies.

Stakeholder Engagement and Involvement: This measure emphasizes that successful stakeholder engagement involves a two-way exchange of information via an early, frequent, and ongoing process. Engagement is acknowledged as helping to build consensus, improve the outcomes of planning efforts, and build support for implementation.

Include Socio Economic Criteria: This measure emphasizes the significance of early analysis and integration of multiple benefits (e.g. cost savings, environmental equity) of energy efficiency practices. Socio-economic criteria can be relevant at both project and planning scales.

Implement Effective and Efficient Organisational Processes: This measure outlines mechanisms to assist in moving the principles of a sustainable project beyond its lifetime through the creation of a functional organisation. It compares the organisation of processes within the local administration for cross-sectoral initiatives and helps to identify relevant local / regional (key) stakeholders.
Further information is provided in Volume 2.

Application of strategic measures

To understand how implementation champions apply the strategic measures, national case studies were collected. Implementation champions are understood here to be stakeholders in the city who take the initiative to lead and facilitate implementation processes. In general, the following aspects are relevant:

Where: Energy targets seen in isolation are seldom an effective driving force for implementation.

Who: Implementation champions can almost be anybody, as illustrated by the case studies.

What: Implementation champions actively apply and combine strategic measures.

How: Implementation champions work in an iterative way and take great care over knowing and learning during the process.
Further information is provided in Volume 3.

Stakeholder support materials

The following stakeholder support materials were developed within the framework of the project, to support the starting phase of such implementation processes:

Municipality Self-Assessment tool: The aim of the self-assessment tool is to facilitate the application of the strategic measures. The target group for the self-assessment is the municipality considering the urban and energy planning process as a whole, as well as the sum of implemented projects. The collection of the answers for the self-assessment will result in an overview of the strengths and weaknesses regarding the application of strategic measures.

Capacity building and skills: By using the self-assessment tool, one could determine if and what central roles and skills are missing within the decision making process, e.g. the coordination function by a transition manager or implementation champion is often missing. This stakeholder support material gives recommendations on how to optimize an organisation with respect to capacity building and skills development.

Workshop format and procedures: The content of this stakeholder support material is a description of workshop procedures and workshop formats that can be used to moderate such implementation processes.

Informational slides for presentations: This material can be used to create individual presentations by choosing interesting slides from the slide pool. In total, more than 183 slides are available that summarise all of the project results.

Education materials: These include an inventory of relevant education materials. The aim is to support the implementation of courses with energy engineering for urban planners and urban planning for engineers.
Further information is provided in Volume 4.

Recommendations

Finally, all lessons learned during this development process were collected and translated into recommendations. The recommendations relevant for strategy are as listed below:

1. Capacity building
2. Effective organizational structures in municipalities
3. Intergovernmental coordination and local to national linkage
4. Fully understand and utilize legal frameworks
5. Pilot projects – experimentation to advance innovation
6. Link community (social) goals to business case / private interests
7. Future research – including but not limited to the IEA TCPs

The target groups of these recommendations might vary from country to country due to different administrative and organisational structures, and to different actors / stake-holders. While some of the recommendations direct address communities, others focus on intermediaries, universities, public bodies on regional or national level which are e.g. creating framework conditions such as developing research programs, and so on.

Further information is provided in Volume 5.

Project Participants

Country	Organisation
Austria	Salzburg Institute for Regional Planning and Housing (SIR)
Canada	Natural Resources Canada
Denmark	Aalborg University Cenergia a part of Kuben Management Technical University of Denmark (DTU)
France	European Institute for Energy Research (EIfER)
Germany	Beratungs- und Service-Gesellschaft Umwelt mbH. (B.&S.U) German Association for Housing, Urban and Spatial Development Fraunhofer-Institut für Solare Energiesysteme ISE Institut für Ressourceneffizienz und Energiestrategien (IREES) RWTH Aachen University, E.ON Energy Research Center, Institute for Energy Efficient Buildings and Indoor Climate

Country	Organisation
Ireland	Sustainable Energy Authority of Ireland (SEAI)
Japan	Osaka University
the Netherlands	ZUYD University & Netherlands Enterprise Agency
Norway	Norwegian University of Science and Technology (NTNU) SINTEF Building and Infrastructure, Architectural engineering
Switzerland	ENCO – Energie-Consulting AG Intep – Integrale Planung GmbH
USA	University of Minnesota Urban and Regional Planning Program

Project Publications

1. H. Strasser, V. Aagesen, I. Andresen, R. Buggie, K. Church, J. Freudenberg, D. Kellenberger, J. Kimman, A. Koch, M. Kornmann, Å. Lekang-Sørensen, U. Lynar, J.P. Petersen, M.B. Quitzau, A. Roser, C. Schively-Slotterback, Y. Shimoda, R. Streblow, G. Stryi-Hipp (2017): Annex 63: Implementation of energy strategies in communities: Volume 0: Documentation of workshops and involvement of cities, IEA EBC project Annex 63, Salzburg Institute for Regional Planning and Housing, Salzburg, 2017
2. K. Church, V. Aagesen, I. Andresen, R. Buggie, J. Freudenberg, D. Kellenberger, J. Kimman, A. Koch, M. Kornmann, Å. Lekang-Sørensen, U. Lynar, J.P. Petersen, M.B. Quitzau, A. Roser, C. Schively-Slotterback, Y. Shimoda, H. Strasser, R. Streblow, G. Stryi-Hipp (2017): Annex 63: Implementation of energy strategies in communities: Volume 1: Inventory of measures, IEA EBC project Annex 63, Salzburg Institute for Regional Planning and Housing, Salzburg, 2017
3. D. Kellenberger, V. Aagesen, I. Andresen, R. Buggie, K. Church, J. Freudenberg, J. Kimman, A. Koch, M. Kornmann, Å. Lekang-Sørensen, U. Lynar, J.P. Petersen, M.B. Quitzau, A. Roser, C. Schively-Slotterback, Y. Shimoda, H. Strasser, R. Streblow, G. Stryi-Hipp (2017): Annex 63: Implementation of energy strategies in communities: Volume 2: Development of strategic measures, IEA EBC project Annex 63, Salzburg Institute for Regional Planning and Housing, Salzburg, 2017
4. M.B. Quitzau, J.P. Petersen, V. Aagesen, I. Andresen, R. Buggie, K. Church, J. Freudenberg, D. Kellenberger, A, J. Kimman, Koch, M. Kornmann, Å. Lekang-Sørensen, U. Lynar, A. Roser, C. Schively-Slotterback, Y. Shimoda, H. Strasser, R. Streblow, G. Stryi-Hipp (2018): Annex 63: Implementation of energy strategies in communities: Volume 3: Application of Strategic Measures, IEA EBC project Annex 63, Salzburg Institute for Regional Planning and Housing, Salzburg, 2018

5. J. Kimman, V. Aagesen, I. Andresen, R. Buggie, K. Church, J. Freudenberg, D. Kellenberger, A. Koch, M. Kornmann, Å. Lekang-Sørensen, U. Lynar, J.P. Petersen, M.B. Quitzau, A. Roser, C. Schively-Slotterback, Y. Shimoda, H. Strasser, R. Streblow, G. Stryi-Hipp (2018): Annex 63: Implementation of energy strategies in communities: Volume 4: Stakeholder Support Materials, IEA EBC project Annex 63, Salzburg Institute for Regional Planning and Housing, Salzburg, 2018
6. H. Strasser, V. Aagesen, I. Andresen, R. Buggie, K. Church, J. Freudenberg, D. Kellenberger, J. Kimman, A. Koch, M. Kornmann, Å. Lekang-Sørensen, U. Lynar, J.P. Petersen, M.B. Quitzau, A. Roser, C. Schively-Slotterback, Y. Shimoda, R. Streblow, G. Stryi-Hipp (2017): Annex 63: Implementation of energy strategies in communities: Volume 5: Recommendations, IEA EBC project Annex 63, Salzburg Institute for Regional Planning and Housing, Salzburg, 2018

EBC and the IEA

The 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 31 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 IEA Energy in Buildings and Communities Programme

The IEA co-ordinates international energy research and development (R&D) activities through a comprehensive portfolio of Technology Collaboration Programmes.
The mission of the IEA Energy in Buildings and Communities (IEA 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 IEA Energy Conservation in Buildings and Community Systems Programme, ECBCS.)
The R&D 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. These R&D strategies 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 areas of focus 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 5:	Air Infiltration and Ventilation Centre
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 (FC+COGEN-SIM) (*)
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 (EnERGo) (*)
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 (RAP-RETRO) (*)
Annex 56:	Cost Effective Energy and CO_2 Emissions Optimization in Building Renovation (*)
Annex 57:	Evaluation of Embodied Energy and CO_2 Equivalent 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 (*)
Annex 68:	Indoor Air Quality Design and Control in Low Energy Residential Buildings (*)
Annex 69:	Strategy and Practice of Adaptive Thermal Comfort in Low Energy Buildings (*)
Annex 70:	Energy Epidemiology: Analysis of Real Building Energy Use at Scale
Annex 71:	Building Energy Performance Assessment Based on In-situ Measurements (*)
Annex 72:	Assessing Life Cycle Related Environmental Impacts Caused by Buildings (*)
Annex 73:	Towards Net Zero Resilient Energy Public Communities (*)
Annex 74:	Competition and Living Lab Platform (*)
Annex 75:	Cost-effective Building Renovation at District Level Combining Energy Efficiency and Renewables (*)
Annex 76:	Deep Renovation of Historic Buildings Towards Lowest Possible Energy Demand and CO_2 Emissions (*)
Annex 77:	Integrated Solutions for Daylight and Electric Lighting (*)
Annex 78:	Supplementing Ventilation with Gas-phase Air Cleaning, Implementation and Energy Implications

Annex 79:	Occupant-centric Building Design and Operation
Annex 80:	Resilient Cooling
Annex 81:	Data-Driven Smart Buildings
Annex 82:	Energy Flexible Buildings towards Resilient Low Carbon Energy Systems
Annex 83:	Positive Energy Districts
Annex 84:	Demand Management of Buildings in Thermal Networks
Annex 85:	Indirect Evaporative Cooling
Annex 86:	Energy Efficient Indoor Air Quality Management in Residential Buildings
Annex 87:	Energy and Indoor Environmental Quality Performance of Personalised Environmental Control Systems
Annex 88:	Evaluation and Demonstration of Actual Energy Efficiency of Heat Pump Systems in Buildings
Annex 89:	Ways to Implement Net-zero Whole Life Carbon Buildings
Annex 90:	Low Carbon, High Comfort Integrated Lighting
Annex 91:	Open BIM for Energy Efficient Buildings
Working Group -	Energy Efficiency in Educational Buildings (*)
Working Group -	Indicators of Energy Efficiency in Cold Climate Buildings (*)
Working Group -	Annex 36 Extension: The Energy Concept Adviser (*)
Working Group -	HVAC Energy Calculation Methodologies for Non-residential Buildings (*)
Working Group -	Cities and Communities (*)
Working Group -	Building Energy Codes

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