EBC

Energy in Buildings and Communities Programme

International Energy Agency

Strategic Plan 2019 – 2024

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Technology Collaboration Programme

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September 2019

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Cover picture: São Paolo, Brazil. The highest increases in population and energy demand during the next 20 years will happen in cities in emerging economies.
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Published by AECOM Ltd, The Colmore Building, Colmore Circus Queensway, Birmingham B4 6AT, United Kingdom

Participating countries in EBC: Australia, Austria, Belgium, 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, United Kingdom and the United States of America.

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Preface

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 30 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) Technology Collaboration 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.

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 (*) and joint projects with the IEA Solar Heating and Cooling Technology Collaboration Programme 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 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 Energy Resilient 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

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
Working Group - International Building Materials Database

Management Summary

Within the framework of the International Energy Agency (IEA) Technology Collaboration Programmes (TCPs), the Energy in Buildings and Communities (EBC) Programme is conducting collaborative research projects among its 24 member countries. The vision of the EBC Programme is that for new buildings and communities sustainable solutions have been adopted by 2030 giving near-zero primary energy use and carbon dioxide emissions, and a wide range of reliable technical solutions have been made available for the existing building stock. Its mission is to accelerate the transformation of the built environment towards more energy efficient and sustainable buildings and communities, by the development of knowledge and technologies through international collaborative research and open innovation.

Overall control of the EBC Programme is maintained by an Executive Committee, which not only monitors existing projects, but also identifies new areas where collaborative efforts may be beneficial. To date, 81 major international research and development (R&D) projects have been initiated within the Programme since 1977. The EBC Programme follows an open innovation R&D model, and works cooperatively with industry in its member countries, including designers and manufacturers.

The R&D strategy of the EBC Programme for the five year period from 2019 to 2024 is derived from an initial survey of the Executive Committee members, the outputs from the IEA Future Buildings Forum held in Singapore in October 2017 and from a Strategy Planning Workshop, held at the Executive Committee Meeting in Ottawa, Canada, in November 2017. This strategy represents the collective input of the members, and is intended to exploit technological opportunities to save energy in the buildings sector, and to remove technical obstacles to market penetration of new energy conservation technologies.
The Strategy Planning Workshop resulted in ten high priority research themes that can be separated into two types, namely 'Objectives' and 'Means'.

Objectives: The strategic objectives of the EBC Programme are as follows:

– reinforcing the technical and economic basis for refurbishment of buildings, including financing, engagement of stakeholders and promotion of co-benefits;
– improvement of planning, construction and management processes to reduce the performance gap between design stage assessments and real world operation;
– the creation of 'low tech', robust and affordable technologies;

– the further development of energy efficient cooling in hot and humid, or dry climates, avoiding mechanical cooling if possible;
– the creation of holistic solution sets for district level systems taking into account energy grids, overall performance, business models, engagement of stakeholders, and transport implications.

Means: The strategic objectives of the EBC Programme will be achieved by the means listed below:

– the creation of tools for supporting design and construction through to operations and maintenance, including building energy standards and life cycle analysis;
– benefitting from 'living labs' to provide experience of and overcome barriers to adoption of energy efficiency measures;
– improving smart control of building services technical installations, including occupant and operator interfaces;
– addressing data issues in buildings, including non-intrusive and secure data collection;
– the development of building information modelling (BIM) as a game changer, from design and construction through to operations and maintenance.

Contents

1. Introduction

The member countries of the International Energy Agency (IEA) Energy in Buildings and Communities (EBC) Technology Collaboration Programme (TCP) share a common interest in research and development (R&D) supporting more effective policies to improve building energy performance. This Strategic Plan provides a common understanding of the future R&D needed to support such policies.

Buildings use approximately 40% of all energy produced globally. The buildings sector is also widely recognized as having a large potential to reduce its energy use and related carbon dioxide (CO_2) emissions at relatively low cost in comparison with other sectors. In reports issued by global stakeholders, including the IEA and the International Panel on Climate Change (IPCC), this has been clearly acknowledged and quantified.

The EBC Programme has responded to these expectations and pressures by creating a concrete and focused R&D strategy for its next five year operating period between 2019 and 2024. This is to support the realization of the energy savings potential of the buildings sector and to provide a scientific foundation for the transformation of the international energy economy.

2. Current Environment, Barriers and Challenges

2.1 IEA Perspectives and Expectations for the Buildings Sector

In December 2015, 196 Parties to the UN Framework Convention on Climate Change (UNFCCC) adopted the Paris Agreement, a new legally-binding framework for an internationally coordinated effort to tackle climate change. For the first time, non-state actors were invited to be an intrinsic part of the process. Not only were public energy stakeholders included in the process, but non-governmental organisations (NGOs), the private sector, and regional and local entities as well. Cities were among the front runners, with their strong role in the lead-up to COP21 through the Lima-Paris Action Agenda, as well their support for the Paris Pledge for Action. The need to accelerate low-carbon technology innovation has also received significant attention in international fora, with the newly created Mission Innovation and the Breakthrough Energy Coalition aimed at catalysing and expanding investments in transformational technologies to accelerate decarbonisation.

The IEA Energy Technologies Perspective (ETP) 2016 has recognised that the transition requires massive changes in the energy system, in which the '2 Degrees Scenario' (2DS) highlights targeted measures needed to deploy low-carbon technologies, so as to achieve a cost-effective transition. 2DS represents a future scenario that keeps the increase in global average temperature to below 2°C, as set out by COP21. Increasingly the energy landscape is shaped by cities. With more than half of the global population and about 80% of the world's GDP in 2013, cities account for about two-thirds of primary energy demand and 70% of total energy-related carbon dioxide (CO_2) emissions. The energy and carbon footprint of urban areas will increase with urbanisation and the growing economic activity of urban citizens. By 2050, the urban population is expected to grow to two-thirds of the global population, with the urban share of global GDP at about 85%. Continuing current energy system trends, driven by existing policies such as in the ETP '6 Degrees Scenario' (6DS), would increase urban primary energy demand by 70% from 2013 levels to about 620 exajoules (EJ) in 2050, by when it would account for 66% of the total (Figure 2.1).

While the buildings sector energy intensity per unit area of floor space has improved in many regions, this has not been fast enough to offset the doubling of global floor area since 1990. Overall building energy use on a per capita level has remained practically constant

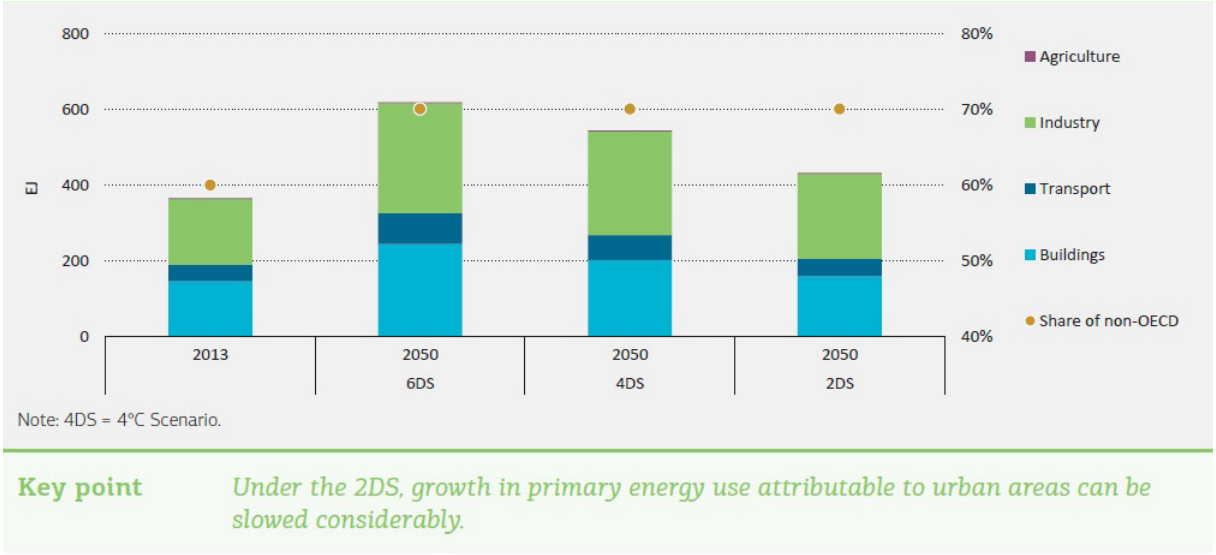
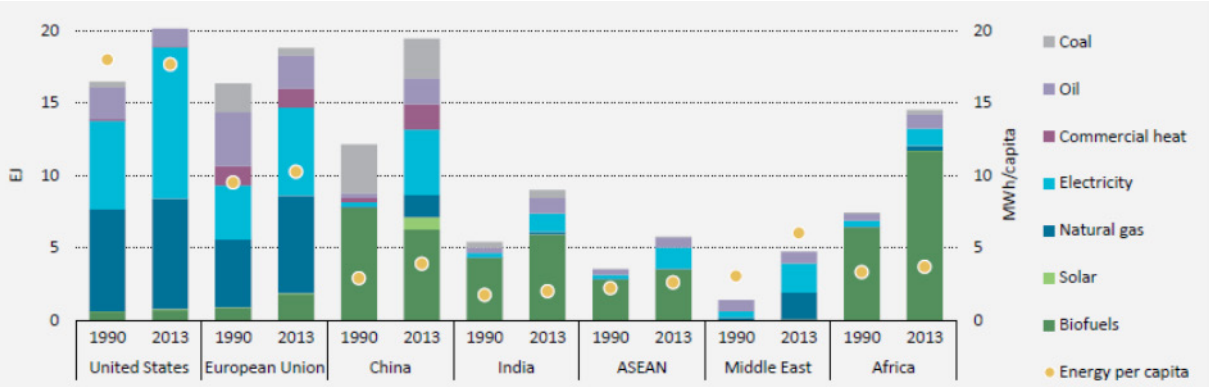


Figure 2.1 Urban primary energy demand in the ETP scenarios, 2013 - 2050
Source:IEA Energy Technologies Perspective 2016

at 5 megawatt hours (MWh) per person per year since 1990. The large potential for energy efficiency gains remains untapped, and assertive action is needed now to speed up intensity improvements by at least 50% and avoid the lock-in of inefficient, long-lived investments up to 2050.

However, current investment in building energy efficiency is not on track to achieve the 2DS targets. Although an increasing number of countries have implemented or improved energy efficiency policies related to buildings and appliances, progress has not offset increasing demand for better thermal comfort and ownership of energy-consuming products. The adoption and implementation of energy efficiency measures need to be accelerated rapidly, especially in emerging economies, such as P.R. China and India, where a window of opportunity still exists to address future building energy demand and to prevent the lock-in of inefficient, long-lived building investments. In developed countries, acceleration of deep energy renovations of existing buildings and installation of high-efficiency building construction products are critical to reaching or surpassing 2DS targets. Globally, building energy performance needs to improve from a reduction rate of 1.5% per year observed over the past decade to at least 2.5% per year required over the next decade beyond 2025.



Notes: Figures and data that appear in this report can be downloaded from www.iea.org/etp2016; ASEAN – Association of Southeast Asian Nations; Commercial heat refers to heat produced for sale (e.g. district heat) and that is available for consumption by final end users; Biofuels mainly comprise traditional sources such as fuelwood, charcoal, agricultural waste and dung; Figures and data that appear in this report can be downloaded from www.iea.org/etp2016.
Source: IEA (2015a), *IEA World Energy Statistics and Balances* (database), www.iea.org/statistics.

Key point *Few countries have decoupled building energy use from population growth. Energy efficiency is crucial to offsetting building energy growth while still providing comfort and improved quality of life.*

Figure 2.2 Building final energy use (exajoules, EJ) and intensity per person (MWh / capita) in selected regions
Source: IEA Energy Technologies Perspective 2016

– ETP 2016 presents key findings for energy efficiency in buildings in the urban environment that set the scene for the EBC Strategic Plan: If aggressive energy efficiency policies are pursued in line with 2DS, urban building energy use would be reduced by 30% in 2050 compared with 6DS. Urban areas are assumed to account for more than 75% of global building energy reductions under 2DS.
– Energy efficiency measures and fuel switching away from fossil fuels under 2DS would lead to a 50% reduction of direct CO_2 emissions in urban buildings in 2050 compared with 6DS. Indirect emissions (from upstream generation of electricity and commercial heat) would decrease by 93%. The majority of direct CO_2 emissions reductions from urban buildings would be achieved through decreased space heating and cooling.
– Low-energy new buildings, deep energy renovation of existing buildings, and low-carbon, energy-efficient heating and cooling technologies are the most important means to reduce CO_2 emissions from buildings in urban areas. Energy efficiency measures in buildings can also achieve multiple benefits for local communities, including job creation, improved air quality, improved thermal comfort, more affordable energy, reduced maintenance costs and more stable and resilient energy networks.

– While zero-energy buildings (ZEBs) and near-zero energy buildings (nZEBs) are generally technically feasible in urban areas, challenges (e.g. high urban densities and limited on-site renewable potential) may limit achieving these in practice. Efficient district heating and cooling (DHC) in combination with heat pumps and renewables, can play a vital role in achieving low-carbon and even carbon neutral communities.
– Integrated building and district energy measures can help to cost-effectively meet energy and emissions targets for 2050. A strategic long-term vision is necessary to encourage the effective planning and implementation of building renovation measures with district heat network investments.

Globally, increased efforts are needed to achieve high market penetration of energy-efficient building technologies, including high-performance windows, insulation, appliances, lighting and other building services equipment including ventilation, space heating and cooling systems, through minimum energy performance standards (MEPS) and construction product regulations. The integration of energy-efficient buildings and modern district energy networks using heat pumps, renewable energy technologies, thermal storage and other low-carbon heat sources (e.g. excess heat recovery) in dense urban areas can place the buildings sector and local energy networks on a sustainable, efficient 2DS pathway.

Additional assessments are also needed of the (non-technical) social, market and regulatory barriers, on both the local and national levels, that hinder the pursuit of more energy efficient buildings and sustainable low energy networks. These barriers, more than technical challenges, are the reason for slow progress to date and without greater understanding and workable solutions to overcome them it will be difficult to achieve the 2DS target.

Lastly, data, and a more acute sense of building energy needs and opportunities, are valuable resources that both national and local governments can use to analyse and shape policy decisions and prioritise energy efficiency efforts. Data can also play a critical role in targeting the right stakeholders at both the local and national scales to increase adoption of energy efficiency measures. Greater effort to improve global understanding of buildings sector energy performance and efficiency therefore should be a priority across all countries to select the right measures to put the buildings sector on an efficient, sustainable and cost-effective 2DS pathway.

3. Review of the EBC Programme

3.1 Background

The aim of the EBC Programme is to carry out science-based research in the field of energy in buildings and communities. The outcomes of EBC's international collaborative research projects address determining factors for energy in that domain, e.g. technological aspects, environmental aspects, processes (planning, construction and management), policy measures and behavioural aspects.

On the basis of the previous Strategic Plan 2014 - 2019, EBC has progressively evolved over the past few years. This is reflected in the steadily increasing number of EBC's R&D Annexes which form the basis of the Programme. While there were around 10 ongoing Annexes in 2010, by 2016 this has increases to 16. And with the expanding list of EBC research projects, the number of participating countries is also expected to increase in parallel, as there is a growing interest for joining the Programme.

One driver for the increasing interest is that reducing energy demand in buildings and communities continues to be of great importance globally and therefore of interest for the international research community. Although many technological and other approaches for reducing energy use and for the introduction of renewable energy have been developed in recent years, they are still to be widely deployed. One important reason for this is the investment needed to implement the required measures. Apart from technological methods for buildings, EBC-supported research also examines socio-economic approaches and the benefits of synergies at neighbourhood and community scales. The frequent technical, political and other changes underlying energy research and innovation require regular reviews, with the goal of further refining EBC's strategic direction.

The Strategic Plans for the IEA's Technology Collaboration Programmes (TCPs), including EBC, are typically renewed every five years by the programmes and approved by IEA Committee on Energy Research and Technology (CERT). This Strategic Plan for EBC covers the period 2019 – 2024.

The previous EBC Strategic Plan was developed in 2013 in consultation with the IEA Energy End Use Working Party (EUWP) and CERT, and is also based on the outcomes of an IEA Future Buildings Forum workshop. The IEA Future Buildings Forum is a regular activity run

jointly with the other buildings-related IEA TCPs. It is intended to identify long term energy, environmental, economic and other technical and non-technical issues for research and innovation, and to assess their potential effects on future building energy supply and demand.

3.2 Recent activities

The previous Strategic Plan focused on five priority research themes and their implementation:

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

The selection of themes reflected the broad scope encompassed by the EBC Programme. While the programme has worked primarily at the building level, it has also dealt with the large number of interfaces between different technologies in the larger spatial context of communities. As an overview, Figure 3.1 shows all EBC Annexes that have been or are

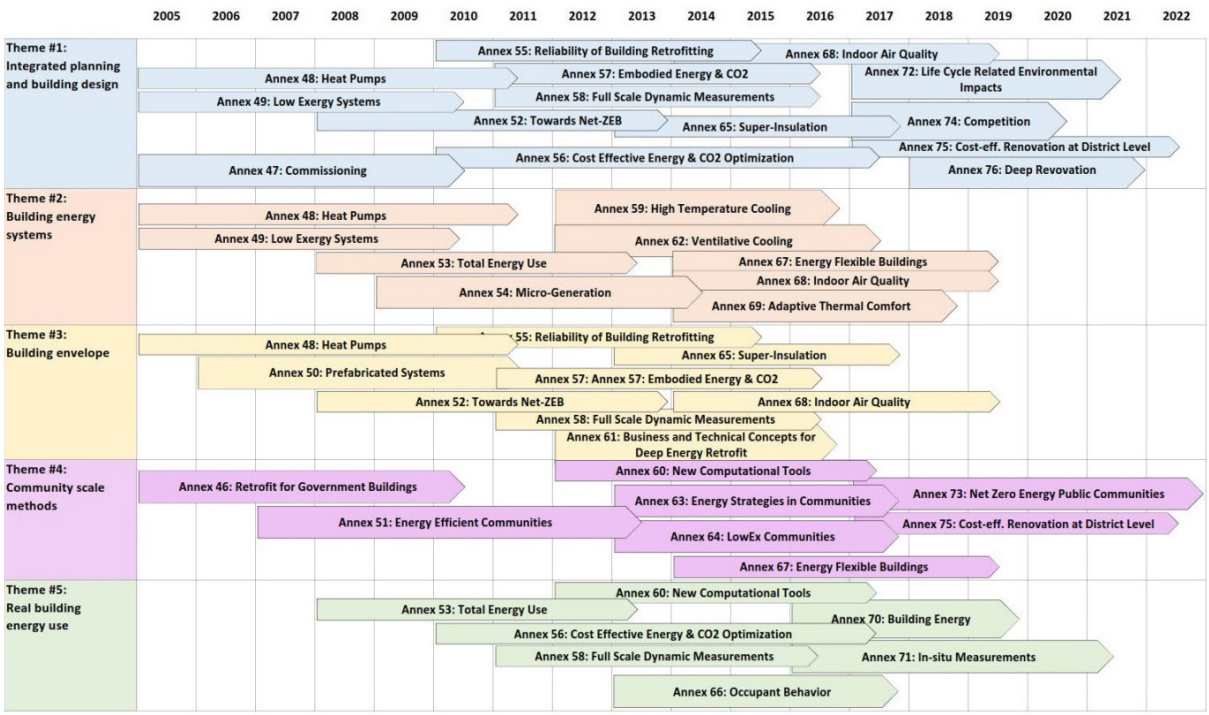


Figure 3.1: Mapping from EBC Annexes to the five focus themes of the previous Strategic Plan 2014 – 2019.
Source: Rolf Moser

running from 2005 until the present time: These Annexes are mapped into the five prioritized themes for the previous strategy period.

Thirteen new EBC research projects have been approved during the period 2014 – 2018 covering all the five priority themes. This includes establishing new EBC Working Groups on 'HVAC Energy Calculation Methodologies for Non-residential Buildings' and 'Communities and Cities'.

A Mid-Term Assessment of the Strategic Plan 2014 – 2019 was undertaken. An initial analysis of gaps in the work programme with regard to the objectives of the Strategic Plan was carried out by the EBC Executive Committee. In this assessment, all Annexes established since 2000 were thematically analysed and compared with the topics and sub-topics set out in the Strategic Plan. This analysis showed a number of key findings, not only on the implementation of EBC's previous strategy, but also emerging issues to form the future strategy, as follows:

– There was found to be good implementation of the strategy through the current Annexes, with ongoing Annexes on most of the many sub-topics identified in the Strategic Plan. Particularly for the recently approved Annexes, the consistency with the strategy was very good.
– Strengthening of activities was recommended within the framework of the gap analysis in the field of 'real building energy use', which has since been addressed by the approval of Annexes 70 and 71.
– In addition to technical topics, more non-technical aspects should be included in energy research for buildings and cities for the future. These include socio-economic aspects, occupant behaviour, and the motivations of building owners with regard to the renovation of their properties.
– The Strategic Plan did not however include organizational aspects of the work, such as approval criteria for new Annexes, which have an important influence on research activities.

Further advancement of the EBC Programme is expected, with important topics gaining even more emphasis in the future, especially in light of a range of highly relevant and application-ready results that have been published as outcomes from the research projects. In addition, the Programme’s management approach has been strengthened, with the large number of current Annexes calling for new Executive Committee governance structures. To put one of these into practice, EBC has recently adopted a new management concept by appointing 'Annex Advisors' to more closely connect the Committee with the work of the Operating Agents, who are in charge of leading the collaborative research projects. The effectiveness of the Sub-Committees was also successfully strengthened during the last period, to support

the Executive Committee Chair and intensify their related activities, with the following now in place:

– Communications and Technology Transfer
– Quality Assurance
– Finance

Examples of new types of activities and Annexes established within the EBC Programme during recent years have included competition development and conference coorganization. The EBC Annex 74 'Competition and Living Lab Platform' competition framework and knowledge sharing platform is an atypical project for the Programme. In this project, the existing Solar Decathlon competition format is being evolved to address building renovation, building energy systems, life cycle resource optimization and possibly even transport energy system issues. This is an opportunity to extend the outreach of the Programme to a wider audience.

3.3 Outlook

The IEA TCPs in the buildings and communities sector are important R&D platforms that greatly support international knowledge exchange and avoiding duplication of research efforts. With their continued expansion by involving emerging economies, research findings can very quickly have impact in practice. This applies in the case of new construction projects, as well as for existing buildings and neighbourhoods. The built environment remains one of the sectors where most energy is used in the world. This situation will continue for a long time e.g. due to the needs of people in the developing nations to achieve greater living standards, health and comfort. Therefore, it is of great importance to improve the energy efficiency in the built environment globally.

The EBC Executive Committee needs to ensure that high quality research is maintained in the Programme, while managing an increasing number of Annexes. In creating the new strategy, therefore, topics such as acceptance criteria for new Annexes are important. Another major question is how Annexes should be established. Should this be 'bottom-up', with proposals mainly from the research community, or should the Executive Committee undertake more efforts on developing proposals i.e. 'topdown'? Lastly, but not least, concrete recommendations for policy and decision makers as a result of the research are increasingly important. The handling of this aspect has also been considered in this new strategy.

4. Vision and Mission

4.1 Vision towards 2030

The vision of the IEA Energy in Buildings and Communities Programme is that:

For new buildings and communities sustainable solutions have been adopted by 2030 giving near-zero primary energy use and carbon dioxide emissions, and a wide range of reliable technical solutions have been made available for the existing building stock. al building energy use

4.2 Mission

The mission statement of the EBC Programme is:

To support the acceleration of the transformation of the built environment towards more energy efficient and sustainable buildings and communities, by the development and dissemination of knowledge, technologies and processes and other solutions through international collaborative research and open innovation.

5. Strategy Implementation and Dissemination

5.1 Introduction

The year 2019 marks the 44th anniversary of the IEA Technology Collaboration Programmes (TCPs), formerly known as Implementing Agreements. The IEA Governing Board approved the establishment of TCPs in 1975 as the principal IEA tool for multilateral technology collaboration. Their creation stemmed from the idea that countries had more to gain from pooling their tightening budgets for research activities with other governments, industry and academia rather than carrying out separate efforts. Sharing information and experiences through a TCP accelerates outcomes on innovative energy technologies to the collective benefit of all IEA members, who face similar energy challenges. This principle of collective innovation to meet shared challenges has been at the heart of the TCPs for the last 43 years.

But how should efficiency be assured, not only in research, but also in information that covers the needs of the market and the users? How should activities be enabled that ultimately lead to substantial impacts on energy use? Even if researchers do not always have these criteria in mind, the success of their work depends on implementation aspects and on carefully preparing for the application of the research outcomes.

5.2 Current EBC operation and motivation for a new strategy

Until now, EBC activities have depended strongly on the engagement of researchers within the buildings field. Motivated researchers would propose new Annexes, organise research groups and apply for funding. Good cross-linking with other researchers and with the EBC Executive Committee ensures the mutual cooperation. Moreover, the completion of one Annex often leads to the creation of a new Annex, as a continuation of the work of the well-established research group.

This 'bottom-up' approach has many advantages, which will be discussed further in Section 5.3. On the other hand, it may lead to proposals for activities that do not necessarily cover the most important and urgent research topics. With this new Strategic Plan, the Executive Committee has set new research priorities and intends to improve the impact of the Annexes.

5.3 Origins and development of new EBC Annexes

On the subject of the creation of new Annexes, certain aspects have to be carefully considered: Since Annexes usually operate for 3 to 4 years, one has to be aware that changes in the strategy only impact on the research outcomes months or even years later. During recent years, the number of current Annexes in the EBC Programme has steadily increased. For organisational purposes, a high number of ongoing Annexes could lead to an excessive administrative burden on the Executive Committee, with the possibility of decreasing quality. Therefore, the process for the creation and development of new Annexes needs to follow a certain number of practical 'rules', which are described below.

Cost shared or Task shared activities

While the EBC Programme enables both 'task shared' and 'cost shared' activities, task shared Annexes are the most common form adopted by the Programme. With this approach, all participants are directly funded for their contributions from within their own countries. Task shared activities require approval of an overall time-based budget covering the contributions of the participants to meet the proposed work plan. (Joint funding contributions are not made with this collaboration model.)

Cost shared Annexes start with a budget being prepared for specific activities based on a common fund. As the financing of cost shared activities depends on funding being offered by multiple organisations, in practice the equivalent budgets are usually less substantial than those of task shared Annexes. They can however more rapidly respond to needs for short term research.

Bottom-up generation of new Annexes

Typically, new Annexes within the EBC Programme are initiated by research groups from the bottom-up. These groups would formulate an Annex proposal on a specific topic about which they have made some preliminary research. This mechanism for new Annex generation has certain advantages (+), but also inconveniences (-):

– (+) The bottom-up approach has the advantage that new trends for research topics emerge through the state-of-the-art knowledge of research groups and their motivation to start work on them.
– (-) As set out in the current EBC Implementing Agreement, the threshold for establishing a new Annex is rather low, as only two supporting countries may agree to start a new Annex.

– (-) Successful research groups often propose a new Annex after concluding a previous one, on account of the good collaboration experienced within the existing group. But, this does not guarantee that the highest ambitions of the EBC Programme will be met.

Top-down generation of new Annexes

In the EBC Programme, top-down generation of a new Annex has been rare until the present time. On the one hand, such influence on research topics could have the advantages of filling gaps that appear in meeting the objectives of the current Strategic Plan and of creating new alliances in the wider research community. On the other hand, the research groups needed have to be actively brought together through the efforts of the national Executive Committee Members, along with the organisation of the funding for their work.

Roles and responsibilities

This section describes the roles and responsibilities of different partners, who would contribute to the development, implementation and long-term assessment of the EBC Strategic Plan, and to the creation and successful operation of new Annexes:

– The EBC Executive Committee appoints a Strategic Plan Working Group to develop the new Strategic Plan in consultation with the full Committee and define time schedules for later assessments of the Plan.
– The Executive Committee approves the new Strategic Plan and makes a formal Request for Extension to CERT. The new Strategic Plan is subject to approval by CERT with the advice of the EWUP, and which forms a key aspect of the decision by CERT in the IEA TCP Request for Extension process.
– On behalf of the Committee, the Strategic Plan Working Group elaborates each new strategy as required and is responsible for assessments during its active phase.
– The Executive Committee Chair initiates the abovementioned Committee tasks and coordinates development of the Strategic Plan within the IEA framework (with the EUWP, CERT and other buildings-related TCPs).
– If necessary, the Executive Committee proposes or initiates new Annexes, if certain topics of the Strategic Plan are not already covered by ongoing Annexes. The Committee approves new Annexes, appoints Operating Agents and Annex Advisers.
– The Committee can consider whether to adapt the current Strategic Plan to respond to new trends for R&D topics as they emerge.
– The Operating Agents are responsible for managing Annexes, not only with good technical expertise, but also with sound management skills. Some of their main responsibilities are:
    - regularly reporting on project progress and any issues to the Executive Committee;

- regularly communicating with the Annex Adviser;
- ensuring that each participant is fulfilling their agreed commitments;
- keeping the project running to schedule and quality;
- supervising the production, quality, financing (if applicable) and dissemination of Annex outcomes.

– The Annex Advisers assure that proposed new Annexes are in line with the Strategic Plan and that certain minimal criteria are fulfilled by proposals. They accompany the Annexes during their different phases of their evolution and provide advice for the Executive Committee on Annex development. Annex Advisers are a relatively new concept and the efficacy of the role will be evaluated once sufficient experience is gained.

5.4 How to improve the impacts of energy research

The impacts of research occur in many ways – through knowledge exchange, new innovative products and processes, new companies and job creation, skills development, increasing the effectiveness of public services and policy, enhancing quality of life and health, international development and so on. Thinking about and planning for societal, economic, environmental and academic impacts at the very beginning of a research project improves how it proceeds and the effect of the research. The key steps [1] needed to plan for successful research impacts are to:

– articulate problems and reasons why relevant aspects or targeted parts of buildings and their technical services systems do not currently function in satisfactory ways, and how these problems can be solved;
– identify and focus on potential outcomes;
– identify and actively engage relevant end users of research outcomes and stakeholders at appropriate project stages and document evidence of any existing engagement with them;
– explain the context and needs of users and consider ways for the proposed research to meet these needs or impact upon understanding of these needs;
– outline the planning and management of associated project activities including timing, personnel, skills, budget (in terms of time required, and cost if applicable), deliverables and feasibility of meeting the research objectives given the scope;

First of all identifying and keeping these steps in mind during the development of a new Annex as well as during later phases is called the 'pathway to impact', one of the criteria for the approval of new EBC Annexes.

[1] Adapted from https://epsrc.ukri.org/funding/assessmentprocess/review/formsandguidancenotes/networkgrants/

5.5 New Annex Approval Procedure

The existing procedure for approving a new Annex within the EBC Programme consists of the following steps:

- generation of a top-down or a bottom-up idea for a new Annex;
- based on this idea, presentation and discussion of a Project Concept at an Executive Committee Meeting;
- if accepted, assignment of an Annex Adviser and development of an Annex proposal based on an international workshop by interested countries;
- elaboration of a preliminary Technology Readiness Assessment (pTRA) by interested countries;
- presentation and discussion of the Annex proposal at a following Executive Committee Meeting;
- if accepted, approval of the new Annex.

At the EBC Strategy Planning Workshop held in November 2017, the idea was developed to strengthen the existing approval procedure for a new Annex by taking into account new criteria. These are explained below.

New Annex Approval Criteria

To be able to contribute to the aims of the EBC Strategic Plan, a new Annex should satisfy a certain number of criteria. Further to the existing procedure, the following elements have to be examined in the Annex proposal:

- Minimum participation: There should be a minimum of three EBC countries that formally commit to participate as part of the Annex proposal.
- Quality and relevance: The Annex proposal should be of good scientific quality and highly relevant to EBC's mission and vision.
- Organization, participants: The participating Operating Agent and the Subtask Leaders should preferably be experienced in their roles with secure funding. An Operating Agent should preferably have been a Subtask Leader in a completed EBC Annex, or have equivalent experience.
- Energy efficiency and greenhouse gas emissions reductions: When widely deployed, the outcomes of the Annex when completed should perceptibly contribute to improve energy efficiency, to the application of renewable energy sources, or be of importance for those aspects. The rated parameter is the reduction of greenhouse gas emissions.

– Co-benefits: The outcomes of the Annex when completed should contribute to possible co-benefits, or at least not create significant disadvantageous side effects.
– State-of-the-art review: The preliminary Technology Readiness Assessment (pTRA) process will be reviewed by the EBC Executive Committee with the aim that this becomes a minimum requirement for a 'State-of-the-Art Review' and the pTRA could be one way of satisfying this requirement. Further guidance on the 'State-of-the-Art Review' will be developed by the Committee.
– Pathway to impact: An important part of the Annex proposal is an analysis and a description of the planned ways of how to create impact with the results of an Annex.
– Topics of the Strategic Plan: The initiators of a new Annex proposal should show, which of the high priority research topics mentioned in the Strategic Plan are covered.

New Annex proposals should therefore be assessed according to whether they meet these criteria. An appropriate, more detailed, process will be established by the EBC Executive Committee.

5.6 Dissemination

Typically within each Annex, a subtask for dissemination is included, and comprehensible outputs and official deliverables shaped for the target audiences are created. Depending on the form and content of the elaborated results, the following types of dissemination are used:

– **EBC Technical Day held in conjunction with each EBC Executive Committee Meeting:** The EBC Technical Day is organized twice a year together with Executive Committee Meetings and is a good opportunity to disseminate results from Annexes to the national audience in the host country.
– **EBC website, newsletter and Annual Report:** The EBC website is a central instrument to disseminate outputs from Annexes including full reports and comprehensible booklets. The quality of the contents needs to be constantly up-dated, maintained and improved. The EBC newsletter and the Annual Report are also very important for widely disseminating the outputs from EBC activities.
– **International conferences and workshops:** A significant means to disseminate outputs from the Annexes are international conferences and workshops. The AIVC Annual Conference, which is organized by Annex 5, is an example of a good opportunity to arrange special sessions for presenting EBC Annexes.
– **Academic publications, journal papers and technical articles:** As part of their careers, many of the researchers involved in Annexes are required to author academic publications and journal papers and other technical articles. Sometimes, it may be appropriate to

engage a professional author for articles for technical newsletters to formulate the content in a readily comprehensive way for a wider audience that for purely academic publications.
– **Involvement of research end users:** The involvement of target groups may facilitate indirect dissemination of results of the re-search work, e.g. within utility companies, construction product manufacturers, designers, and so on.

EBC Executive Committee Support Services Unit

The EBC Executive Committee Support Services Unit (ESSU) provides the Executive Committee with a wide range of administrative and information dissemination services to enhance its operational effectiveness. The ESSU assist the Committee in overall Programme management. It works in three major areas: administrative support, programme support and information dissemination.

– **Administrative support:** Before EBC Executive Committee Meetings, the ESSU provides pre-meeting preparations and timely dissemination of meeting documents to delegates. It produces the minutes of each Meeting, which form the legal record of decisions and policies of the Committee. The ESSU assists the Executive Committee Chair in keeping business flowing between meetings.
– **Programme support:** The ESSU assists all EBC Annexes, the IEA Buildings Coordination Group, the Future Buildings Forum, Working Groups, and other related activities in meeting the administrative requirements of the EBC Executive Committee and the IEA Secretariat.
– **Information dissemination:** The ESSU promotes the overall EBC Programme and individual activities to achieve greater awareness and participation. The ESSU strengthens the communication links between the Executive Committee and the IEA Secretariat, other TCPs and non-participating countries, and between the EBC Programme and its target audiences.

EBC Annex Communications Groups

While many EBC Annexes already establish Subtasks for dissemination, to further improve the overall quality of EBC Programme outputs, and assist the Operating Agent(s) with implementing the pathway to impact, the Executive Committee will consider whether to require each new Annex to form an 'Annex Communications Group'. This would consist of a core group within each Annex with the general terms of reference to extensively support Operating Agent(s) with the effective communication of emerging and final Annex results intended for the agreed target audiences, where necessary using terminology standardised across the EBC Programme, closely following the EBC Corporate Design for document formatting, and using the most effective communications channels for dissemination.

6. Main Research Themes

6.1 Introduction

The high priority research themes in this strategy are based on research drivers, national programs within EBC countries, the Future Buildings Forum (FBF) Think Tank Workshop held in Singapore in October 2017 and a Strategy Planning Workshop held at the EBC Executive Committee Meeting in November 2017. The research themes represent a collective input of the Executive Committee members and Operating Agents to exploit technological and other opportunities to save energy in the buildings sector, and to remove technical obstacles to market penetration of new energy technologies, systems and processes. Future EBC collaborative research and innovation work should have its focus on these themes. The research themes apply to all types of buildings and community systems and across the EBC Research Landscape as represented in Figure 6.1. This Figure attempts to give a clear

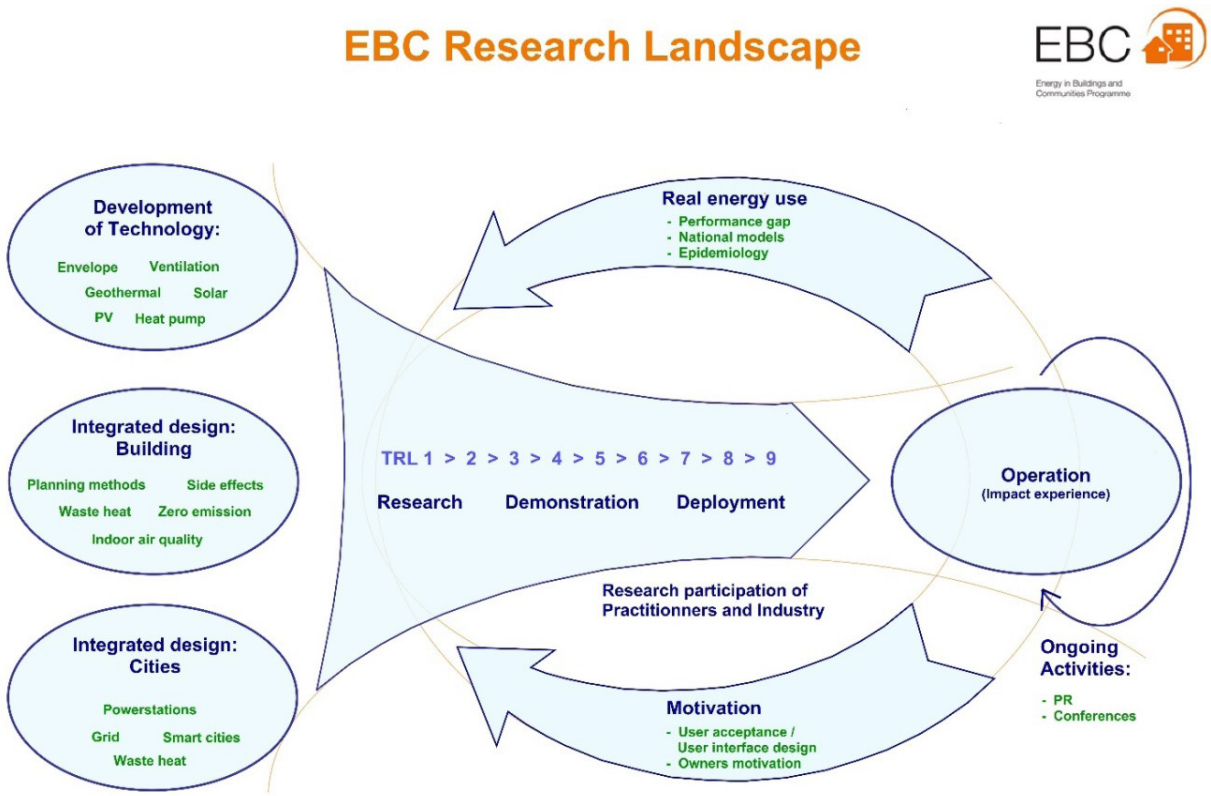


Figure 6.1: The Research Landscape of the EBC Programme, showing the development of research through the different stages of progress towards operation.
Source: Rolf Moser

structure to the research topics and to show the relationships between research, development and operation. At the Strategy Planning Workshop in 2017, some 40 research themes were developed. From those 40 themes, 10 themes of special high priority have been extracted, taking into consideration a score that was given to each theme at the workshop.

The 10 high priority themes can be separated in two types namely 'Objectives' and 'Means'. These two groups are distinguished for a better understanding of the different themes.

Objectives: The strategic objectives of the EBC Programme are as follows:

– reinforcing the technical and economic basis for refurbishment of existing buildings, including financing, engagement of stakeholders and promotion of co-benefits;
– improvement of planning, construction and management processes to reduce the performance gap between design stage assessments and real world operation;
– the creation of 'low tech', robust and affordable technologies;
– the further development of energy efficient cooling in hot and humid, or dry climates, avoiding mechanical cooling if possible;
– the creation of holistic solution sets for district level systems taking into account energy grids, overall performance, business models, engagement of stakeholders, and transport energy system implications.

Means: The strategic objectives of the EBC Programme will be achieved by the means listed below:

– the creation of tools for supporting design and construction through to operations and maintenance, including building energy standards and life cycle analysis (LCA);
– benefitting from 'living labs' to provide experience of and overcome barriers to adoption of energy efficiency measures;
– improving smart control of building services technical installations, including occupant and operator interfaces;
– addressing data issues in buildings, including non-intrusive and secure data collection;
– the development of building information modelling (BIM) as a game changer, from design and construction through to operations and maintenance.

The themes in both groups can be the subject for new Annexes, but what distinguishes them is that the 'objectives' themes are final goals or solutions (or part of) for an energy efficient built environment, while the 'means' themes are instruments or enablers to reach such a goal. These themes are explained in more detail below.

6.2 Research Themes: Objectives

Theme: Refurbishment of existing buildings: Finance, stakeholders and co-benefits

Research issues and aspects: Finance, behaviour, environmental assessment, co-benefits, stakeholders, a building as a system, technology, methods, models

Description: There is a global interest of aspects of renovation of existing building stocks. Many projects regarding renovation have been performed. In addition to energy performance, the overall performance of existing buildings is also of interest in order to plan and realize large-scale retrofit and refurbishment actions. Platforms are needed that enhance the promotion of energy efficiency service provision and improve the continuous and accurate information to decision makers, in industry and policymaking. The research challenge is to develop efficient and intelligent auditing, monitoring, benchmarking and diagnosis methods and tools covering the whole system including funding and the motivation of stakeholders.

Theme: Planning, construction and management process reducing the performance gap

Research issues and aspects: Methods, models, industrialised construction, performance gap

Description: There is clear evidence that buildings do not function as desired. Reasons could be that the targets of the construction project have been unclear, solutions have not been examined enough or quality control has been insufficient, or did not cover the whole chain from the initial planning to maintenance in use. The management of the persistence of targets and performance over the whole life cycle demands for proper monitoring, instrumentation and reporting. Concepts, models and diagnostics for the extensive management of performance characteristics and for the guaranteed performance need to be further developed. There is a need for tools that identify sources of performance gaps and provide feedback to designers, as well as to building owners and operators.

Theme: Low tech, robust and affordable technology

Research issues and aspects: Low tech, building technology, building services, materials, a building as a system

Description: There is scope for new and enhanced tools to adopt feedback from previous projects to simplify solutions and ensure they are robust. Work is required to specifically examine robustness, occupant comfort and satisfaction with low tech solutions. At present there is limited use of smart controls and technologies to ensure robust performance without overcomplicating solutions. Data are needed to demonstrate robustness of performance: energy, environmental, durability, and so on.

Theme: Energy efficient cooling in hot and humid, or dry climates, avoiding mechanical cooling if possible

Research issues and aspects: Technology, models, methods, a building as a system

Description: Simplified or sophisticated tools for the minimisation or elimination of cooling demand and the incorporation of passive solutions should be developed. Smart controls and technologies to enable passive and low energy cooling are also needed. The real energy performance of space cooling and dehumidification systems have to be clarified, so that correct design decisions can be taken by comparing cost effectiveness and life cycle environmental impacts of passive and mechanical cooling methods.

Theme: Holistic solution sets on a district level: energy grids, overall performance, business models, stakeholders, transport energy system implications

Research issues and aspects: Energy grids, business models, stakeholders, technology, transport energy system implications, energy sources

Description: Sustainable local solutions (building blocks, neighbourhoods) are attained by a combination of technologies that can be used in the specific local context to achieve the required level of energy use, building performance and economy. Integrated system optimisation needs to be applied to promote maximally energy-efficient systems. The adaptability of different solutions and technologies to developing and transition economies needs to be studied through a holistic approach. Solution databases of best practices applicable in different regions need to be developed. Tools are needed that link individual building design and operational performance to community systems for energy delivery and related infrastructure.

6.3 Research Themes: Means

Theme: Tools for design to operation, including building energy standards and LCA

Research issues and aspects: Design to operation, building energy standards, LCA
Description: Embodied energy and resources should be accounted for. Tools to support financing for energy services companies (ESCOs) and performance guarantees should be created. There is a need for tools that link individual building design and operational performance to community systems for energy delivery and related infrastructure. Useful tools applicable at stages from design to operation should be supplied to practitioners. These include energy calculation tools, which can be used for decision making at early design stage or for national building energy standards. They also include tools for various types of commissioning practices, and tools for life cycle analysis of buildings' environmental impacts.

Theme: Living labs to provide experience and barriers of adoption of energy efficiency measures

Research issues and aspects: Occupant behaviour, acceptance and comfort
Description: Living labs are based on a systematic user co-creation approach integrating research and innovation processes. Living labs allows all involved stakeholders to concurrently consider both the global performance of a product or service and its potential adoption by users. Occupant response and evaluate performance, including possible risks and unintended consequences of retrofits can be explored. Living labs could be used to explore operational aspects in more detail and to test the impact of changes over time. A further purpose is to specifically examine robustness, occupant comfort and satisfaction. They can be used to explore community level demonstrations of holistic solution sets.

Theme: Smart control of building services technical installations, including occupant and operator interfaces

Research issues and aspects: Technical building services installations, user interfaces for occupants and operators
Description: Technical building services systems contain a large number of components and are therefore difficult to operate perfectly from the outset. Automated monitoring helps to detect malfunctions and excessive energy use. Optimized controls depend on real building utilisation and occupant behaviour. New technologies, such as Internet of Things (IoT) and artificial intelligence (AI) may improve the effectiveness and indoor environmental quality.

Theme: Data issue in buildings, non-intrusive and secure data collection

Research issues and aspects: Data issue in buildings, non-intrusive and secure data collection

Description: Data collection at scale is required to evaluate opportunities for refurbishment and post-refurbishment performance. Medium to large scale data gathering on residential and non-residential projects should be carried out to understand the sources of performance gaps in the operational phase.

Theme: BIM as a game changer, from design to operation

Research issues and aspects: Building information modelling (BIM) as a game changer, from design and construction through to operations and maintenance, industrialised construction

Description: Digitisation of existing building information will help to minimise retrofit risk and maximise benefits. BIM for effective design construction and operation of passive solutions should be investigated, as well as effective integration and operation of low energy cooling solutions.

7. Collaboration

7.1 Collaboration with the IEA Secretariat and other IEA TCPs

The IEA Secretariat draws together the needs of its member countries and points out the general research directions and objectives that the TCPs should adopt in response. There is especially an urgent need for the reduction of energy use in the buildings sector, which is closely related to the TCPs within the EUWP and REWP, overseen by the Buildings Coordination Group. Cooperation with EUWP and CERT is important for EBC, to keep in touch with IEA Secretariat policies and outcomes, and to support collaboration with the above-mentioned TCPs.

At the building scale, collaboration with the Solar Heating and Cooling (SHC), Heat Pumping Technologies (HPT), Photovoltaic Power Systems (PVPS) and Efficient Electrical End-Use Equipment (4E) TCPs should be sought. Working with HPT and PVPS, evaluation of heat sources for HVAC, domestic hot water systems and photovoltaic systems can be themes for information and knowledge exchange.

At the community scale, collaboration with the District Heating and Cooling (DHC), Demand Side Management (DSM), Energy Conservation through Energy Storage (ECES), International Smart Grid Action Network (ISGAN) and Advanced Materials for Transportation (AMT) TCPs should be sought. Working with DHC, matching thermal and electrical loads in buildings with the capacity of energy generation sources in the central station (also known as an energy centre) can be a theme for collaboration. Specifically, EBC needs information about the total efficiency of district heating and cooling systems to estimate energy use of buildings and community systems together. Working with DSM and ISGAN, not only the total energy use in buildings and community systems, but also the timing of electricity demand can be a research theme. Better co-ordination between electricity supply systems and energy systems on the end user side can minimize primary energy and CO_2 emissions rate per unit delivered electricity. This also contributes to peak load reductions. Working with ECES, technologies to move surplus thermal and electrical energy over short or long time scales can form the basis for collaboration at both the community and building scales.

Periodic joint meetings and workshop on particular topics with other TCPs should be planned. Key representatives from the IEA Secretariat, EUWP and BCG should be invited to such joint meetings and workshops, as well as to EBC Executive Committee Meetings and working meetings of the EBC Annexes.

7.2 Collaboration with the IEA SHC Implementing Agreement

While there are several TCPs that are related to the buildings sector, the EBC Programme and the SHC TCP focus primarily on buildings and communities. Synergies between these two TCPs occur because one seeks to meet a large portion of energy demand using solar energy, while the other seeks to cost-effectively reduce energy demand. The combined effect results in buildings that require less purchased energy, thereby saving operating costs and conventional energy resources, and reducing greenhouse gas emissions. SHC has the primary responsibility for solar designs and solar technologies to supply energy to buildings. The EBC Programme has primary responsibility for efficient use of energy in buildings and communities. To facilitate this collaboration the Executive Committees will meet together every two years to discuss areas of common interest, including new Annexes / Tasks. The Programmes have agreed to a formal procedure for coordination of their work activities. Under this agreement during the initial planning for each new Annex / Task initiated by either programme, the other Executive Committee is invited to determine the degree of coordination, if any.

To facilitate collaborative activities with other TCPs, the EBC Executive Committee has approved a policy on collaborative Annexes / Tasks with other IEA TCPs. This policy recognizes that although from a management point of view it is better to formally manage an Annex / Task in only one Executive Committee at a time, there are Annexes / Tasks that lend themselves to collaboration. To facilitate this process, the Executive Committees of both EBC and SHC, have agreed upon common four levels of collaboration as follows:

– Minimal
– Moderate
– High
– Joint

Determining the degree of coordination:

Potential joint activities should be identified at an early stage of their development. To facilitate identification of suitable future collaborative work this information should already be given

in the first draft of work proposal, thus be included in the Project Concept template. The Executive Committees then perform the following steps:

1. Executive Committee A identifies potential collaborative work in an early stage.
2. Executive Committee A proposes level of collaboration and leading Executive Committee to Executive Committee B and lists their arguments.
3. Executive Committee B discusses proposed collaboration. If Executive Committee B does not agree with the proposal it makes a counterproposal to Executive Committee A and lists their arguments.
4. If a counterproposal has been made the Executive Committee Chairs decide on this acting in unanimity.

7.3 New Member Countries

Countries that have common topics with this Strategic Plan on their research agendas are welcome to join EBC. This is not only to strengthen international research collaboration, but also to enhance EBC's outreach. In addition, a special interest of the IEA Secretariat lies in supporting emerging economies, even when they are not member countries. EBC will search for opportunities to be able to contribute to such economies where CO_2 emissions in buildings sector are rapidly increasing, through dissemination of EBC’s knowledge and expertise.

7.4 Collaboration with Non-IEA Bodies

Energy efficiency in buildings is a major topic in European Union policy and in RTD (Research and Technological Development) programmes. In terms of energy policy in buildings, the various related Directives (Energy Performance of Buildings Directive, Renewable Energies Directive, Energy Efficiency Directive, and so on) have a major impact on the energy policies and action plans of the EU Member States and are a major driver for many action plans and research programmes. Also, European standardisation is receiving much attention in the context of the implementation of these various Directives. Given this context, it is important to actively seek close collaboration.

Collaboration with relevant technical committees in ISO, CEN and ASHRAE is important for the EBC Programme. Relevant ISO Technical Committees need a much greater scientific basis than currently exists, for example. Collaboration with ISO, CEN Technical Committees and other international committees on standards should be arranged. In the period covered by this Strategic Plan, information exchange should be more frequent and intensive than before.

As previously mentioned, building energy codes in each country and region are the most dependable methods to transform practices in the buildings sector. The extent to which higher energy performance is required in such codes depends on national circumstances, but much of the core knowledge base can be shared and developed in international collaboration within this Programme. Therefore, information exchange on building energy codes among EBC participating countries is very important. Setting high standards for practices in the buildings sector is one of the most important tools to initiate market transformation to cost effective energy efficient practices.

Production of tailored country-specific summaries of Annex outputs including policy recommendations is strongly encouraged to have impacts on national policies including on building energy codes and regulations.

The International Partnership for Energy Efficiency Cooperation (IPEEC) is an autonomous organisation, which is hosted by the IEA Secretariat. It includes 15 voluntary member countries that participate in their work through Task Groups and encompasses both developing and developed economies. The member countries collectively account for around 75% of global GDP and energy use. IPEEC reports at ministerial level to the G20 and Clean Energy Ministerials and tries to percolate technical information up to ministerial level. Relating to this, there is a need for credible, comprehensible information. As IPEEC is dealing with some of the key non-technical barriers to technology deployment, including user (occupant) behaviour and marketing, collaboration with IPEEC, especially for dissemination of Annex results should be established.

Mission Innovation is another organization with which EBC should explore ways for collaboration. In particular, one of its Innovation Challenges, “Theme 7. Affordable Heating and Cooling of Buildings”, should be focused upon by the EBC Programme.

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