EBC

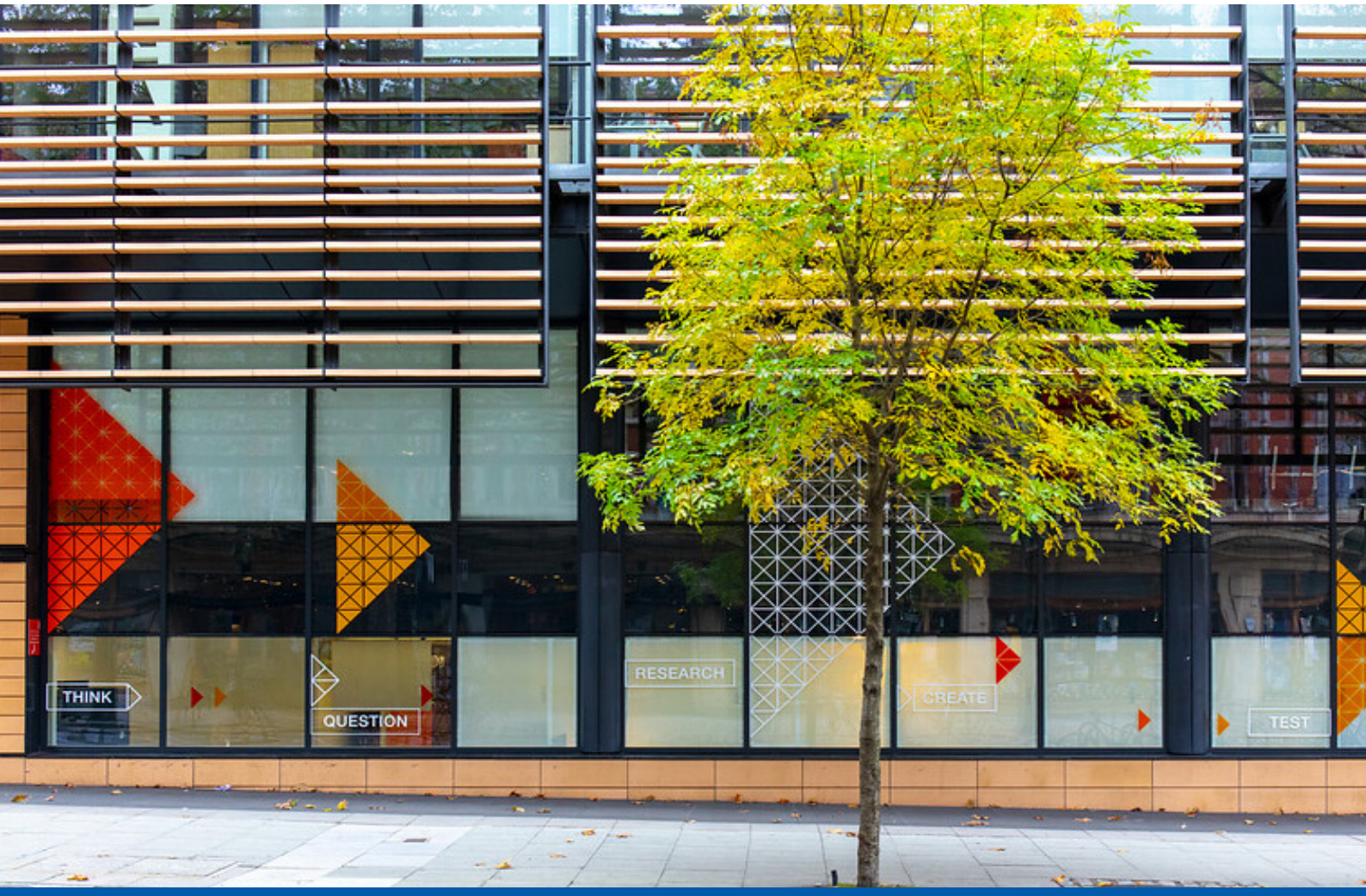
Energy in Buildings and Communities Programme

International Energy Agency

Strategic Plan 2024 – 2029

Energy in Buildings and Communities

Technology Collaboration Programme



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Strategic Plan 2025 – 2029

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Technology Collaboration Programme

November 2023

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Participating countries in the EBC TCP: 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, Türkiye, United Kingdom, and the United States of America.

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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 26 member countries. The vision of the EBC Programme is that by 2030, new buildings and communities have adopted sustainable solutions with near-zero primary use and greenhouse 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 developing new knowledge and technologies through international collaborative research and open innovation.

Overall control of the EBC Programme is maintained by an Executive Committee (ExCo), which not only monitors existing projects, but also identifies new areas where collaborative efforts may be beneficial. To date, 89 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 current priority areas for EBC research are set out in Chapter 3 of this report.

The R&D strategy of the EBC Programme for the five year period from 2024-2029 is derived from the Future Building Forum Think Tank Workshop convened jointly with the other buildings-related TCPs, as the members of the IEA Buildings Co-ordination Group and held in October 2022 in Gatineau, Canada, as well as the strategic planning meeting held at the EBC ExCo meeting in Istanbul, Turkey in November 2022.

Four main themes form the basis of this the 2024-29 EBC Strategic Plan. These are:

1. Collaboration with related TCPs
2. Refreshing the Priority Research Topics
3. Achieving impact from EBC research activities
4. Developing EBC Governance

A series of actions are proposed for each.

Collaboration with related TCPs

– Introduce a process for evaluating and, if appropriate, proposing collaboration with other TCPs as part of the review of proposals at the Concept stage to ensure early communication with other TCPs.
– Introduce a process by which ExCo members from EBC can work with ExCo members from other TCPs to propose fully collaborative projects.
– Introduce a process to scrutinise concepts put forward to the ExCo to decide if they are more relevant to another TCP and should be directed accordingly.

Refreshing the Priority Research Topics

– The overall objective should follow the IEA 'Net Zero by 2050 – A Roadmap for the Global Energy Sector', with a demand-led approach that focuses on reduction in energy use and energy demand.
– Members countries should be asked to actively propose topics for research based on their priorities.
– In developed countries the overriding objective must be to address the retrofit of the existing building stock. Whilst in emerging economies more emphasis should be placed on delivering net-zero new buildings.
– Recognising the need to deliver energy security, avoid unnecessary infrastructure reinforce-ment, and to fully utilise fluctuating renewable energy supplies will require equal attention to demand management and flexibility alongside energy efficiency.
– Achieving performance in practice by closing the performance gap will be vital to delivering net zero emissions by 2050.
– Ensuring that energy efficiency/decarbonisation measures in buildings needing to be future-proof and ready for our 2050 climate.

Achieving impact from EBC research activities

– The main responsibility for delivering impact to rest with each Annex.
– Encourage Annexes to engage early with stakeholders that facilitate the introduction of the developed technologies and processes to practicing engineers, architects, designers and the market.
– Include criteria in evaluating Annex Texts that scrutinise pathways to impact.
– Use 'Theory of Change' [1] to identify relevant actors and their information needs for Annex outputs.
– Tailor outputs to the information needs and literacy of the relevant stakeholders, e.g., policy briefings to follow best practice guidance.
– Work with established channels for dissemination, eg, ASHRAE, REVHA, CIBSE, etc.

[1] Theory of Change explains the process of change by outlining causal linkages in an initiative, i.e., its shorter-term, intermediate, and longer-term outcomes. H. Clark & D. Taplin (2012). Theory of Change Basics: A Primer on Theory of Change (PDF). New York: Acknowledge.Tailor outputs to the information needs and literacy of the relevant stakeholders, eg, policy briefings to follow best practice guidance.

Developing EBC Governance

– Modernise the EBC Implementing Agreement (IA), including introducing ‘limited sponsors’ with their benefits and obligations to be defined.
– Develop EBC policy on equality, diversity and inclusion.
– Reduce number of running Annexes.
– Nominated ExCo members to review new proposals and to be selective.
– Create platform for Operating Agents (OAs) to share experience.
– Consider proposals for funding ExCo agreed activities.

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 2024 and 2029. 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. Vision and Mission

2.1 Vision towards 2030

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

Vision (updated for this Strategic Plan)
By 2030, to make available the evidence required for decision makers to adopt and implement measures that drive energy efficiency, maintain comfortable indoor environments, build system resilience and enhance energy flexibility to deliver net zero carbon emissions for new and existing buildings and communities by 2050.

2.2 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.

3. High Priority Research

The high priority areas of research and the means by which these may be addressed, first identified in the 2018-2023 Strategic Plan, remain in place and new proposals for EBC Annexes should address one or more of these. Over the course of the period 2024-2029 these will be reviewed and refreshed as explained in Section 6.2 below.

For Research Priorities:

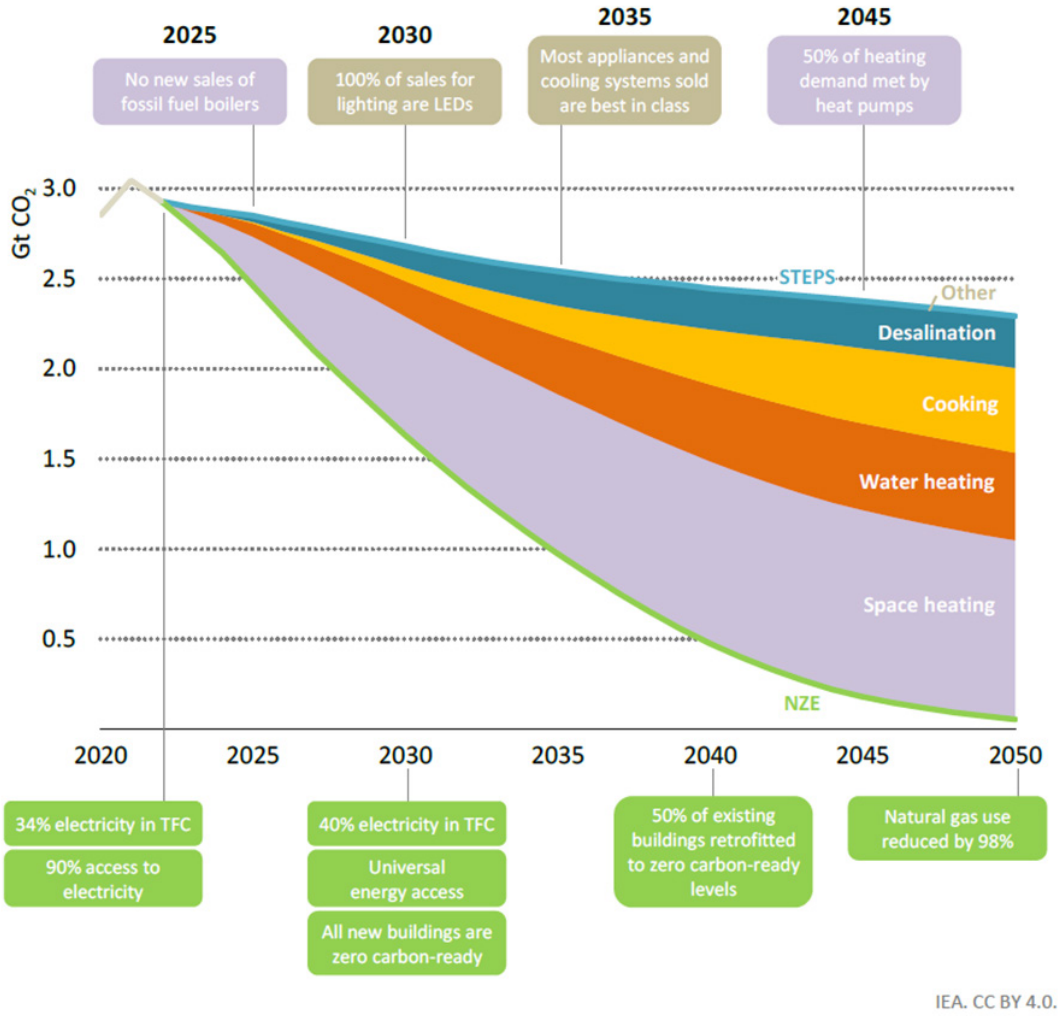
1. Building retrofit for low energy and low carbon performance, considering technical, economic and user perspectives.
2. Reduction of the energy and carbon performance gap between predictions and real world operation.
3. Creation of 'low tech', robust and affordable technologies;
4. Further development of energy efficient resilient cooling.
5. Holistic solution sets for district level systems, accounting for energy grids, overall performance, business models and engagement of stakeholders.

Means: The research priorities may be addressed by means such as:

A. Development of support tools
B. Testing and evaluation in living labs
C. Application of smart controls
D. Better use of data
E. BIM and digitisation

4. Buildings Sector Energy Outlook

The buildings sector accounted for 132 EJ of energy consumption in 2021, or 30% of total global final energy consumption according to the IE World Energy Outlook [2]. The sector's 3 Gt CO_2 emissions accounted for 15% of total emissions from end-use sectors in 2021, but this share doubles if indirect emissions from electricity and heat production are included. Despite a gradual shift away from fossil fuels, direct emissions from the buildings sector have risen by 0.5% per year since 2010, driven by rising demand for energy services.



Space heating delivers 50% of emissions reductions in buildings, driven by electrification and demand reductions from efficiency and behavioural changes

Figure 4.1 Emissions reductions and key milestones in the buildings sector in the NZE Scenario relative to the STEPS, 2020-2050

[2] World Energy Outlook 2022, IEA, www.iea.org

The IEA Energy Outlook predicts that activity levels in the buildings sector continue to rise. Floor area in the buildings sector worldwide is expected to increase 20% between 2021 and 2030, of which 80% is in emerging market and developing economies. It expects the number of air conditioners in the global stock is set to increase by 50% by 2030, compounded by the increasing effects of climate change (i.e.: rising temperatures). The Outlook suggests that expanding the role of electricity in cooking, water heating and space heating is key to the decarbonisation of the buildings sector. In the Outlook's NZE Scenario, despite the projected growth in service demand, direct CO_2 emissions from the buildings sector decline by 45% to 2030 and more than 98% by 2050 (Figure 4.1). Taken together, energy efficiency, electrification and behavioural change provide 80% of the emissions reductions in the buildings sector by 2030, and 70% by 2050

5. Review of the EBC Programme

5.1 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.

The previous strategic plan undertook a comprehensive analysis of the EBC activities from 2005 to 2022. It proposed a set of five strategic objectives with five 'means' by which these could be delivered. These Objectives and Means are set out below and the reader is referred to the 2019-2024 Strategic Plan for further details of the analysis that produced them.

5.2 Recent activities

Since the previous strategic plan 9 new annexes have commenced, 2 concepts are in development, a liaison is in place with 1 Heat Pumping Technologies annex and consideration is being given to liaison with 1 Solar Heating and Cooling task.

The following projects are in the working phase

- 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 Personalise Environmental Control Systems

The following projects are in the preparation phase

- Annex 88 Evaluation and Demonstration of Actual Energy Efficiency of Heat Pump Systems in Buildings
- Annex 89 Implementing Net Zero Emissions Buildings

The following concepts are in development:

– Project Concept: Open BIM for Energy Efficient Buildings – International meeting to be organised
– Project Concept: Building Energy Codes Future Activities – Concept note to be prepared

There is an ongoing liaison with the Heat Pumping Technologies TCP:

– HPT Annex 60: Retrofitting Heat Pumps in Large Non-domestic Buildings

Consideration is being given to a possible liaison with the Solar Heating and Cooling TCP in respect of one task:

– SHC Task Proposal: Low Carbon, High Comfort Integrated Lighting – liaison possible

Annexes 81, 82, 83 and 84 reflect the growing importance of applying advanced technologies to manage the use of energy within individual buildings and to manage the interaction of buildings and energy supply systems, both thermal and electrical. The need to manage demand and provide flexibility is critically important to make the optimum use of both new and existing electrical and thermal supply infrastructure. As Annex 83 aims to demonstrate this can result in districts that are not merely net zero emissions but ones that deliver a surplus of low or zero carbon energy back into the energy supply network.

Annex 85 recognises the dominant role that will be played by cooling in a warming world, especially in the global south. By investigating evaporative cooling technology it seeks to address this future demand with systems that have much lower requirements for input energy.

Annexes 86 and 87 are concerned with indoor environmental quality and comfort in residential and non-residential spaces. Annex 86 aims to improve the energy efficiency of the indoor air quality management strategies in operation and to improve their acceptability, control, installation quality and long-term reliability in residential buildings. In Annex 87 the focus on personal energy comfort systems (PECS) investigates the significant potential for systems that can limit energy use by providing localised heating, cooling and ventilation with individual control to meet the differing needs of building users in both residential and non-residential buildings. This annex will liaise with the USERS TCP which has a strong interest in PECS.

Annex 88 will focus attention on the actual performance of heat pumps in buildings since it is critical that this technology delivers at high efficiency in the field as well as in the test lab. The overall objective is to establish the scientific basis for more accurate estimation of the energy efficiency of heat pump systems for heating and cooling of buildings and for more reliable and transparent design strategies for building applications of heat pump systems. In a similar

way Annex 89 examines the challenge of achieving net zero emissions in practice (not just in theory) in buildings as a whole, including the role of Building Information Modelling (BIM). A related annex is in the early stages of development focusing on Open BIM for energy efficient buildings.

The Working Group on Energy Codes has operated throughout the period 2019-2024 strategic plan and based on the considerable insights that it has established into the operation of codes and regulations throughout participant countries a proposal has been put forward to establish a new project with further activities in this area.

Collaboration with the Heating Pumping Technologies TCP has been established through liaison on HPT Annex 60, Retrofitting Heat Pumps in Large Non-domestic Buildings and collaboration is under consideration with the Solar Heating and Cooling TCP in respect of the proposal for a project on Low Carbon, High Comfort Integrated Lighting.

6. 2024 - 2029 Strategic Plan

Four main themes have been established for further action by the EBC ExCo in the period 2024-2029. These are:

1. Collaboration with related TCPs
2. Refreshing the Priority Research Topics
3. Achieving impact from EBC research activities
4. Developing EBC Governance

6.1 Collaboration with other TCPs

IEA has requested, and the TCPs broadly agree, that there should be greater collaboration between TCPs where this brings both strategic and tactical advantage, and that duplication of research should be avoided. Identifying and understanding how to deliver effective collaboration was a key topic at the Future Building Forum in October 2022.

Whilst it is highly desirable, collaboration is nonetheless challenging in practice as it presents a number of questions that are difficult to answer:

- Who would be collaborating? Each TCP is structured slightly differently, but in the main the only people continuously and regularly involved in each TCP are the ExCo members. However, ExCo members typically don't lead or even become involved in projects (annexes or tasks). The Operating Agents and participants come and go with each project and tend to be focused towards the topic of a particular TCP.

- How to facilitate collaboration? TCP ExCos typically meet twice a year in-person, online or often in hybrid meetings. These meeting are 2-3 days long in varying locations around the world. Arranging for regular interaction at the level of TCP ExCos is practically difficult and EBC has only previously managed to meet every 3-4 years with SHC and only with other TCPs every 5 years at the Future Buildings Forum.

- What are the specific objectives of collaboration? Much discussion took place at the Future Building Forum in October 2022 on this issue and the clearest objectives were to avoid unnecessary duplication and make sure that the most appropriate experts were

involved in each research project. This presents a particular challenge for EBC because its remit is quite wide ranging and can easily overlap with other TCPs focusing on specific technologies that are included in buildings and communities.

It is perhaps with this last question that we might begin by ensuring that future projects are closely scrutinised to confirm that they would not be better served by another TCP if they feature strongly a particular technology. If it is concluded that another TCP should take the lead then the EBC ExCo should recommend this and if another TCP agrees to take the topic forward EBC could recommend relevant experts to ensure that 'buildings' and/or 'communities' dimensions are appropriately addressed and a level of collaboration should be agreed following the principles already established with SHC.

Action: A process should be formally introduced into the review of proposals at the Concept stage to evaluate overlap.

If on the other hand a concept is reviewed and confirmed to be primarily focused on buildings and/or communities but to also have one or more 'touch points' to other TCPs then proposals should be made to those TCPs for an appropriate level of collaboration using the principles already established with SHC.

Action: A process for proposing collaboration should be introduced as part of the review of proposals at the Concept stage

Proposals for fully collaborative projects may emerge from discussions between ExCo members for different TCPs, most likely between representatives from one country. In these cases the ExCo members concerned must propose the level and type of collaboration. They should also make clear the specific aims of the collaboration and they should put in place the practical arrangements for collaborative working.

Action: Introduce a process by which ExCo members from EBC can work with ExCo members from other TCPs to propose fully collaborative projects.

6.2 Refreshing the Priority Research Topics

The priority research topics established in the 2018-2023 Strategic Plan (see Chapter 3) were reviewed in a strategic planning meeting at the EBC ExCo meeting in Istanbul in November 2022. It was concluded that:

1. The overall objective should follow the IEA 'Net Zero by 2050 – A Roadmap for the Global Energy Sector' with a demand led approach which focuses on reduction in energy use and energy demand.
2. Members countries should be asked to actively propose topics for research based on their priorities.
3. In mature economies the overriding objective must be to address the retrofit of the existing building stock. Whilst in emerging ones more emphasis should be placed on delivering net-zero new buildings.
4. Recognising the need to deliver energy security, avoid unnecessary infrastructure reinforcement, and to fully utilise fluctuating renewable energy supplies will require equal attention to be paid to managing power demand alongside energy efficiency.
5. Achieving performance in practice by closing the performance gap will be vital to delivering net zero emissions by 2050.
6. Ensuring that energy efficiency/decarbonisation measures in buildings needing to be future-proof and ready for our 2050 climate

Action: Refresh priority research topics to reflect the above.

6.3 Achieving impact from EBC research activities

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. A number of specific actions are proposed to increase impact of EBC annexes.

Actions:

1. The main responsibility for delivering impact to rest with each Annex.
2. Encourage Annexes to engage early with stakeholders that facilitate the introduction of the developed technologies and processes to practicing engineers, architects, designers and the market
3. Include criteria in evaluating Annex Texts that scrutinse pathways to impact.
4. Use 'Theory of Change' to identify relevant actors and their information needs for Annex outputs.
5. Tailor outputs, eg, policy briefings to follow best practice guidance.
6. Work with established channels for dissemination, eg, ASHRAE, REVHA, CIBSE, etc.

6.4 Developing EBC Governance

A review of the EBC governance process resulted in agreement to take forward a number of proposals. The first of these is the need to modernise the implementing agreement in line with new guidance provided by the IEA Executive. As part of this a new process for supporting annexes will be introduced in which 'Limited Sponsors' can participate in individual annexes without the requirement for their country of origin to be a Contracting Party to the EBC Implementing Agreement. Further work is required to define benefits and obligations of sponsorship but as a starting point for discussion the annual cost could be set at a level depending on the national GDP, similarly to the national ExCo Support Fund contributions for participating countries.

It has been recognised for some time by the ExCo that the make-up of the ExCo itself and the OA representing the annexes is limited in diversity by age, ethnicity and other factors. It is therefore proposed to develop a Equality, Diversity and Inclusion (EDI) policy to be considered and adopted by the ExCo in due course, and that funds should be made available to support improvements in EDI subject to the approval of the ExCo of specific proposals.

In recent years the number of active annexes has increased so that at the present time there are at least fifteen in progress. This number presents many practical challenges for the operation of the ExCo in the scrutiny of the projects and review of their outputs. It is therefore proposed to make efforts to reduce the number of concurrently operating annexes by limiting the creation of new annexes. This could be achieved by limiting to approval of concepts to one at each ExCo meeting. (However this way of limiting the number of Annexes needs further discussion by the ExCo.). Unsuccessful concept proposals could be advised on how to improve or to withdraw if the proposal is not in line EBC priority research topics, in which case they may be offered to another TCP where they may be a better fit.

To achieve greater scrutiny of concepts and annexes moving from preparation to the operating phase it is proposed that one member of the ExCo should be nominated to review the relevant documentation prior to each ExCo meeting and make a recommendation to the ExCo on how to proceed.

Experience of operating the Operating Agent forums in parallel with and prior to the ExCo meetings has revealed the wealth of experience that is available on the successful operation of annexes. To ensure that this experience is captured and made available to future operating agents and annex participants it is proposed that an online platform is created to provide a

space in which important documents and other material can be stored and made accessible to those whom it would benefit.

Over recent years the EBC has built up funds that exceed the requirement for secure operation of the TCP (taken to be 50% of the annual cost of operation). It has been agreed that the ExCo should consider proposals from member countries and OAs for the use of these funds in activities that would benefit the EBC community. Such proposals will be considered at the 93rd and subsequent ExCo meetings.

Summarising the above, the actions are:

1. Modernise the EBC Implementing Agreement (IA), including introducing 'limited sponsors' with their benefits and obligations to be defined.
2. Develop EBC policy on equality, diversity and inclusion.
3. Limit the number of running Annexes by carefully scrutinising proposals for new ones.
4. Nominated ExCo members to review new proposals and to be selective.
5. Create platform for Operating Agents (OAs) to share experience.
6. Consider proposals for funding ExCo agreed activities.

Appendix A IEA and EBC

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 member countries and 11 association 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.

Appendix B EBC Annexes

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 CO2 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 (*)
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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
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:	Implementing Net Zero Emissions 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