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Annual report 2024

Ways to implement net-zero whole life carbon buildings

IEA EBC ANNEX 89

Construction site in Chennai (Madras), India, one of the participating countries in IEA EBC Annex 89
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1. Annex description

The project is focusing on the pathways and actions needed by various stakeholders and decision-makers to implement whole life cycle based net-zero greenhouse gas (GHG) emissions from buildings in policy and practice. This means explicitly considering both embodied and operational GHG emissions across all stages of the built asset life cycle – also referred to as whole life carbon (WLC) – to achieve the overarching (or ultimate) goal of the Paris Agreement, which is to limit global warming to well below 2°C, and preferably to 1.5°C, above pre-industrial levels by aiming to achieve climate neutrality by 2050 latest. In this context, policies, initiatives and actions that share, support and contribute to this goal are referred to as 'Paris-goal compatible'. The project is contributing to the transition of the building and real estate sector towards net-zero whole-life carbon (NetZ-WLC) outcomes through the following work program:

– developing guidelines and recommendations on establishing whole life carbon targets (including carbon budgets) for the building and real estate sector at various scales and perspectives and identifying critical carbon reduction pathways and actions;

– establishing Paris-goal compatible assessment frameworks and evaluating the suitability and application(s) of different assessment methods to achieve NetZ-WLC buildings at various scales;

– mapping and assessing the relevance and effectiveness of a range of tools, aids and instruments available to different stakeholders in their decision-making contexts and objective(s);

– understanding the conditions that are conducive for in-practice uptake and more effective implementation of context-based solutions and actions by key stakeholders; and

– ensuring efficient and effective engagement and knowledge exchange with diverse stakeholder groups and disseminating project outputs that maximise opportunities to 'get it to the ground' from local to global scale.

There is a critical and urgent need to effectively implement science-based targets, assessment methods, and solutions into policy and practice to enable a broad range of stakeholders and key decision-makers across the world to promote and support the delivery of NetZ-WLC buildings at speed and at scale. It builds on the extensive work and results of IEA EBC Annex 72[1].

The subtasks and activities

The Annex is structured in 5 subtasks (see Figure 1). Subtask leaders and co-leaders of Annex 89 are:

– Subtask 1: Greg Foliente, The University of Melbourne (AU)

– Subtask 2: Marcella Saade, Graz University of Technology (AT) and Vanessa Gomes, University of Campinas (BR)

– Subtask 3: Maria Balouktsi, Aalborg University Copenhagen (DK) and Bernardette Soust-Verdaguer (ES)

– Subtask 4: Freja Nygaard Rasmussen, NTNU (NO) and Alice Moncaster, Open University (UK)

– Subtask 5: Alexander Passer, Graz University of Technology (AT) with Thomas Lützkendorf (DE) and Rolf Frischknecht (CH)

[1] see https://annex72.iea-ebc.org/publications.

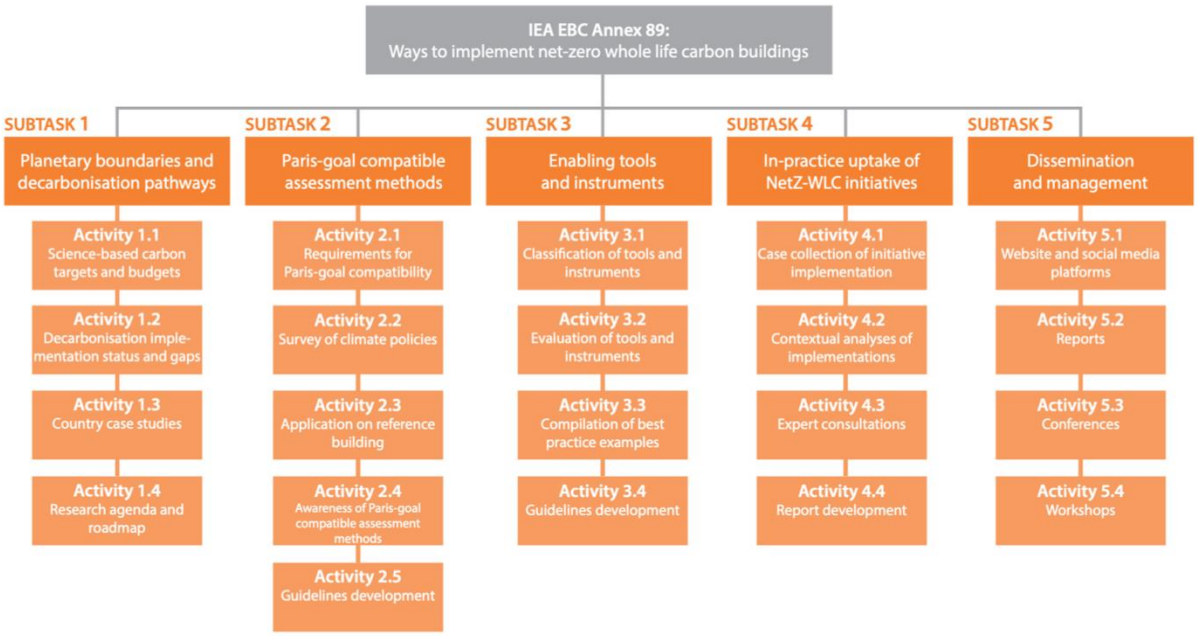

Figure 1: Subtasks and Activities of IEA EBC Annex 89

Objectives

Annex 89 will contribute to the overarching goal of the COP21 Paris Agreement by supporting the key stakeholders and decision-makers in the building and real estate sector with guidelines and recommendations to transition the sector towards NetZ-WLC outcomes. Its work program, activities and background papers will be synthesised into major reports that will guide these stakeholders on:

– setting carbon targets and reduction paths and actions towards NetZ-WLC buildings based on different contexts of countries and jurisdictions;

– selecting and applying assessment methods to estimate and determine Paris-goal compatible NetZ-WLC status of buildings;

– planning and adopting relevant tools and instruments to support NetZ-WLC building implementation; and

– applying lessons from in-practice case studies and stakeholder consultations – together with the above outputs – to transfer and/or adapt them to different contexts of implementation.

With increasing interest from nations and jurisdictions to develop and implement effective Paris-goal compatible schemes and solutions to achieve NetZ-WLC buildings at multiple scales, Annex 89 has an important and timely role to support the aspirations of these national economies and jurisdictions.

The object of the investigation ranges from individual buildings (new construction and major refurbishment of residential and non-residential buildings) to the building stock (as defined by the scope of specific development or redevelopment projects, and/or by jurisdiction areas such as local, state or province and national governments).

The focus will be on the decarbonisation status and activities in the building and real estate sector in countries that have participating experts, but relevant developments (in research, policy and/or activities) in other parts of the world will also be considered, especially as part of Annex 89 case studies.

Deliverables and target groups

The deliverables are listed in Table 1 below. They are grouped according to the objectives of the Annex, as distributed across subtasks ST1 to ST4.

Table 1: List of deliverables

	Official deliverables	***Target group***	***ST***
D1	Report on guidelines and recommendations on establishing carbon reduction paths and actions towards NetZ-WLC buildings based on relevant contexts of countries and jurisdictions	Policy makers, regulators, standards bodies, professional associations, construction industry groups and service providers, designers and planners, investors and financial institutions, researchers and educators	1
D2	Report on guidelines for selection and application of assessment methods to estimate and determine Paris-goal compatible NetZ-WLC status of buildings	Experts involved in LCA of buildings, architects and designers, engineers and consultants, policy makers, regulators, standards bodies, data and statistics authorities, and researchers and scientists	2
D3	Report on enabling tools and instruments to increase NetZ-WLC building implementation at national and regional (e.g., EU) level.	Policy makers, regulators, standards bodies, data and statistics authorities, design and engineering professionals and their associations, investors and financial institutions, researchers and educators	3
D4	Report on enabling and disabling factors for implementation of NetZ-WLC initiatives, and lessons learnt for transferring to different contexts	Policy makers, public administrations, developers	4

All these reports will be published electronically via the website and promoted through various media channels.

Work undertaken and findings obtained

The work phase was successfully started; the Operating Agent (OA) and the Subtask Leaders (STLs) hold coordination meetings (called Subtask-Leader Jour Fixes) once every two weeks to report the advancements of the weeks and establish an action list for the next meeting. Each subtask established objectives and the activities needed to reach them. The potential inputs from the participants were gathered and compiled as national contributions, and based on them, detailed work plans for the individual ST were developed. The progress, as stated by every ST Leader is as follows:

ST1: Planetary boundaries and decarbonization pathways

- *ST1 Leader: Greg Foliente, University of Melbourne (AU)*
- *ST1 Activity Leaders: Aoife Houlihan Wiberg, University of Bath (UK); Claudiane Ouellet-Plamondon, ETS, Université du Quebec (CA), Harpa Birgisdottir, Aalborg University (DK); Jannik Giesekam, University of Strathclyde (UK)*

ST1 aims to develop guidelines & recommendations on establishing Paris-compatible carbon targets for the building and real estate sector and identifying critical carbon reduction pathways and actions considering planetary thresholds and social issues. The core activity leaders and participants – consisting of around 45 participants from 22 countries – have been reviewing academic literature and national/country information or publications on net-zero solutions, targets and roadmaps, with a special focus on whole-life carbon reduction pathways. Our last meeting, in preparation for the upcoming Experts Meeting in Melbourne (Nov 2024), was held online on 07 October 2024.

Based on these recent activities, we are now preparing a number or reports/publications on:

- Scenarios modelling and assessment of net-zero whole-life carbon (NZ-WLC) pathways for the building stock
- Research trends and challenges based on academic literature and in relation to pathways.
- Key elements of, and lessons from, development and implementation of whole-life carbon reduction rioadmaps

- The relationship between macro-economic cross-sectoral issues from building stocks to individual buildings and vice versa
- Relevant ST-related sections or questions for the Annex-89-wide effort to publish a paper on "Ten Questions" for NZ-WLC Buildings.

We are also now developing a complete outline for main deliverable, along with a draft of an initial Net-Zero Whole-Life Carbon (NZ-WLC) Capability Development Framework for the building and real estate sector. We have identified a couple of countries to test the framework.

ST1 activity leaders and core members are presenting progress across the above activities. They will discuss country and individual participants' contributions in the next meeting in Melbourne and plan the next set of tasks for the following year.

ST2: Paris-goal compatible assessment methods

- *ST2 Leader: Marcella Ruschi Mendes Saade[2], Graz University of Technology (AT)*
- *ST2 Co-Leader: Vanessa Gomes, University of Campinas (BR).*
- *ST2 Activity Leaders: José Dinis-Silvestre, Instituto Superior Técnico, University of Lisbon (PT)*

This subtask aims to establish frameworks for whole life carbon assessment (including LCA) methods, GHG emissions and carbon dioxide removal (negative emissions) calculation approaches in view of NetZ-WLC. Focus is given to both standardized and non-standardized LCA approaches typically adopted for addressing NetZ-WLC and the balance of positive and negative emissions. As a starting point, it relies on the guidelines agreed upon and published by IEA EBC Annex 72 and others. ST2 has until now 40 registered participants with declared contributions from 16 countries. The expert meeting in Berlin indicated the state of play of calculation methods in countries where they are available. After said expert meeting, this subtask held three more online workshops defining the set of open methodological questions that should be covered in the final deliverable, categorizing them intro three pillars of requirements: (i) legally binding, (ii) robust and (iii) target-proof. It has been defined that the three pillars of methodological requirements shall be fed by a set of seven background reports. Authorship is being defined. Matt Roberts, Robert Ries, Patricia Schneider-Marin and Larissa Neves have already agreed to lead authorship, together with the ST Leaders.

So far, one background report entitled "Negative emissions in the LCA of buildings – measures to achieve whole life cycle net zero carbon buildings" has already been submitted in a preliminary status, authored by Rolf Frischknecht. Moreover, a preliminary table of contents for the main deliverable has been discussed in the last workshop, held on October 30th. Activitiy 2.3, covering the application of different calculation methods to a case study building, has also initiated, and should be completed by mid-2025.

ST3: Enabling tools and instruments.

- *ST3 Leader: Maria Balouktsi, Aalborg University (DK)*
- *ST3 Co-Leader: Bernardette Soust-Verdaguer, Universidad de Sevilla (ES)*

ST3 focuses on identifying, categorizing, and evaluating existing policy and non-policy instruments, as well as aids and tools to facilitate the implementation of NetZ-WLC, as well as identifying best practice examples. This process includes developing typologies based on prior literature and conducting expert surveys across Annex 89 participating countries to collect data about to policy instrument mixes and aids and tools availability across the regions to facilitate mutual learning and offer valuable insights for global policymakers and other stakeholders. After the Berlin 2024 meeting, we initiated an online survey to map available digital tools across various countries and locate Annex 89 experts and external tool users and developers for a more detailed follow-up survey. We received approximately 20 answers of possible cases we could analyse further. This longer survey will assess tools based on their effectiveness in meeting stakeholder needs and usability criteria. To support this, we created a standardized Excel template for data collection, which has been refined with input from selected experts. We are also exploring an online version of this template to improve accessibility for external

stakeholders. We plan to distribute the longer survey by mid-November, aiming to collect and analyze initial results by year-end.

Additionally, we are refining a template to map national and regional instruments related to regulations, financial incentives, and informational resources. Survey collection will begin one week before our next meeting. An OECD survey recently published provides valuable information from 28 countries regarding adoption rates of various policy instruments as well as current and future priorities in this field, which we will integrate into our findings alongside our survey results. We have also developed a template to gather data for exemplary building case studies, in collaboration with ST4, which is currently being tested by volunteer experts. The outputs from these data collection efforts will feed into the final ST3 deliverable, recently drafted by ST3 leaders and discussed with the ST leader group. This draft outlines the structure, content, and goals for each section.

We have completed a preliminary review of relevant literature on instruments and aids and expect to receive participant feedback by the Melbourne meeting for further discussion. We are also coordinating contributions to a publication for the Building and Environment Journal's Special Issue on the Net Zero Carbon Built Environment. Continuous coordination among ST3 participants is planned for the upcoming Annex 89 meeting in Melbourne. To accommodate those unable to travel, we will hold an online meeting for ST3 experts one week prior to the in-person gathering in Melbourne, ensuring ongoing engagement and collaboration as the project progresses.

ST4: In-practice uptake of NetZ-WLC initiatives

- *ST4 Leader: Freja Nygaard Rasmussen, Norwegian University of Science and Technology (NO)*
- *ST4 Co-Leader: Alice Moncaster, University of West of England (UK); Martin Jakob, TE¨Energy (CH)*

The ST4 work focuses on the processes involved between stakeholders (and within theirspecific context) that enable or disable NetZ-WLC initiatives. The general Annex 89 expert meeting in Berlin (June 2024) provided an excellent arena for discussion among the ST4 participants, as well as for the broader group of Annex 89 experts. ST4 and ST3 has initiated a collaboration activity where high-performing (energy-, carbon-wise) building projects are documented from a quantitative perspective (design features, energy efficiency, life cycle GHGe) as well as from a qualitative and implementation perspective (which actors where involved, how was the process, what was the learnings).

An excel template for collecting building data is now being tested with ST4/ST3 participants, and first results on this are expected to be ready by the expert meeting in Melbourne, November 2024. In parallel, online meetings are being arranged for thematic clusters of case study providers dealing with qualitative studies on implementation success and failures of NetZ-WLC in 1) different building projects, in 2) methods/tools/benchmarks and 3) regulation/organisation. Guideline for carrying out the interviews has been shared and discussed with the ST4 participant in online meetings. The output of the data collecting activities will feed into the final ST4 deliverable, which has recently been drafted and discussed with the ST4 participant and with the ST lead group.

ST5: Dissemination and management

- *ST5 Leader: Alexander Passer, Graz University of Technology (AT)*
- *ST5 Co-Leaders: Thomas Lützkendorf, Karlsruhe Institute of Technology (DE); Rolf Frischknecht, Treeze Ltd. (CH)*

Over the past half year, the Annex 89 group organized the WSBE24 conference at which we hosted a special session and roundtable on our work and research. This was a great chance for Annex 89 members to showcase findings of their work, engage with the wider research community and discuss important discussion points.

We wrote an editorial for GAM21 (Graz Architectural Magazine) which highlights important parts of our research and its relevance to the world of architecture. The purpose of this editorial was to provide an opportunity to introduce the vision and findings of Annex 89 to better connect architecture and sustainable building research.

Subtask Leaders got together for a day-long workshop on ongoing projects. In the workshop, we developed the 'ten questions paper', activities and submissions for the 3rd Expert Meeting, and developed content for other conferences. The session enabled in-depth discussions on project progress and collaborative planning for the coming months.

We are working to make sure Annex 89 is well represented at the SBE25 conference. We're preparing research outputs, developing abstracts and facilitating the publication of several key works to help us position ourselves within the global sustainability research community.

Preparations are on for the 3rd expert meeting in Melbourne, Australia. This meeting will provide essential steps for Subtask Leaders and team members to showcase progress, establish new goals, and engage in productive workshops. Having an office in Melbourne will also help us to forge connections with local stakeholders and boost our global engagement.

Apart from the Expert Meeting, Annex 89 is also organizing and representing at the DBI24 conference taking place in Melbourne. These events are being planned together, so that you and other Annex 89 partners can discuss things and leverage from each other, as per our goal.

We’re also working on the “ten questions paper” for a special issue of the Building and Environment journal. This paper will ask key questions on sustainable building and environmental performance. It will probably be due on 1 November. The paper will contribute to the discussion on sustainable construction practices.

Within the Annex 89 team, biweekly "Jour Fixes" meetings are organized to ensure coordination on those. These sessions are meant for Subtask Leaders to discuss the progress and align on actions and challenges faced by the subtasks.

National cooperation

Most likely several Swiss member organisations (University of Applied Sciences of Western Switzerland (HES-SO), ETH Zurich, Paul Scherrer Institute, TEP Energy Architekturbüro K. Pfäffli and treeze) will participate in this Annex. K. Pfäffli co-operates with treeze focusing on the assessment of the Annex reference building and further Swiss case study buildings qualifying for net zero greenhouse gas emissions. The coordination among the remaining organisations is currently being organised. Most of the organisations listed co-operate in the SFOE project “Netto-Null Treibhausgasemissionen im Gebäudebereich”, which aimed at harmonising methodology and definition of net zero greenhouse gas emission buildings.

International cooperation

Up to 60 institutions from 26 countries (from Europe, Asia/Australasia and from the Americas) and 4 observer countries are likely to participate in the IEA EBC Annex 89. The IEA EBC Annex 89 fosters international cooperation and functions as a platform to exchange experience and knowledge. We use this to support the application of LCA on buildings in countries with yet little experience. We particularly continue to support the Indian expert in IEA EBC Annex 89 in the development of guidelines to establish an easy-to-use LCA database for the construction sector profiting from the long-term experience with the KBOB/ecobau list 2009/1:2022 (KBOB et al. 2022). Egypt and Turkey are willing to join the Annex and are keen getting support in developing LCA activities in the construction sector in their respective countries.

Evaluation 2024 and outlook for 2025

Evaluation 2024

Rolf Frischknecht attended the regular bi-weekly subtask leaders coordination calls, commented on the draft outline of the main deliverable of Subtask 2 and of the reporting template used to describe

and characterise national light tower example buildings, and drafted a background report on “Negative emissions in the LCA of buildings – measures to achieve whole life cycle net zero carbon buildings”. He participated in a round table on “Net zero emissions: towards whole life carbon” organised during the online World Sustainable Built Environment conference in June 2024, gave an overview on the outcomes of IEA EBC Annex 72[3] and its Monte Verità Declaration (IEA EBC Annex 72 experts 2021) and presented LCA methodology aspects during a special session on IEA EBC Annex 72 during the same event.

One of the main events to get input from climate scientists initially scheduled for the second half of 2024 is delayed and now scheduled for early 2025. This is also true for many of the activities in Subtasks 2 and 3, to which treeze and Katrin Pfäffli contribute substantially. In particular, the reference building on which participants will apply their national method has not been selected yet.

Another main Swiss contribution, the assessment of promising example buildings by Katrin Pfäffli is delayed because we preferred to wait for the outcome of the “net zero GHG emissions buildings” project funded and led by BFE and because the reporting template is only now being discussed and finalised.

Finally the letter of participation (LoP) for treeze/Katrin Pfäffli is expected to be submitted to the ExCo ahead of the November 2024 meeting in Melbourne, Australia.

Outlook for 2025

The following actions are planned for 2025:

ST1: Planetary boundaries and decarbonization pathways

- Annex 89-wide survey of country NZ-WLC roadmaps or pathways
- Guidelines draft outline and clarification of concepts, terms, and definitions
- Preparation of literature review report/paper on carbon targets and roadmaps, also considering macro-economic cross-sectoral issues
- Preparation of literature review report/paper on NZ-WLC Capability Development Framework for the building and real estate sector, in parallel with case studies
- Collection of case studies to support the above two reviews
- Join the ST2 Climate Scientists workshop and results analyses
- Organize next online meeting to progress tasks and activities
- Plan and organize the next Annex 89 experts meeting in Melbourne in Nov 2024

ST2: Paris-goal compatible assessment methods

- Further discussions on the status of background reports and more detailed description of country-wide methods or guidelines are expected to take place during the expert meeting in Melbourne.
- Assessment of the reference building using national methods and guidelines.
- Select, assess and document light tower buildings (joint activity with Subtask 3)

ST3: Enabling tools and instruments.

- Adjust the data collection templates for instruments, aids, and tools, and convert the surveys into online formats for easy distribution beyond the A89 group.
- Evaluate the collected data within parallel working groups and finalize the authors' groups for the related background reports. This will involve literature analysis, presentation of survey results, and synthesis of useful insights.
- Collaborate on ST3-related publications for the upcoming SBE 2025 conferences and relevant journals to ensure ongoing dissemination of results and engagement with the broader scientific community and other stakeholders.

[3] https://annex72.iea-ebc.org/, access on 12 November 2024

ST4: In-practice uptake of NetZ-WLC initiatives

- Test and adjust template for collection of building projects (in collaboration with ST3)
- Finish ongoing literature review of interdisciplinary approaches to implementation of NetZ-WLC buildings
- Work in parallel thematic tracks with ST4 participants in the effort of collecting qualitative information from interviews with relevant stakeholders

ST5: Dissemination and management

- Publication of "Ten Questions" special issue in Buildings and Environment (Dec 2024)
- 2-weekly ST-Leader Jour Fixes will continue to take place
- 4th Status Report for the next ExCo-meeting
- Climate Scientist Workshop organization (Early 2025)

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