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CALL FOR PAPERS: special issue

Carbon metrics for buildings and cities:

Assessing and controlling GHG-emissions across different scales

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The built environment's types and ranges of contributions to greenhouse gas (GHG) emissions and thus to climate change are well known. There is acceptance of the need to drastically reduce GHG emissions and that the built environment must have a significant role. The focus of this special issue is to go substantially beyond the calculation of embodied and lifetime energy / CO_2, to explore the appropriate units of assessment and their scalability for each country's or region's built environment in relation to the Nationally Determined Contributions (NDCs) and the more recent commitment to limiting global warming to 1.5 C or less.

Given the wide array of sectors and industries that shape the built environment (e.g. the construction products industry, building design and urban planning, civil engineering, construction, facility management, the finance and insurance industry, policy making at international, national and urban levels, etc.), it becomes clear that basic principles, methods and tools for determining, assessing and influencing GHG emissions are urgently needed. An important consideration is whether and how to adapt the principles, methods and tools to the specific context – the object of assessment and the application case. What variation or concession (if any) should be made to account for different national contexts or circumstances? Furthermore, all these elements should be able to be integrated into a common planning and decision-making process. This raises questions such as:

- Is there a need for carbon metrics[1] and benchmarks or target values that can be used widely?
- Would the creation of carbon metric(s) for the built environment help to accelerate the societal goal of reducing GHG emissions?

There are two reasons for counting GHG emissions and developing carbon metrics:

- to assist with the development of national and city public policies, regulations, targets, incentives and disincentives for the monitoring of public policies and regulations for their efficacy.
- to improve planning, building design, construction and operation of buildings, neighbourhoods and cities (top-down or bottom-up approaches). Benchmarks and metrics can inspire new investments, behaviours and management practices (for organisations as well as individuals), as well as identify individual places, buildings or neighbourhood areas that need additional support. It may also help to identify and make the case for specific positive interventions at different scales.

What is currently lacking is a consistent, robust basis for GHG / carbon metrics associated with the built environment. The development and application of life cycle analysis and sustainability assessments have led to numerous initiatives. Terms, concepts, guidelines, databases and tools nowadays proliferate in a seemingly endless variety. Clarity and consistency are needed on boundary definitions and although carbon metrics exist, they deserve further scrutiny and development to create a next generation of metrics. In this way, the topic also takes on a new dimension: While carbon metrics have been the subject of scientific discussion in the past, their results should now become a reliable and directional basis for real decisions.

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[1] The term "carbon metrics" is used here to refer to all GHG emissions, as an accepted way exists for quantifying GHG emissions as CO_2 equivalents (CO_2e) for their global warming potential.

Appropriate and consistent methods, data and tools are needed to support the collection, assessment, communication and interpretation of relevant information. This raises questions such as:

(1) Are the results still reliable?
(2) Can the data be easily exchanged between actors?
(3) Do scientifically-sound answers already exist to address new questions (e.g. physical discounting and treatment of technical progress in long-term considerations)?
(4) Can an ex-post evaluation be transformed into a proactive formulation and pursuit of goals?
(5) Are the metrics scalable and usable at building, neighbourhood and city levels?
(6) Are the metrics-based results easy to understand and interpret?
(7) Can the metrics be used across different kinds of economies (developed, emerging, least developed, etc.)?
(8) What are the unintended consequences (from the use of metrics) and how can they be avoided? For example, a building using renewable energy (and hence low carbon) may be energy inefficient in the provision of its services (space conditioning, lighting, hot water, etc.) or a carbon-based metric may disincentivize users to reduce demand.
(9) What units of measurement are appropriate? Typically, it has been CO2/m2 which allows simple comparison but masks other issues such as occupant density. What other (complimentary) reference units are needed?
(10) Should embodied carbon be disaggregated from operational carbon?
(11) Are there new developments in research and standardization to assess a GWP?

This special issue addresses these questions in detail. The aim is to develop a common basis for the identification and assessment of GHG emissions in the context of the different scales of the built environment. (city, neighbourhood, individual building) to present possible applications and opportunities, address methodological questions, improve transparency and provide impetus for public policies. However, it is also possible to present and discuss different approaches and trends in methodological questions or forms of communication.

In principle, dealing with a metric for GHG emissions (carbon metric) can also be applied to other impacts on the global and local environment and the use of natural resources. In this sense, the carbon metric can be viewed as a pilot case. Other international and European standards already enable the application of rules for identification, assessment and communication for other impact categories, various national sustainability assessment systems already contain corresponding criteria and benchmarks. Furthermore, the damage costs of selected additional impact categories can increasingly be found in literature. Nevertheless, the topic of a carbon metric has a special position. It is met with great interest by both politicians and the public, generates an increasing willingness to act and is directly linked to the topic of the preservation of natural basis of life. This alone justifies the complex analysis of carbon metric in the form of a special issue, to which we warmly invite you to contribute.

Possible topics for research or policy analysis papers, include, but not limited to:

- **Basics**
  Carbon budget, carbon cycle, climate change
- **Tasks and context**
  Description and assessment of GHG emissions as an integral part of environmental performance assessment; climate as an area of protection, COP; IPCC; SDG
- **Energy and/or carbon performance**
  Linkages, job-sharing
- **Terms and definitions**
  Carbon metric, carbon content, carbon footprint, GWP, GHG-emissions, carbon neutrality, net-zero-emission – Explanation of terms, contexts, application cases
- **Rules for assessment**
  Rules for calculation, valuation and communication; methods and system boundaries in relation to specific objects of assessment (construction products, construction works, city districts, cities; examples for guidelines
- **Method related research activities**
  Physical discounting; dealing with technical progress; dealing with uncertainties, next generation of LCA
- **Data**
  Data availability, data quality, data providing as a service
- **Tools**
  Tools for carbon metric assessment, tools with integrated carbon metric assessment; BIM-able carbon metric
- **Benchmarks and budgets**
  Limit and target values / performance levels for performance assessment; budgets for client briefs and early design stages

- **Standardisation**
  Latest developments in international, European and national standardisation activities
- **Policy / governance / legislation**
  Trends and roadmaps in legislation, examples from specific countries. Policy analysis of possible outcomes. Key policy drivers. Baskets of measures and their interactions.
- **Synergies/correlation and target conflicts with other indicators**
  Multi criteria decision making
- **Additional user and use cases**
  Sustainable finance & taxonomy; economic valuation and risk assessment; sustainability reporting; environmental product declaration; product environmental footprint
- **Monetisation and internalisation**
  Damage cost, external cost, carbon tax
- **Carbon metric as KPI**
  Integration into building design and town planning
- **Case studies**
  Results/consequences in building design and town planning; impacts on carbon metric
- **Business case**
  Carbon metric as a service

Briefing Note for Contributors

You are invited to submit an abstract for a journal paper in this special issue of *Buildings & Cities*. In the first instance, please send a **500 word (maximum) abstract** defining the scope, methods and results to editor **Richard Lorch** richard@rlorch.net **by Thursday 26 September 2019.**

The initial submission should include:

- the author's and all co-author's names, affiliations and contact details
- the question(s) in this Call for Papers that the abstract and intended paper addresses
- the abstract (300 - 500 words maximum)

Abstracts will be reviewed by the editors to ensure a varied, yet integrated selection of papers around the topic of the special issue. Authors of accepted abstracts will be invited to submit a full paper (6000-7500 words), which will be subject to a double-blind review process.

Timeline

Deadline for abstract submission:	**26 September 2019**
Full papers due:	06 January 2020
Referees' comments:	09 March 2020
Final version due:	30 March 2020
Publication:	June 2020

Buildings & Cities

Buildings & Cities is an international, open access, double-blind peer-reviewed research journal. Its focus is the interactions between buildings, neighbourhoods and cities by understanding their supporting social, economic and environmental systems. More information including its Aims & Scope and Editorial Board can be found online: www.buildingsandcities.org

Questions?

If you have a question, please contact:
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Further reading

Standards

ISO 16745-1:2017. Sustainability in buildings and civil engineering works -- Carbon metric of an existing building during use stage -- Part 1: Calculation, reporting and communication.

ISO 14067:2018. Greenhouse gases -- Carbon footprint of products -- Requirements and guidelines for quantification.

ISO 14080:2018. Greenhouse gas management and related activities -- Framework and principles for methodologies on climate actions.

Research papers

Chau, C. K., Leung, T. M., & Ng, W. Y. (2015). A review on life cycle assessment, life cycle energy assessment and life cycle carbon emissions assessment on buildings. *Applied Energy*, *143*, 395-413.

De Wolf, C., Pomponi, F., & Moncaster, A. (2017). Measuring embodied carbon dioxide equivalent of buildings: A review and critique of current industry practice. *Energy and Buildings*, *140*, 68-80. https://www.sciencedirect.com/science/article/pii/S0378778817302815

Fenner, A. E., Kibert, C. J., Woo, J., Morque, S., Razkenari, M., Hakim, H., & Lu, X. (2018). The carbon footprint of buildings: A review of methodologies and applications. *Renewable and Sustainable Energy Reviews*, *94*, 1142-1152. https://www.sciencedirect.com/science/article/pii/S1364032118305069

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Hertwich, E. G., & Peters, G. P. (2009). Carbon footprint of nations: A global, trade-linked analysis. *Environmental Science & Technology*, *43*(16), 6414-6420. https://pubs.acs.org/doi/pdfplus/10.1021/es803496a

Ibn-Mohammed, T., Greenough, R., Taylor, S., Ozawa-Meida, L., & Acquaye, A. (2013). Operational vs. embodied emissions in buildings—A review of current trends. *Energy and Buildings*, *66*, 232-245. https://www.sciencedirect.com/science/article/pii/S0378778813004143?via%3Dih

Lütken, S., & Wretlind, P. H. (2016). City Based Carbon Budgets for Buildings. *UNEP DTU Low Carbon Development Programme Partnership*. http://orbit.dtu.dk/ws/files/142228385/Working_Paper_13_LCD_final_3_.pdf

Ramaswami, A., & Chavez, A. (2013). What metrics best reflect the energy and carbon intensity of cities? Insights from theory and modeling of 20 US cities. *Environmental Research Letters*, *8*(3), page 035011. https://iopscience.iop.org/article/10.1088/1748-9326/8/3/035011/meta

Full life cycle guidance

Embodied and whole life carbon assessment for architects. (2018). London: Royal Institute of British Architects. https://www.architecture.com/-/media/gathercontent/whole-life-carbon-assessment-for-architects/additional-documents/11241wholelifecarbonguidancev7pdf.pdf

Framework for "carbon-neutral buildings and sites" (2018). Stuttgart: Deutsche Gesellschaft für Nachhaltiges Bauen – DGNB e.V. (German Sustainable Building Council). https://static.dgnb.de/fileadmin/en/dgnb_ev/reports/Framework-carbon-neutral-buildings.pdf

Kuittinen, M. & le Roux, S. (2018) *Procurement criteria for low-carbon building.* Helsinki: Finish Ministry of the Environment. http://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/160737/EG_2017_Producement%20criteria.pdf?sequence=1

Life cycle assessment of buildings: A practice guide (2018). Seattle: The Carbon Leadership Forum, Department of Architecture University of Washington. http://www.carbonleadershipforum.org/wp-content/uploads/2018/06/CLF-LCA-Practice-Guide-v1.0-2018-06-28.pdf

Net zero carbon buildings: A framework definition (2019). London: UK Green Building Council. https://www.ukgbc.org/wp-content/uploads/2019/04/Net-Zero-Carbon-Buildings-A-framework-definition.pdf

Whole life carbon assessment for the built environment: RICS professional statement, UK. (2017). London: Royal Institution of Chartered Surveyors. https://www.rics.org/globalassets/rics-website/media/news/whole-life-carbon-assessment-for-the--built-environment-november-2017.pdf

Embodied carbon guidance

Chae, Chang-U & Kim, Sunghee (eds). (2016). *Evaluation of embodied energy and CO2eq for building construction (IEA Annex 57) subtask 2: A literature review*. Paris: International Energy Agency. http://www.iea-ebc.org/Data/publications/EBC_Annex_57_ST2_Literature_Review.pdf

Lützkendorf, Thomas & Balouktsi, Maria (eds). (2016). *Basics for the assessment of embodied energy and embodied GHG emissions for building construction: Guideline for designers and consultants – Part 1.* IEA Energy in Buildings and Communities Programme, Annex 57. Paris: International Energy Agency. ISBN 978-4-909107-00-8. http://www.iea-ebc.org/Data/publications/EBC_Annex_57_Guideline_for_Designers_Part_1.pdf

Methodology to calculate embodied carbon: RICS Professional Guidance, Global. (2014). London: Royal Institution of Chartered Surveyors. ISBN 978-1-78321-056-5 https://www.globalabc.org/uploads/media/default/0001/01/5214e617d8b555f132431aeddfc95e3907d41b2d.pdf