

Reviewer comments – responses

General comments

The doctoral dissertation prepared by Iskander BEN RJIBA addresses the development of analytical and decision-support approaches for urban climate action planning and the environmental assessment of selected climate interventions. The topic is timely and scientifically relevant, considering the increasing need for evidence-based, transparent, and context-sensitive urban climate governance. The dissertation combines four related research components: the systematic categorisation of urban climate actions, the exploratory assessment of public awareness and education-related factors, the development of a decision-tree-based decision-support model, and the project-level environmental assessment of construction materials. The revised dissertation is approximately 124 pages long and contains 29 figures, 13 tables, a list of publications, appendices, and an extensive bibliography. Its structure has been substantially improved compared to the version submitted for the home defence. The new title is more precise and accurately reflects the main scientific components of the work. The logical relationship among the research questions, research assumptions, methodological steps, and research theses has also become considerably clearer. The integrated research framework appropriately presents the four parts of the dissertation as a consecutive process of categorising, understanding, selecting, and evaluating urban climate actions. The dissertation is based on a broad range of scientific literature and several datasets derived mainly from the Covenant of Mayors platform and related databases. The strongest elements of the work are the development of a structured urban climate action database, the interpretable decision-support model, and the material-centred environmental assessment framework. The revised version has addressed most of the substantive comments formulated in my previous review, particularly those concerning methodological transparency, the formulation of the research theses, model validation, and the scope of the environmental assessment.

Thank you very much for this comprehensive and encouraging overall assessment. I am grateful to the reviewer for engaging so closely with the revised dissertation and for recognising the relevance of the topic within the wider need for evidence-based and context-sensitive urban climate governance.

I am pleased that the four components are seen to come together as a consecutive process of categorising, understanding, selecting, and evaluating urban climate actions, and that the revised title, together with the clearer logical connection among the research questions, assumptions, methodological steps, and theses, is regarded as a meaningful improvement over the version presented at the home defence. It is especially rewarding that the structured climate action database, the interpretable decision-support model, and the material-centred environmental assessment framework are identified as the strongest elements of the work.

I also appreciate the reviewer's acknowledgement that the revised version addresses most of the substantive points raised previously, particularly those concerning methodological transparency, the formulation of the research theses, model validation, and the scope of the environmental assessment. I sincerely thank the reviewer for the constructive guidance provided throughout this process, which has clearly contributed to strengthening the dissertation.

Comments - answers

- The title of the dissertation has been corrected and made considerably more specific. The new title appropriately refers to urban climate action planning, decision support, and environmental assessment and is therefore consistent with the actual scientific content of the dissertation.

Thank you very much for this positive feedback. I am glad that the revised title now clearly reflects the actual scientific content of the dissertation, and I appreciate the reviewer's guidance, which helped me arrive at a more specific and accurate formulation referring to urban climate action planning, decision support, and environmental assessment.

- The research gap is now presented more clearly and systematically. The revised text identifies the limited comparability of heterogeneous climate actions, the underutilisation of publicly available climate action plan databases for operational decision support, and the insufficient integration of planning, social, and material-related environmental assessment approaches. These gaps are directly connected to the methodological contributions of the dissertation.

Thank you for this encouraging assessment. I am grateful for the reviewer's earlier guidance, which helped me sharpen this part of the dissertation. I am pleased that the three shortcomings motivating the work, relating to the comparability of climate actions, the practical use of existing plan databases for decision support, and the integration of the planning, social, and material dimensions, now emerge more clearly and are explicitly tied to the methodological contributions that follow.

- The relationship among the research questions, research assumptions, and research theses has been clarified. Four research questions are now formulated, corresponding to the four main research components. A summary table at the end of the dissertation also presents the respective research questions, assumptions, and theses together, which significantly improves the transparency of the research logic.

Thank you for this positive feedback. I appreciate the reviewer's input, which encouraged me to make the underlying research logic more explicit. I am glad that the alignment across the four components now comes through more clearly, and that the summary table bringing these elements together at the end of the dissertation helps the reader follow how each part connects, improving the overall transparency of the work.

- The role of the exploratory analysis of the SECAP reports has been appropriately explained. The revised dissertation identifies this analysis as a pilot study that tested the applicability of the text-mining approach and produced the initial categorisation scheme. It is also clearly stated that the initial dataset was insufficient for model development and was therefore enlarged to 454 reports from 443 European cities in 32 countries.

Thank you for this positive assessment. I am grateful for the reviewer's guidance, which prompted me to clarify the purpose of this early analysis. I am pleased that its role now comes through clearly — as a preliminary step that validated the feasibility of the text-mining approach and yielded the first categorisation scheme — and that the reasoning behind expanding the initial sample into the larger dataset used for model development is now made explicit.

- The methodological limitations of the public-awareness analysis are now described more explicitly. The author acknowledges that the comparison of Germany, Brazil, and Kenya is exploratory, is based primarily on national-level indicators, and cannot provide evidence of causal relationships.

Thank you for this constructive feedback. I appreciate the reviewer's earlier comments, which helped me frame this part of the work more carefully. I am glad that its exploratory character now comes through clearly, including the reliance on national-level indicators and the fact that the cross-country comparison is intended to reveal associations rather than to establish causal relationships.

- The dependent variable of the decision-tree model has been clarified. Although cities generally implement several climate actions simultaneously, the model predicts the dominant or most extensively represented action category identified in each report.

Thank you for this helpful observation. I am grateful for the reviewer's input, which encouraged me to make this aspect of the model clearer. I am pleased that the definition of the predicted variable is now explicit, namely that, while cities typically pursue several measures at once, the model focuses on the leading action category that is most strongly represented in each report.

- The validation of the decision-tree model has been substantially improved. The revised dissertation includes held-out test results, five-fold stratified cross-validation, macro- and weighted-F1 scores, precision, recall, baseline comparisons, category-level performance measures, and a confusion matrix.

Thank you for this positive assessment. I appreciate the reviewer's earlier suggestions, which guided a much fuller treatment of the model's validation. I am glad that its performance is now demonstrated in a far more complete and transparent way, drawing on a held-out test set, stratified cross-validation, several complementary metrics, comparisons against baselines, and category-level results together with the confusion matrix.

- The interpretation of the decision-support model has also become more precise. The revised research thesis appropriately describes the model as identifying the action category most consistent with the observed practices of cities with similar characteristics. However, expressions such as “optimal”, “high-impact”, or “cost-effective” should still be used with caution because these characteristics were not directly validated by the model.

Thank you for this thoughtful assessment. I appreciate the reviewer's guidance, which helped me state the model's interpretation more precisely, describing it as identifying the action category most consistent with the observed practices of cities sharing similar characteristics. I fully agree with the caution regarding terms such as "optimal", "high-impact", or "cost-effective": since these properties were not directly validated by the model, the dissertation treats the model's output as reflecting established patterns of practice rather than a verified judgement of optimality or impact.

- The environmental assessment component has been methodologically strengthened. The revised dissertation clearly states that the analysis is a material-centred application of life-cycle-assessment principles rather than a complete ISO 14040/14044-compliant LCA. The cradle-to-gate system boundary, the excluded life-cycle stages, the GaBi characterisation data, the selected GWP, ODP, and HT indicators, and the category-specific functional units are now properly described.

Thank you for this positive assessment. I appreciate the reviewer's earlier guidance, which helped me describe this component with greater methodological rigour. I am glad that its scope now comes through clearly, as a material-centred application of life-cycle-assessment principles rather than a full ISO 14040/14044-compliant study, and that the system boundary, the stages left outside it, the characterisation data, the chosen impact indicators, and the category-specific functional units are now properly specified.

- The author now distinguishes appropriately between comparisons within the same climate action category and comparisons across heterogeneous categories. Category-specific functional units are used for building renovation, green-space development, heating and insulation projects, and flood-prevention interventions.

Thank you for this positive feedback. I am grateful for the reviewer's input, which helped me handle these comparisons more rigorously. I am pleased that the distinction between comparing projects within a single category and comparing across fundamentally different ones now comes through clearly, supported by the use of functional units defined specifically for each type of intervention, including building renovation, green-space development, heating and insulation projects, and flood-prevention measures.

- The presentation quality of the figures has partly improved, and the complete decision tree and confusion matrix are included in the appendices. However, the full decision tree

remains difficult to interpret in the main text. Some linguistic, cross-referencing, table-numbering, and formatting errors also remain.

Thank you for this constructive assessment. I appreciate the reviewer's attention to these details. I am glad that the improved figures, together with the complete decision tree and confusion matrix now placed in the appendices, are seen as a step forward, and I take note of the point regarding the readability of the full decision tree in the main text. Regarding the linguistic, cross-referencing, table-numbering, and formatting issues, these were carefully reviewed and corrected before the final version was printed, so that the remaining errors identified have been addressed in the printed dissertation.

Specific comments regarding the theses

1. Thesis 1 can be accepted as a new scientific result. The author developed a bottom-up categorisation of urban climate actions based on an exploratory sample of 99 SECAP reports and a subsequently enlarged database of 454 reports from 443 European cities in 32 countries. The classification into ten functionally equivalent action categories and the associated categorisation of co-benefits provide a structured basis for comparative analysis and subsequent modelling. The novelty lies particularly in deriving the categorisation from observed municipal practices rather than applying only an existing top-down sectoral taxonomy.

2. Thesis 2 can be accepted as a limited and exploratory scientific result. The analysis draws attention to the potential supporting role of public awareness and education in urban climate action and identifies associations with air-quality and greenhouse-gas-emission trends. However, the empirical basis consists of three national cases, the indicators refer to different years, and the analysis does not control for the numerous socioeconomic, technological, and structural factors affecting national emissions. Consequently, the novelty of this thesis is primarily the integration of social and educational factors into the broader climate-action-planning framework.

3. Thesis 3 can be accepted as a new scientific result. The author compiled and structured a database containing 454 climate action reports and 24 geodemographic, spatial, and action-related variables and developed an interpretable Gini-based classification-tree model supported by SHAP analysis and post-pruning. The scientific novelty is provided by transforming a large body of municipal climate-planning experience into a transparent and reproducible decision-support structure. The moderate predictive performance and the low performance of some rare categories should be regarded as limitations, but they do not eliminate the methodological contribution of the model.

4. Thesis 4 can be accepted as a new scientific result. The author developed a material-centred environmental assessment framework based on project-level material quantification, the calculation of GWP, ODP, and HT impacts, and the application of category-specific

functional units. The results demonstrate that material composition and material intensity may lead to substantial differences even between projects belonging to the same climate-action category. The combination of absolute project impacts and normalised impact intensities provides a useful methodological contribution to the environmental evaluation of urban climate projects.

Thank you very much for this careful and encouraging assessment of the four research theses. I am sincerely grateful to the reviewer for evaluating each contribution individually and for recognising the scientific novelty of the work, the bottom-up categorisation derived from observed municipal practices, the integration of social and educational factors into the planning framework, the transparent and reproducible decision-support structure, and the material-centred environmental assessment framework. I also fully accept the limitations the reviewer points out, in particular the exploratory and association-based character of the public-awareness analysis and the moderate predictive performance of the classification model, especially for the rarer categories. These boundaries are stated explicitly in the dissertation, and I agree that they appropriately delimit the scope of the contributions without diminishing their methodological value. I am grateful that this constructive feedback has helped me improve the rigour and clarity of the work, and I sincerely thank the reviewer for this positive overall evaluation of the theses.

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