

A DECISION-MAKING TOOL SUITE FOR SCALING UP DEEP ENERGY RETROFITS

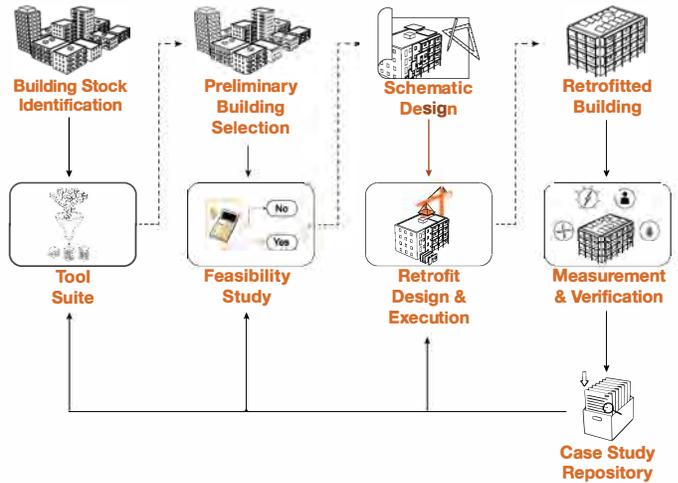
INTRODUCTION

Buildings are responsible for nearly 40% of global greenhouse gas emissions¹. Panelized deep energy retrofits (DERs), where one wraps a building with prefabricated insulated panels and replaces mechanical systems with more efficient ones, cut a building's emissions by 50-80%, making them a potential solution that can significantly help reduce emissions on a larger scale.

To save time and expense, Reconstruct is developing a suite of tools that can quickly pick out the most promising buildings for a first wave of pilot retrofits. The tool suite assesses the technical feasibility of a project and its potential emissions savings (both operational and embodied), estimates the costs of a retrofit and weighs the interests of multiple stakeholders.

As there is extensive overlap in the data inputs required by the different tools, the tool suite will include a common database to store building information. In the future, machine learning and Google Maps API can be combined to automate data collection and fill in commonly encountered data gaps^{2,3}.

When completed, this tool suite will support pre-retrofit decision-making and streamline the process of retrofit candidate selection, facilitating wider deep energy retrofit adoption in Quebec and across Canada.



DECISION-MAKING TOOL SUITE

1. CANADA'S BUILDING STOCK



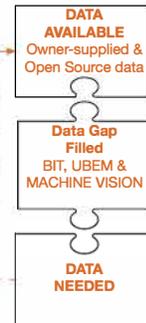
Canada has an aging building stock, 70% of which will still be in use in 2050.⁴ Since most of these buildings are not energy-efficient, deep energy retrofit is an important strategy for meeting emission targets.

2. BUILDING PORTFOLIO



High potential portfolios, such as Quebec's multi-unit residential buildings, are selected and engaged with. The building owner then uploads their building data to the database.

3. DATA GAP



Data gaps are filled by crowdsourcing using the Building Identification Tool (BIT) combined with machine learning algorithms running on Google Maps API.

4. MCDA FRAMEWORK

Using building data from the database, along with cost and carbon estimates produced by the tool suite, the Multi-criteria Decision Analysis (MCDA) Tool ranks buildings based on the values and priorities of different stakeholders.



5. CANDIDATE SELECTION

Cost-effectiveness scores from the MCDA help select candidates for a more in-depth feasibility assessment, which is time-consuming and costly.



6. FEASIBILITY STUDY

The feasibility of retrofitting a specific candidate is determined by considering energy models, life cycle assessment, cost estimates, and detailed panel designs, along with funding, motivation, and capacity of the building owner.



7. PILOT PROJECT



Only the DER projects that are deemed feasible and beneficial proceed to the next stages of design and realization.

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[1] United Nations Environment Programme, & Yale Center for Ecosystems + Architecture (2023). Building Materials and the Climate: Constructing a New Future. <https://wedoc.unep.org/20.500.11822/43293>.
 [2] Su, A. J., Ren, A., Xu, K. C., & Dogan, T. (2025). Scalable building reconstruction and window detection for urban building energy modelling applications. *Journal of Building Performance Simulation*, 1-19. <https://doi.org/10.1080/19401493.2025.2501151>
 [3]Szczepaniak, J. T., Ang, Y. O., Letellier-Duchesne, S., & Reinhart, C. F. (2022). A method for using street view imagery to auto-extract window-to-wall ratios and its relevance for urban-level daylighting and energy simulations. *Building and Environment*, 207, 108108. <https://doi.org/10.1016/j.buildenv.2021.108108>
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