Detailed User Manual

Step 1 — Select the analysis method

- Select the analysis method from the "Navigation" at the top of the left side of the app.
- LCA Optimization — Proposed optimized retrofit strategies focusing on the lifecycle performances of the retrofitted building.
- Annual Optimization — Proposed optimized retrofit strategies focusing on the yearly performances of the retrofitted building.

Step 2 — Insert the basic parameters of the existing building

- Enter the basic parameters of the existing building under the relevant rows representing "Parameters" on the left side of the app.
- Energy Consumption Baseline (kWh/m^2) — Enter the annual energy consumption of the selected building in kWh/m^2.
- Carbon emissions baseline ($kgCO_2$) — Enter the annual operational carbon emissions from the selected building in $kgCO_2$).
- PPD Baseline — Enter the average percentage of occupant dissatisfaction within the selected building.
- Lifetime (years) — Enter the expected lifetime of the selected building after retrofitting in years.
- Energy Cost — Enter the average cost per energy unit.
- Area (m^2) — Enter the gross floor area of the selected building in m^2.
- Algorithm — This app supports three optimization algorithms namely; (1) non-dominated sorting genetic algorithm II (NSGA II), (2) non-dominated sorting genetic algorithm III (NSGA III), and (3) adaptive grid-based evolutionary algorithm (AGE-MOEA). Users can choose one of these three algorithms.

Step 3 — Enter data to the model

- "Data Selection" allows users to select their data or proceed with the sample data.
- Select "Upload own data" to upload a data file developed by the users based on the selected building or select "Use Sample Data" to proceed with any of the sample data provided by the developers.
- The data file needs to be an Excel or CSV file.
- The first columns of the datasheet should include the variables (different retrofit measures) while the last five columns should be for the "Energy Consumption per area (kWh/m^2)", "Carbon emission ($kgCO_2$)", "PPD", "Embodied Carbon ($kgCO_2e$)", "Initial Cost" as indicated below.

A	B	C	D	E	F	G	H	I	J	K
Insulation	Shading	Window	HVAC	PV	Energy Consumption per area (kWh/m2)	Carbon emission (kgCO2)	PPD	Embodied Carbon (kgCO2e)	Initial Cost (HKD)	
100	400	6,6	no	1	85.70	1163.50	13.74	595.97	10,176.82	
100	400	6,6	no	2	70.70	977.20	13.74	649.71	13,164.13	
100	400	6,6	no	3	55.70	790.90	13.74	717.36	16,151.44	
100	400	6,6	no	4	40.70	604.60	13.74	771.35	19,138.75	
100	400	6,6	no	5	25.70	418.30	13.74	839.00	22,126.06	

Data format example

- There should not be empty cells or cells containing the value "0". Those cells should be filled as "no" in the dataset.

Step 4 — Configuration

- After data is selected for the model, users can observe decision variables are displayed at "Select decision variables".
- The users can add and remove decision variables from the row displaying variables.
- Next, users need to "Map Target Columns." They should map the relevant columns from the uploaded data file to the given descriptions.

Step 5 — Data Analysis and Optimization

- After mapping the target columns "Data Analysis" is displayed.
- Under "Decision Variable Options", the options under each decision variable are displayed.
- "Processed Data Preview" displayed only the first five columns of the data file after processing with carbon saving (Csave) and economic profitability (EP) calculations.
- Click "Start Optimization" to proceed with the optimization.

Step 6 — Download the optimization results

- The model will take a few minutes to run the optimization. After completing the optimization, users can visualize the
- Optimization Results
- Pareto Front
- Solution Space Analysis
- Users can download the results of optimization and figures of Pareto front and space solutions using "Download Pareto Front Plot", "Download Solution Space Plot", and "Download Results CSV".