Evaluation of Emerging Building Technologies at the Urban Scale in the Context of Climate Change

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# Abstract

To address vital demands, all residential and commercial buildings are connected to traditional electricity, gas, and water supply lines, resulting in major environmental concerns. At the same time, climate change is regarded as a critical issue for humanity, with major and global environmental effects. According to the Representative Concentration Pathways 8.5 (RCP8.5) models, global surface warming is likely to exceed 2°C in 2100. This means that building constructed today must be designed to function successfully in both the current and future climates.

Emerging building technologies, such as indoor vegetation systems and double skin façade systems, have recently demonstrated tremendous potential for energy savings and better thermal comfort. However, most of that research was conducted on a local setting, without considering the climate or the urban scale weather they were exposed to. Furthermore, reducing pollutant emissions and environmental damage requires a comprehensive approach. There is a research gap in evaluating cutting-edge building technology for urban scale analyses in the context of climate change.

In this study, we will use the generated future weather data to assess the influence of climate change on emerging building technologies from urban scale. Heating and cooling requirements will be assessed.

## Literature Reviews

1. Emerging building technologies in the form of E+ simulation.
2. Future weather data.
3. Urban climate modeling.

## Methodology

Integration of the emerging technologies into urban scale climate model under the context of climate change.

## Comparison

1. Climate scenarios
   1. RCP4.5, intermediate scenarios.
   2. RCP8.5, high greenhouse gas emissions scenarios.
2. Building technologies scenarios
   1. Baseline
   2. Photovoltaics
   3. Phase change material
   4. Indoor greenery systems

## Building Performance Modeling within Urban Canyon Layer

The input epw is:

https://ibis.geog.ubc.ca/~achristn/research/BUBBLE/data/BUBBLE\_AT\_IOP.txt

The output air temperature is: <https://ibis.geog.ubc.ca/~achristn/research/BUBBLE/data/BUBBLE_BSPR_AT_PROFILE_IOP.txt>

UWG and VCWG may not receive preferential consideration in the building performance validation. They'll assume the building model is fine as long as the expected canyon temperature matches.

Based on the summarized thermal properties in UWG (Bueno et al., 2013) paper, (Bueno et al., 2013) and (Moradi et al., 2021, 2022) declaimed that building characteristic in the BUBBLE campaign (Rotach et al., 2005) should be modified based on the post-80s’ mid-rise apartments reference building model (*Commercial Reference Buildings*, n.d.).

# Orientation

Graphical user interface

Description automatically generated

A screenshot of a map

Description automatically generated with medium confidence

Building,  
 Ref Bldg Midrise Apartment Post1980\_v1.3\_5.0, !- Name  
 40.0000, !- North Axis {deg}

UMG:

theta\_canyon,-20, # Canyon direction from geographical north,

# P0 = 100000 Pa

BSPR CVRMSE:2002-06-10 01:00:00 to 2002-07-09 22:00:00-10min Canyon Temperature. p0 100000 pa

Height 2.6m. BEMCalc-VCWG Potential: 10.26%, BEMCalc-VCWG Real: 9.75%,\_BSPR\_bypass\_refining\_M2 Potential: 15.39%, \_BSPR\_bypass\_refining\_M2 Real: 12.9%

Height 13.9m. BEMCalc-VCWG Potential: 11.4%, BEMCalc-VCWG Real: 12.25%,\_BSPR\_bypass\_refining\_M2 Potential: 12.79%, \_BSPR\_bypass\_refining\_M2 Real: 11.79%

Height 17.5m. BEMCalc-VCWG Potential: 11.79%, BEMCalc-VCWG Real: 13.11%,\_BSPR\_bypass\_refining\_M2 Potential: 11.28%, \_BSPR\_bypass\_refining\_M2 Real: 11.34%

Height 21.5m. BEMCalc-VCWG Potential: 11.72%, BEMCalc-VCWG Real: 13.46%,\_BSPR\_bypass\_refining\_M2 Potential: 10.59%, \_BSPR\_bypass\_refining\_M2 Real: 11.52%

Height 25.5m. BEMCalc-VCWG Potential: 11.76%, BEMCalc-VCWG Real: 13.7%,\_BSPR\_bypass\_refining\_M2 Potential: 10.46%, \_BSPR\_bypass\_refining\_M2 Real: 11.85%

Height 31.2m. BEMCalc-VCWG Potential: 11.9%, BEMCalc-VCWG Real: 14.3%,\_BSPR\_bypass\_refining\_M2 Potential: 10.66%, \_BSPR\_bypass\_refining\_M2 Real: 12.81%

## Notes for refinement

sensWaste vs sensHVAC

*# Calculate total sensible waste heat to canyon per unit building footprint area [W m^-2]  
# which can be determined from sensible waste to canyon, energy consumption for domestic hot water and gas consumption  
# Sensible hot water heating demand*

! ZONE LIST:

! G SW Apartment,

! G NW Apartment,

! Office,

! G NE Apartment,

! G N1 Apartment,

! G N2 Apartment,

! G S1 Apartment,

! G S2 Apartment,

! M SW Apartment,

! M NW Apartment,

! M SE Apartment,

! M NE Apartment,

! M N1 Apartment,

! M N2 Apartment,

! M S1 Apartment,

! M S2 Apartment,

! T SW Apartment,

! T NW Apartment,

! T SE Apartment,

! T NE Apartment,

! T N1 Apartment,

! T N2 Apartment,

! T S1 Apartment,

! T S2 Apartment,

! T Corridor,

! G Corridor,

Diagram

Description automatically generated

# Cases List

[ver0, ver1, ver2]

BUBBLE, Ue1, [ver0, ver1, ver2]

BUBBLE, Ue2, [ver0, ver1, ver2]