Multi-Scale Assessment of Life Cycle Energy and GHG Emissions of Australian Buildings

Introduction

Building sector plays a dominant role in the energy use and GHG emissions, which contributes nearly 39% of global energy-related carbon dioxide (CO2) emissions and 36% of global final energy use (IEA, 2018). Currently, reduction strategies are primarily focused on the operational stage of buildings. With the decrease of operational energy and GHG emissions of low-energy buildings, embodied energy and GHG emissions account for a growing share. It is necessary to take account of embodied energy/GHG emissions as part of life cycle energy/GHG emissions. Besides, various stakeholders have different roles and decision-making contexts that require explicit consideration of regional and building specific characteristics, but most previous studies focus on one dimension or a single method. There isn’t a comprehensive multi-scale life cycle assessment framework to provide guidelines for different stakeholders.

Research Objectives

- Quantify the life cycle energy and GHG emissions of Australian buildings across multi scales, and explore the driving forces behind the changes in energy use and GHG emissions.
- Analyse the discrepancies of results between the top-down and bottom-up approaches in calculating life cycle energy and GHG emissions.
- Develop effective guidelines for energy and GHG emission reduction for different stakeholders.

Discipline: Civil Engineering

Research Design

Phase 1
Data Collection

Input-output
method

Operational data
-Statistical energy use
-Electricity and gas

Building data
-Building numbers/floor area
-Archetypes
-Assemblies
-BOQ

Embodied data
-Input-Output Tables
-Embodied coefficient

Research Design

Phase 2
Assessment and Comparison

Top-down

Input-output method

Quantifying the life cycle energy and GHG emissions of Australian buildings

Macro statistic data based method

Structural decomposition analysis

Exploring the driving forces behind the changes in energy and GHG emissions

Comparison analysis

Bottom-up

Process-based method

Developing a bottom-up framework to quantify and map life cycle energy and GHG emissions of building stocks

Energy simulation

Case study

Validating the reliability of the developed framework in Australian building stocks

Phase 3
Guidelines for Stakeholders

Policy maker

Decision-making contexts and objectives

Designer & Consultant

Investor

Contractor

Construction product manufacturer

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More Information