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Life cycle energy and environmental performance of a new university building: modeling challenges and design implications

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Abstract

A comprehensive case study life cycle assessment (LCA) was conducted of a 7300Â m^2, six-story building with a projected 75 year life span, located on the University of Michigan campus. The bottom three floors and basement are used as classrooms and open-plan offices; the top three floors are used as hotel rooms. An inventory of all installed materials and material replacements was conducted covering the building structure, envelope, interior structure and finishes, as well as the utility and sanitary systems. Computer modeling was used to determine primary energy consumption for heating, cooling, ventilation, lighting, hot water and sanitary water consumption. Demolition and other end-of-life burdens were also inventoried.

The primary energy intensity over the buildingâ€™s life cycle is estimated to be 2.3Ã—

10^6Å GJ, or 316Å GJ/m^2. Production of building materials, their transportation to the site as well as the construction of the building accounts for 2.2% of life cycle primary energy consumption. HVAC and electricity account for 94.4% of life cycle primary energy consumption. Water services account for 3.3% of life cycle primary energy consumption, with water heating being the major factor, due to the presence of hotel rooms in this building. Building demolition and transportation of waste, accounts for only 0.2% of life cycle primary energy consumption.

All impact categories measured (global warming potential, ozone depletion potential, acidification potential, nutrification potential and solid waste generation) correlate closely with primary energy demand.

The challenges in developing a life cycle model of a complex dynamic system with a long service life are explored and the implications for future designs are discussed.

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Keywords

Life cycle assessment; Environmental impact; Primary energy consumption; Embodied energy; Global warming potential; Commercial buildings

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