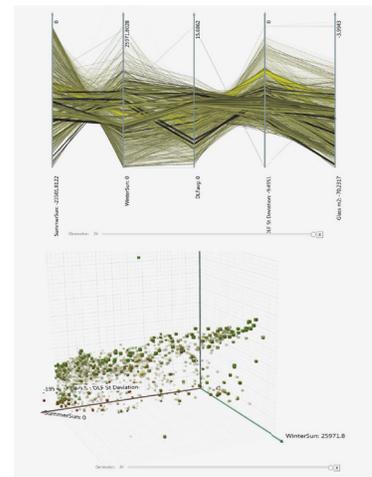


House Zero Natural Ventilation and Indoor Air Quality:

Sensing, monitoring and display

PROBLEM

Natural Ventilation (NV) and Indoor Air Quality (IAQ) are important energy-efficient building strategies. The House Zero* retrofit design strategy seeks to maximize NV performance index while maintaining occupancy comfort and IAQ through the use of computer-controlled motorized robotic-windows, by careful design of interior partitions and air-flow channels, and by the use of CFD simulations to inform design. In order to validate assumptions used in the CFD simulations, empirically confirm air flow patterns in the remodeled building, and provide real-time data for building control systems, a system of measuring NV and IAQ attributes – e.g. air velocity, temperature, humidity, CO₂, and particulate concentrations – must be designed for the House Zero retrofit. Data collected by this system must also be displayed in a range of formats for building automation control and human perception, and archived for scientific experimental purposes.



*The Harvard Center for Green Buildings and Cities is leading an effort to retrofit its headquarters in Cambridge, a pre-1940s house, to beyond net zero energy performance.

GUIDING QUESTIONS

The project evaluates opportunities to measure indoor and outdoor environmental, NV, and IAQ variables, display variables on a monitoring system, archive variable for experimental purposes, and later use said variables to validate, calibrate and enhance CFD simulation and energy modeling by comparing simulated results with measured behavior.

What are viable options for sensing environmental, NV, and IAQ variables?

What tools and techniques are available for storage and analysis of time-series data?

How can real-time displays of such data best provide information to building occupants?

PROJECT DESCRIPTION

The overarching goal is to collect, store, analyze and display real-time and cumulative energy performance measurements of the house after renovation. This project will evaluate currently available NV and IAQ sensor technologies, data storage, and display options, and develop a prototype system for NV and IAQ monitoring and display as a first step towards that goal.



IMPACT

The project will integrate various practices and technologies from measurement, simulation, computation, data storage, building automation control, internet of things, data visualization and display, and others.

Give valuable validation and calibration of CFD simulation.

Provide real-time information about the building's NV and IAQ performance.

Provide objective evaluation of the NV strategies and performance, and IAQ outcomes of the House Zero design.



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