Pacific Northwest
NATIONAL LABORATORY

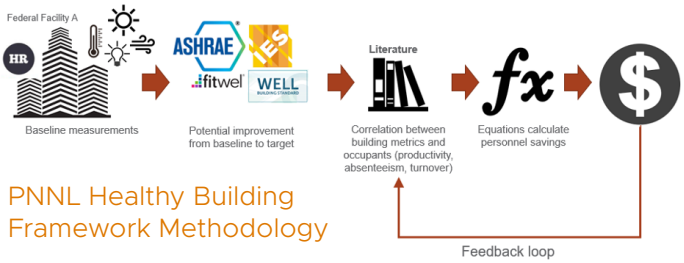
Efficient Buildings, Healthy Buildings

FEMP is currently funding research at Pacific Northwest National Laboratory (PNNL) to develop a framework that quantifies the potential financial costs and savings and non-monetary benefits related to improving occupant health in federal buildings in order to facilitate more holistic decision making.

BACKGROUND

In recent years, the high-performance building sector has started to consider occupant health and well-being as a driver of building design. Today, utility bills make up 6% of employers building costs,[i] whereas employees account for 92% of building costs – therefore, improving occupant health can be a major opportunity to reduce expenses. Similarly, improving occupant productivity from an enhanced indoor environment could result in gains of up to $230 billion nationwide,[ii] with potentially $996 million in gains for federal facilities.[iii]

Heathy building strategies have not yet been widely embraced in general building practice. Many practitioners are skeptical, because these reported occupant benefits are based on one-off case studies under specific context and with many unknown variables or even confounding factors.



PNNL Healthy Building Framework Methodology

HEALTHY BUILDINGS INITIATIVE

Building energy efficiency measures interact with health and occupant comfort implications. PNNL's research is focusing on three key building systems: envelope, electrical, and mechanical systems as they directly affect thermal comfort, visual comfort, and indoor air quality. For example, tighter envelope construction can save energy due to reduced leakage, but may negatively impact occupants' health and cognitive performance due to reduced ventilation. On the other hand, better control of air flow with reduced air leakage combined with demand control ventilation can reduce moisture damage and improve indoor air quality and occupant comfort while lowering the utility bill.

PNNL has developed a framework that quantifies the expected financial and non-monetary costs and savings related to improving occupant health in federal buildings and facilitates holistic decision making.

CALCULATING HEALTH IMPACTS OF ENERGY MEASURES

PNNL conducted an extensive review of studies that correlated indoor air quality, thermal comfort, and lighting to productivity, absenteeism, and turnover. This literature review provided an initial basis for the cost-benefit analysis and set up a more standardized way to extract and utilize data from the past research findings. The potential improvement to occupants is used in conjunction with personnel data (aggregated salaries, turnover rate, etc.) to calculate the potential financial savings of the healthy building improvements.

The framework includes a standard methodology to baseline a building's performance in health and a customized cost-benefit analysis of building improvements that impact health. PNNL's framework begins by looking at inputs, including basic building characteristics, employee information, and building improvement (i.e., energy efficiency) measures.

Next, the baseline health of a building is measured with key performance indicators in one or more of the following categories: electric lighting, daylighting, thermal comfort, and indoor air quality. For example, airborne CO_2 concentration is an indicator of indoor air quality. The baseline measures, which can be obtained from existing sensors, a building automation system, or onsite measurement, are compared to target values that are sourced from the WELL building standard, Illuminating Engineering Society handbook, and ASHRAE standards. The delta between the baseline and the target gives the potential health improvement.

Finally, the estimated potential improvement is converted to a range of personnel savings gains based on a series of regression models derived from existing studies on the benefits of healthy building strategies.

PILOT TEST

PNNL developed a field guide for collecting the building measurements utilized in the framework to calculate potential savings. PNNL is currently conducting a field test, and is piloting the field guide on the PNNL campus to refine input assumptions in the framework and streamline needed inputs to help federal agencies more easily collect and analyze building energy data and potential health savings. PNNL will next work with GSA to pilot the refined methodology in their facilities. We welcome other agencies who are interested in pilot testing the healthy building tool kit in FY 2020.

i https://www.wbdg.org/resources/life-cycle-cost-analysis-lcca

ii W. J. Fisk, "Health and productivity gains from better indoor environments and their relationship with building energy efficiency," Annu. Rev. Energy Environ., vol. 25, pp. 537-566, 2000.

iii Calculated from the portion of total commercial sq. ft. in the US that is in federal buildings. CBECS estimates that there were 5.6 million commercial buildings in the United States in 2012, comprising 87 billion square feet of floorspace (source: https://www.eia.gov/consumption/commercial/reports/2012/buildstock/). The General Services Administration (GSA) owns and leases over 376.9 million square feet of space in 9,600 buildings in more than 2,200 communities nationwide (Source: https://www.gsa.gov/real-estate/gsa-properties).

For more information, contact

FEMP Contact:
Jefferey.Murrell@ee.doe.gov

PNNL Contact:
Nora.Wang@pnnl.gov

U.S. DEPARTMENT OF ENERGY
Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

The Federal Energy Management Program (FEMP), in partnership with the General Services Administration, is currently investigating how traditional building energy efficiency measures can impact health in the federal sector through the Healthy Buildings Initiative.

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