U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

# Healthy Building Industry Review Highlights

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FEMP Federal Energy Management Program

# Background

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

The products, services and companies included in this report are used as examples. The Department of Energy does not endorse any of these products, services or companies.

# Purpose

- This industry review investigates existing resources for facility managers, owners, operators, and other decision-makers to make informed decisions relating to energy efficient buildings that also support occupant health and productivity.
- Healthy building practices have had limited adoption due to lack of awareness and limited research compared to energy efficiency. This review explores the most impactful existing resources for healthy buildings and their integration with energy efficiency. The focus is on the commercial and federal sector and healthy building categories that intersect with energy use (lighting, thermal comfort, and indoor air quality [IAQ]).

# Purpose

- **Over 100 healthy building sources were reviewed and a separate spreadsheet of 96 documented sources is provided in addition to the 99 journal publications from the methodology development. In this presentation, the resources are categorized in:**
  - Guides and Business Cases
  - Tools and Services
  - Government Programs
  - Academic and Applied Research
  - Building Standards and Codes
  - Certification Systems.

# Best Practice Guides and Business Cases

# Best Practice Guides

- **General, high-level guides that overview the principles of healthy building, for example lighting, thermal comfort, acoustics etc.**
  - Targeted towards an audience that is not very familiar with healthy building strategies
  - Tend to include background research connecting buildings to health and productivity, parameters to be concerned with, occasional case studies of improvements a building made, and feedback from the stakeholders, etc.
  - May have references to energy efficiency but not a focus of the documents
  - Mostly commercial, some residential; new and existing construction covered
  - GSA Sustainable Facilities Tool is an interactive guide with links to resources

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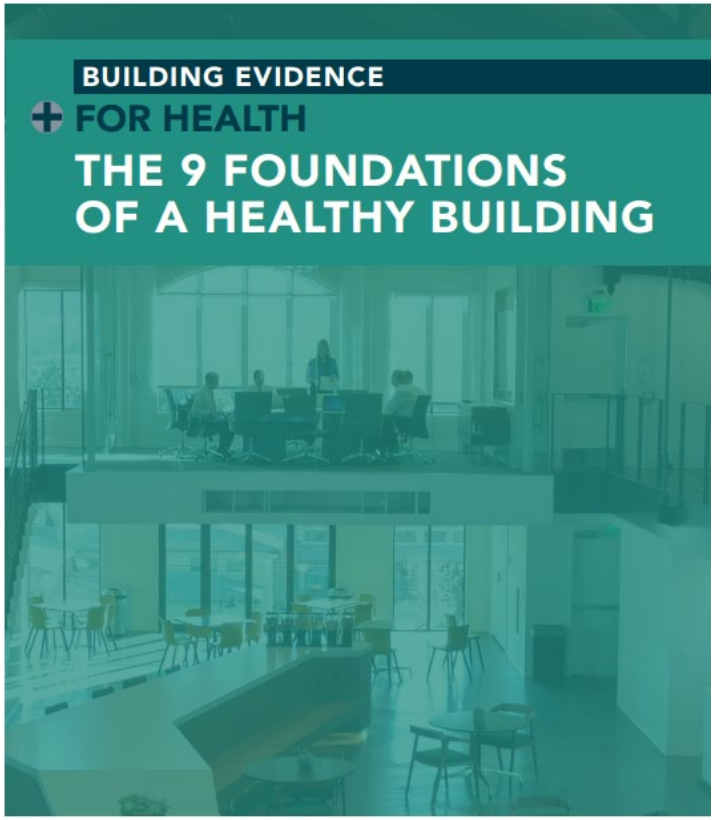
# Best Practice Guides

- Dozens of healthy building guides published
- The 9 Foundations of a Healthy Building, published by Harvard School of Public Health, familiarizes audience with the concepts of healthy building; does not provide technical guidance for project implementation




https://9foundations.forhealth.org/9_Foundations_of_a_Healthy_Building.February_2017.pdf

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# Business Cases

- **Business cases that have financial returns for general healthy building practices**
  - Use existing research to find general return on investment of non-specific health improvements across the various categories (e.g., thermal comfort)
  - Commercial buildings only, new and existing construction covered

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# Business Cases

- The Financial Case for High Performance Buildings, published by Stok, describes the expected financial savings for general healthy building strategies in indoor air quality, thermal comfort, and lighting


https://stok.com/financial-case-for-high-performance-buildings/

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# Tools and Services

# Tools and Services

- Tools are customized resources, whereas guides provide general knowledge
- Consultant companies provide design services – mostly done for new buildings, also available for existing buildings
- Companies sell healthy building products and technology (e.g., apps, sensors, building system equipment, cloud analytics)

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# Tools and Services

- Occupancy surveys summarize the occupants' experience and satisfaction in their building broken down by different areas and can help identify operation issues with building systems and controls
- GSA Tenant Satisfaction Survey is administered every year to federal buildings

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# Tools and Services

- **Tens of healthy building consultant companies**
  - Noresco, for example, is a certified WELL consultant and can be hired for new or existing buildings
- **Berkeley Center for the Built Environment provides a paid service to administer occupant surveys and analyze and benchmark the results**
- **Few tools available for self-evaluation and decision-making for users**

NORESCO

https://www.noresco.com/

CBE
CENTER FOR THE BUILT ENVIRONMENT

https://cbe.berkeley.edu/resources/occupant-survey/

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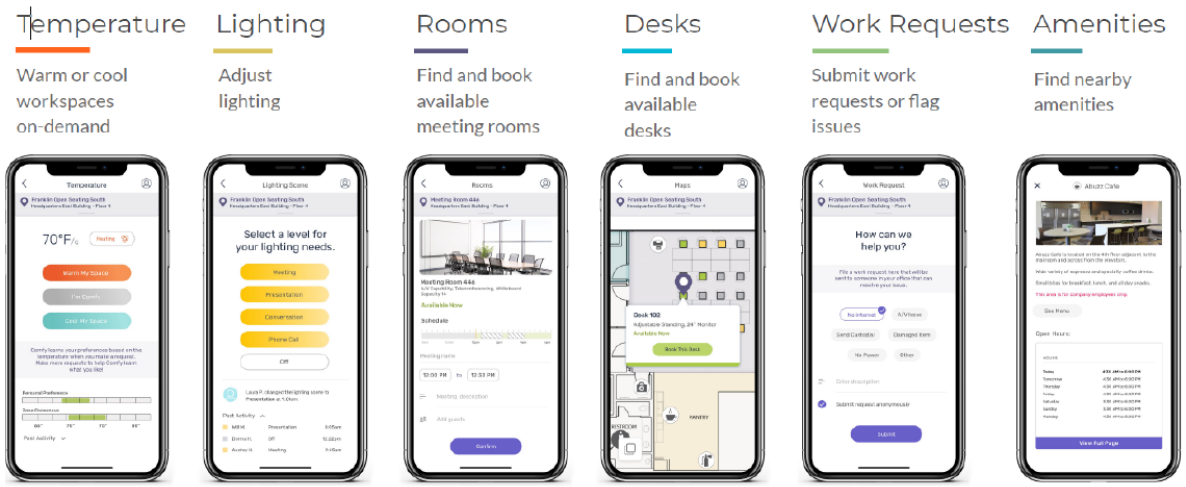
# Tools and Services

- **Tens of companies selling products and technologies**
  - Comfy, for example, provides sensors to measure IEQ data and an app to manage it as well as space utilization and energy efficiency




www.comfyapp.com

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# Government Programs

# Government Programs

- **City, state, and federal green building incentive programs**
  - Low interest loans, tax incentives, grants and other financial incentives to spur development and lower financial barriers
  - Many weatherization programs for low-income housing
  - Almost all are for green building and have an energy focus with health as a secondary consideration
  - Housing programs focus on indoor air quality and/or thermal comfort

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# Government Programs

- **Upward of 100 existing programs, many use LEED certification for qualification, mostly residential and some commercial**
  - Fannie Mae financing will reimburse Fitwel certification fees, valued at $750-6,000, for multifamily affordable housing units
  - Intended for borrowers that have incorporated health-promoting design and operational strategies at the property
  - The City of Pittsburgh, PA offers a sustainable development bonus for commercial LEED-certified buildings including a 20% increase in floor area and height

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# Academic and Applied Research

# Academic and Applied Research

- **Controlled laboratory studies on occupants under different IEQ conditions**
  - Hundreds of studies available; tend to be focus on IAQ (carbon dioxide and ventilation) and temperature.
- **Literature review and analysis**
  - Tens of publications that collect available literature in a certain area healthy building (e.g., ventilation or productivity) and usually synthesize some conclusions or discussions

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# Academic and Applied Research

- **Theoretical frameworks and evaluation methodologies**
  - For example, a sustainability index for healthy buildings or a framework for evaluating ventilation rate effectiveness
  - Tens of studies available
- **Technology research and development**
  - For example, an IoT sensor and machine-learning algorithm for thermal comfort or a testing protocol for identifying sources of VOCs
  - Tens of studies; tend to be in the early stage of research without concrete results

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# Building Standards and Codes and Certification Systems

# Building Standards and Codes

- **ASHRAE, International Code Council (ICC) and Illuminating Engineering Society (IES) release and updates a variety of standards that governments can use to inform building codes and that can be a resource for anyone**
  - For example, ASHRAE 55/62.1/189.1, IESNA Lighting Handbook, and International Green Construction Code (IgCC)
  - Tend to focus on new construction and have limited directly applicable material for existing buildings
  - Mostly for commercial buildings, some geared toward residential

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# Building Standards and Codes

- **The federal sector has some specific standards**
  - GSA created the Facility Standards for the Public Building Service (PBS-P100) which applies to the design and construction of all GSA facilities; provisions for occupant controls in temperature, lighting and acoustics and occupant satisfaction requirements
  - The Guiding Principles for Sustainable Federal Buildings (and DoD Unified Facilities Criteria) has been voluntarily committed to by 22 agencies; emphasize is greatly on energy efficiency but includes some health provisions for IAQ, thermal comfort, and lighting

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# Building Standards and Codes

- The National Healthy Housing Standard by the National Center for Healthy Housing and the American Public Health Association is a standard for the residential sector

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# Certification Systems

- **Two prominent certification systems that focus on healthy buildings: WELL Building Standard and Facility Innovations Toward Wellness Environmental Leadership (Fitwel)**
  - Fitwel created by GSA and CDC and focuses on amenities, policies, and services for occupants
  - WELL focuses on building systems, design and operation and has some amenity and policy credits

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# Certification Systems

- **Green building certification systems include provisions for occupant health in addition to sustainability and energy**
  - Leadership in Energy and Environmental Design (LEED) is the probably most well-known one
  - Of the 126 possible credits in LEED v4.1 BD+C – New Construction, 20 are specifically for occupant comfort, and 12 of those are for IAQ
- **Certification fees have additional and significant costs to projects but have recognition value**

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# Conclusions

# Discussion

- There are many resources available in the field of healthy building; However, for federal building owners and operators, the challenge can be the question of applicability and customized information (what works for one building may not work for another) and the cost of services and technology without confidence of payback
- It is important to determine intersection with energy if that is a priority – many resources do not discuss explicitly

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# Discussion

- **Gaps**
  - Modeling (engineering or statistical/data) IEQ (e.g., computational fluid dynamics or light levels) is still emerging and not widely utilized and modeling occupant outcomes from IEQ models is virtually non-existent
  - Concrete understanding of intersection between energy and health for building systems and design strategies is incomplete or unreliable
  - What is needed is low-cost, high fidelity, customized solutions—our project is applied research and we are targeting these gaps by creating a starting point

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