

Witness Testimony
**U.S. HOUSE OF REPRESENTATIVES COMMITTEE ON TRANSPORTATION &
INFRASTRUCTURE, SUBCOMMITTEE ON ECONOMIC DEVELOPMENT,
PUBLIC BUILDINGS AND EMERGENCY MANAGEMENT**
Hearing: Efficiency and Resilience in Federal Building Design and Construction

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Good morning Chairwoman Titus, Ranking Member Meadows, and Committee Members. I want extend my gratitude to Chairwoman Titus, the Ranking Member, and all members of the committee for the opportunity to submit testimony about energy efficiency and resilience in federal building design and construction. I also want to thank you for your service to our country and your leadership through the impactful work of this subcommittee.

I am Kevin Van Den Wymelenberg, a professor of architecture at the University of Oregon. I direct the Energy Studies in Buildings Laboratory, a laboratory that for the past four decades has focused on passive heating and cooling, passive ventilation and daylighting in buildings. I co-direct the Biology and the Built Environment Center, a center focused on understanding indoor microbial ecology, the microbiome, and the architectural and human factors that influence it. I also lead the Institute for Health in the Built Environment, a cross-disciplinary institute comprising designers and scientists at the University of Oregon and many other collaborating universities, along with an industry partnership program called *Build Health* that seeks to research and design strategies that synthesize energy efficiency and human health.

Today, I will describe how the habitat in which Americans spend the majority of their time is changing and how this is connected with energy resource consumption, human health and well-being, and overall economic productivity. I will describe a vision for improving our built environment and the role of resilient design to achieve energy efficiency and improved human health outcomes. I will illustrate how our efforts to transform energy efficiency markets have taught us important lessons about how to achieve our goals for resilience of individuals, buildings, communities and our country. Finally, I will open a window to illuminate how to initiate and sustain progress toward our goal of resilient buildings and communities.

Over the course of the last 5-7 generations, Americans have transformed how and where we spend our time. We have moved indoors, become an indoor species. We have yet to fully understand the implications of this transformation. Over the same period, we have increased life-expectancy, from below 50 years of age in 1900 to nearly 79 years of age in 2010. But in the last few years, according to the Centers for Disease Control and Prevention, Americans are experiencing annual declines in life expectancy, in part due to factors related to mental health. Furthermore, we are falling behind our peers in Spain, Australia, and Canada, by as much as four years, despite the fact that we spend thousands of dollars more per person each year on healthcare than these countries (per OECD data). Evidence is mounting that highlights a connection between indoor environmental quality and human health outcomes. We have seen steep increases in inflammatory diseases including asthma, especially in families living in low-income housing. We have observed increases in healthcare-associated infection so severe that insurance companies are sometimes not reimbursing these costs and patients are beginning to make health

care choices with infection risk in mind. Similarly, we have experienced increased absenteeism in K-12 schools due to the prevalence of rapidly transmissible viruses which appear increasingly resistant to antimicrobial compounds. In Oregon, as in other states, we have recently witnessed more severe wild fires whose smoke has forced my campus to shut off access to outside air in buildings for days at a time.

In the last 100 years we have dramatically increased energy production and consumption. In recent decades we have made concerted efforts to reduce energy consumption. Over my 20-year career in architectural research, I have witnessed tremendous innovations for energy efficiency by manufacturers of lighting and HVAC equipment, industry service providers of smart building infrastructure software, by public utilities through public benefit charges and incentive programs, by research funded through the US Department of Energy's Building Technology Office, and through standards within the US Government, such as building energy performance targets in federally owned or occupied buildings. These efforts, though incredibly important and substantial, have only *curbed* US total growth in energy consumption, *not* significantly reversed the trend.

I argue that we need a more leveraged suite of tools, a more comprehensive cost/benefit analysis than relying on energy efficiency alone. There is a principle of 3, 30, 300, in workplace facility management that proportionally represents business expenditures, such that if an organization annually spends \$3 per square foot on utilities, and \$30 per square foot on building infrastructure, then that same square foot will cost \$300 for employees annually, scaled by geographic and market location. Today, we are not only talking about federal spending on utilities and buildings, we are also talking about better leveraging spending to support federal employees such that they can more readily achieve the missions expected of them by taxpayers, policy makers, and meet their own high professional standards.

When we get past looking solely at building efficiency and open the discussion to resilience in federal buildings, we increase the scope of our potential impact to the lives of all federal employees. Resilience encompasses several aspects of building design, construction and operation. We can think of resilience as "passive survivability", or the ability for people to survive in a building during a disaster or power outage. Do building occupants have access to light and air? Survivability is critical during an extreme event, but for a more comprehensive understanding of resilience on a day to day basis, we really need a vision of "passive thrive-ability", or environments that improve human productivity and health outcomes while using less energy and approaching net-zero energy performance. We can also think of resilience as supporting the triple bottom line of people, planet, and profit. Resilient buildings improve the health of the people who occupy them, regenerate the health of the planet through their design, construction and operation, and produce a healthy bottom line for the organizations that use them to support governance and commerce.

Conceived in this manner, creating resilient buildings and communities is essential to the prosperity of our country, and indeed represents a grand challenge! The good news is that there are some important lessons to glean from decades of investment into market transformation for energy efficient buildings. First, we have learned it takes ingenuity and innovation. Academics have to generate new ideas, businesses need to create new technologies, and professionals need to innovate new best practices. Second, we need incentives and investment to ignite this innovation. We have seen the beneficial impacts of utility public benefit funded investments, such as that of the Northwest Energy Efficiency Alliance to support integrated design and energy efficiency market transformation, philanthropic and foundation support, such as that of the Alfred P. Sloan Foundation for fundamental research on indoor microbial ecology and indoor chemistry, and federal research funding such as that of the EPA and DOE. We have seen how mission-driven non-profits promote reach standards that focus the public's attention and

provide guidelines for how to achieve these goals, how government organizations such as the General Services Administration can mobilize the private sector by establishing building performance thresholds, and finally how universities and industry can partner, through programs like *Build Health* at the University of Oregon, to sustain this progress by collaboratively exercising their business models.

Many of these lessons are transferrable to our quest to create resilient buildings and communities. We can leverage the power of design to take advantage of synergies in both human health and building energy goals. For example, we can provide people with an operable window, replete with access to a view of nature, filling rooms with abundant daylight, and direct access to fresh air. We can create spaces that achieve high performance thresholds for thermal, visual, and acoustical well-being while providing high air quality. These attributes have been shown to support positive human health outcomes through circadian entrainment, attention restoration, accelerated stress recovery, improved cognition, increased indoor microbial diversity, and reduction of low dose exposures to toxins. When implemented properly, these same strategies can dramatically reduce energy consumption. This is “passive thrive-ability”; this is building resilience.

In order to take advantage of the longer lever arm of our investment in people, there are critical knowledge gaps and barriers in practice to overcome. First, we need a clear vision that defines a healthy building and recognizes that energy efficiency alone is not a sufficient goal. Second, we need resources to ignite innovations that aim to improve human health indoors, document the impact of associated health outcomes, and monetize these for use in lifecycle cost-benefit studies. Third, we need to promote policies, reach standards, and educational programs that sustain continuous improvement and scale up implementation in a collaborative manner, inclusive of government, education, and private industry sectors. It is especially important that care be taken to support equity through these efforts so as to avoid some of the documented pitfalls of socio-economic class disparities that currently exist in our built environment.

I believe that the GSA is already on the pathway to efficient and healthy public buildings, indeed resilient buildings, and that their efforts to date should be lauded and further supported. Federal leadership has made a positive impact on energy efficiency market transformation and holds similar potential for healthy and resilient buildings. These efforts have taught us many important lessons that can accelerate our progress in this new quest. However, we need to be willing to transform our thinking and shift away from what has been a more singular focus on energy efficiency in public buildings and toward the inclusion of the health of federal employees, veterans, security and maintenance staff, guests and others that inhabit our public buildings. Only by harnessing the longer lever arm associated with the resources we investment in people will we achieve our far more ambitious goal of building resilience and support optimal human health and productivity. I encourage the committee to consider the following three recommendations to promote efficient and resilient public buildings that foster thriving occupant communities.

First, we should capitalize on the investments we have made in efficiency to date by documenting the persistent energy savings from strategies implemented and the associated non-energy benefits in domains such as thermal, visual, and acoustical well-being and improved air quality. This will facilitate efforts to establish mechanisms to reinvest these savings to drive deeper efficiency and even more positive human health outcomes. To accomplish this, we need further research to determine measurable and verifiable metrics for monetizing the associated non-energy benefits, case studies to test these approaches, some additional convening to facilitate the peer-review process and consensus building. The results of this

work would have far-reaching impacts beyond GSA, including expanding public utility incentive programs and efforts of energy efficiency market transformation organizations.

Second, we should pilot these reinvestment mechanisms to implement deeper energy efficiency and human health strategies in existing federal and state public buildings. For example, the University of Oregon is in the second year of piloting ongoing building commissioning, a strategy whereby energy savings are achieved through improved building management tools and practices. We are developing metrics to document improved human comfort, productivity, and health outcomes, and developing institutional performance verification and reinvestment strategies. We are documenting the energy savings from ongoing commissioning and reinvesting a portion of these funds to support more ambitious goals for energy and health in existing buildings. We are concurrently developing a cross-disciplinary Resilience Initiative that aims to have teaching, research, and industry engagement components and will benefit from and support the ongoing building commissioning program. The reinvestment strategy creates a self-sustaining pool of resources to promulgate the initiative. The GSA has conducted building commissioning and has additional insights to share. We propose a program I call *BTUs 4 BTUs*, Building Tune-Ups for BTUs (energy), that expands our current work in ongoing commissioning and campus resiliency, and we would relish the opportunity to collaborate with GSA to pilot the program and potentially extend the model through collaboration with other universities and public sector organizations.

Third, the current and emerging investment streams need to be paired with targeted incentives, establishment of federal policies, and research grants that build upon lessons learned from energy efficiency market transformation to fill knowledge gaps and barriers in practices in order to achieve goals of healthy and resilient buildings. These steps can unlock increased energy savings and human productivity improvements while reducing the cost of operating infrastructure.

Public buildings have a well-established tradition of serving as pace-makers and agents of change for our built environment. By building upon these successes and striving for a more holistic vision of resilient buildings we can accelerate the implementation of energy efficiency, innovate best practices, increase productivity, support well-being, and ultimately reverse the disconcerting downward trend in life expectancy and rising cost of healthcare for Americans.

A grand challenge is upon us. Realizing the promise of resilient buildings will improve the health outcomes of the people inside, regenerate the health of the planet, and produce a healthy bottom line for the organizations that use them. Thank you for your time and attention.

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