

WHITE PAPER

NIOSH PERSPECTIVES ON SUSTAINABLE BUILDINGS: GREEN*AND SAFE*

EXECUTIVE SUMMARY

The importance of green jobs has stimulated national discussion and interest. As green and sustainable practices become more common in the U.S, there is an opportunity to promote worker safety and health as a fundamental dimension of true sustainability. Buildings are a logical starting point for increased coordination given their importance to both environmental and occupational practice. Occupational safety and health and environmental health share historical roots, as well as many interests, approaches, and values. Both communities aim to protect health and quality of life, and both recognize the important role that design interventions can play. The White Paper provides an overview of key issues and relevant activities for these two professional practice communities. It describes the role of the U.S Green Building Council (USGBC) and its environmental rating system. It describes the role of the National Institute for Occupational Safety and Health (NIOSH) along with recent developments suggesting increasing interest among NIOSH stakeholders in integrating safety and health into green and sustainable construction approaches. It makes a case for further dialogue and collaboration between the occupational and environmental communities and describes how USGBC and NIOSH are in unique positions to advance this discussion. It concludes with four recommendations for moving forward to ensure that green buildings are safe to construct, operate, maintain and occupy.

(1) INTRODUCTION

Green¹ Construction and **Occupational Safety and Health** are two separate professional fields with specializations related to the construction, maintenance, and operation of buildings. Integrating worker safety and health into sustainable construction is a logical topic for mutual discussion. The purpose of this White Paper is to promote additional discussion. The Paper sets the stage by providing a short overview on environmental and occupational safety and health challenges posed by buildings. It describes key groups and developments for both areas of practice with a focus on building environmental rating systems. After this orientation, the Paper discusses the rationale for further collaboration and then provides specific recommendations for further collaboration.

(2) OVERVIEW OF GREEN CONSTRUCTION AND OCCUPATIONAL SAFETY AND HEALTH CHALLENGES AND PRACTICES

(A) Green Construction and Building Operation

Problem Statement

In the United States commercial and residential buildings taken together account for 40% of primary energy consumption nationwide (this includes 72% of electricity and 55% of U.S. natural gas) (Rogers, 2008). This level of consumption exceeds that for either transportation or industrial sectors, and usage is also increasing at a faster rate (Rogers, 2008). Buildings also use large amounts of potable water, and their construction consumes large amounts of raw materials and generates large quantities of waste. Buildings also have a considerable impact on human health and the environment. Green and sustainable construction practices are a response to this problem. Green building rating systems define and evaluate these practices. The U.S. Environmental Protection Agency (EPA) defines green building as “the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building’s life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building.”²

Key Groups and Developments

At the federal level, the Environmental Protection Agency (EPA) and the Department of Energy (DOE) play major roles in helping to encourage and disseminate green building practices. For example, EPA has an “Energy Star for Buildings” program and DOE has

¹ The terms “Green” and “Sustainable” are often used interchangeably in describing building practices that improve the environment. NIOSH views “sustainability” as a broader term that encompasses social aspects, including occupational safety and health, and will use the term Green to describe current efforts focused primarily on energy efficiency and environmental preservation.

² See EPA Definition at <http://www.epa.gov/greenbuilding/pubs/about.htm>

a “Commercial Buildings Initiative” to improve the energy efficiency of new and existing buildings.

At the non-profit level, the U.S. Green Building Council (USGBC) was established in 1993 as a non-profit organization intended to develop standards for what constitutes a green building. The first version of its *Leadership in Energy and Environmental Design* (LEED ®)³ rating system was introduced in 1998. LEED provides a framework for rating buildings on eight categories: Location and Planning, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation and Design Process, and Regional Priority. Rating involves 100 base points plus 10 additional points for any design innovation and regional priorities. The highest rating is Platinum (80 points and above), followed by Gold (60-79 points), Silver (50-59 points) and Certified (40-49 points). There are LEED rating systems for new construction as well as for renovations of existing buildings. LEED has been widely adopted globally during the last decade. For example, there are LEED projects in all 50 states and in 91 countries (USGBC, 2009). The USGBC has expanded the types of LEED guidance and rating systems. For example, there is a *LEED for Homes* rating program and there is guidance for green remodeling projects. There is a *LEED for Neighborhood Development* rating system and a *LEED for Healthcare Facilities* rating system under development.

The U.S. federal government has embraced sustainable construction. Presidential Executive Orders⁴ spanning several administrations have encouraged and directed federal agencies to use sustainable practices for new construction and renovation upgrades. An infrastructure to support federal agency efforts has developed in response to the Executive Orders. For example, the General Services Administration (GSA) operates an Office of Federal High Performance Green Buildings. DOE supports an Interagency Sustainability Working Group. GSA recently announced that all new federal buildings would need to meet LEED gold certification as a minimum as a way to move the government’s federal buildings to a more sustainable future (GSA, 2010).

The Executive Orders created a number of ambitious best practice environmental and energy goals. For example, EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance, signed by President Obama on October 5, 2009, requires agencies to implement high performance sustainable federal building design, construction, operation and management, maintenance, and deconstruction. Agencies must establish and report a comprehensive inventory of absolute greenhouse emissions. It also requires at least 50% of construction materials and debris from federal buildings to be diverted from landfills by 2015. It looks ahead to require that all new federal buildings entering the planning process after 2020 be designed to achieve zero net energy use by 2030.

³ LEED ® is a registered trademark of the US Green Building Council

⁴ For example, EO 13148 *Greening the Government through Leadership in Environmental Management*, issued under the Clinton Administration; EO 13423 *Strengthening Federal Environmental, Energy, and Transportation Management*, issued under the Bush Administration; and EO 13514 *Federal Leadership in Environmental, Energy and Economic Performance*, issued under the Obama Administration.

Despite the slowdown in the economy, the volume of construction projects registered with or certified by third party environmental ratings groups increased by 11% from 2008 to 2009⁵ (Tulacz, 2010). Green building is growing and the use of environmental rating systems is expanding to corporations, states, and municipalities.

LEED and Occupational Safety and Health

The LEED Environmental Quality category addresses occupational health but in a limited fashion. These credits are intended primarily to enhance occupant comfort and well-being, although several explicitly mention the intent to reduce exposures to potentially hazardous or harmful contaminants. Wargo (2010) raised the question of whether the LEED rating system places enough emphasis on the prevention of human health effects. For example, a new construction project can achieve a Platinum certification, the highest one available with 80 credits and above, without satisfying a single one of the 15 credits allocated to human health (Wargo, 2010). The credits primarily target building occupants; however, several mention construction workers and maintenance workers. Examples of these credits are summarized in Table 1.

Table 1 – Examples of LEED Credits with occupational health value				
LEED Credit	Wording of Intent (emphasis added)	Occupant	Construction	Maintenance
<i>New Construction</i> Prerequisite 1 Minimum Indoor Air Quality Performance	“To establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants. ”	x		
<i>New Construction</i> Credit 3.1 Construction Indoor Air Quality Management Plan – During Construction	“To reduce IAQ problems resulting from construction or renovation and promote the comfort and well being of construction workers and building occupants ”	x	x	
<i>New Construction</i> Credit 3.2 Construction Indoor Air Quality Management Plan – Before Occupancy	“To reduce IAQ problems resulting from construction or renovation to promote comfort and well-being of construction workers and building occupants ”.	x	x	
<i>New Construction</i> Credit 4.1 Low-Emitting Materials- Adhesives and Sealants	“To reduce the quantity of indoor air contaminants that are odorous, irritating, and/or harmful to the comfort and well-being of installers and occupants ” (NOTE: installers would be construction workers)	x	x	

⁵ This figure is derived from revenues from the top 100 green contractors. The total was \$43 billion - up from \$28 billion the previous year.

<p><i>New Construction</i></p> <p>Credit 4.2 Low-Emitting Materials- Paints and Coatings</p>	<p>“To reduce the quantity of indoor air contaminants that are odorous, irritating, and/or harmful to the comfort and well-being of installers and occupants” (NOTE: installers would be construction workers)</p>	<p>x</p>	<p>x</p>	
<p><i>New Construction</i></p> <p>Credit 4.3 Low-Emitting Materials – Flooring Systems</p>	<p>“To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.” (NOTE: installers would be construction workers)</p>	<p>x</p>	<p>x</p>	
<p><i>New Construction</i></p> <p>Credit 4.4 Low-Emitting Materials – Composite Wood and Agrifiber Products</p>	<p>“To reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.” (NOTE: installers would be construction workers)</p>	<p>x</p>	<p>x</p>	
<p><i>Existing Buildings, Operations and Maintenance</i></p> <p>IEQ Prerequisite 3: Green Cleaning Policy</p>	<p>“To reduce exposure of building occupants and maintenance personnel to potentially hazardous chemical, biological and particulate contaminants, which adversely affect air quality, human health, building finishes, building systems, and the environment.</p>	<p>x</p>		<p>x</p>
<p><i>Existing Buildings, Operations and Maintenance</i></p> <p>IEQ Credit 1.5 Indoor Air Quality Best Management Practices – Indoor Air Quality Management for Facility Alterations and Additions.</p>	<p>“To prevent indoor air quality (IAQ) problems resulting from any construction or renovation projects to help sustain the comfort and well being of construction workers and building occupants.”</p>	<p>x</p>	<p>x</p>	

LEED does not appear to explicitly address safety (i.e., injury prevention), and none of the LEED credits directly mention construction, operation, or maintenance worker safety. While each LEED credit includes a requirement section to provide details and references to additional standards or guidance, the scope does not currently include mention of any relevant safety standards or guidance.

There is a generally held belief that green building design offers secondary benefits; however, there is no available evidence that construction practices for green buildings are safer for workers. Rajendran, Gambatese, and Behm (2009) compared recordable injury rates among LEED and non-LEED construction projects and found no statistically significant difference in rates among the projects included in the study.

Occupational safety and health practitioners and researchers have expressed reservations about the hazards inherent in some green building construction activities. Gambatese (2009) pointed out that some green building design features could actually increase jobsite hazards. For example, the greater use of skylights and atria in buildings increase light and give a sense of greater space on the one hand, but they also increase fall hazards during construction, and later, during cleaning and maintenance activities. In another example, there could also be greater risks of musculoskeletal injuries from increased jobsite manual handling and separation of materials to meet

project recycling goals. Gambatese described a “blind spot” in sustainable design practice when it comes to worker safety and health.

Chen (2010) pointed out that green practices such as use of solar energy can involve hazards. She describes a case in which a worker fell off of a roof while installing solar panels. Working 43 feet off the ground, the worker was walking backward when he fell off the two-story building and was killed. She explains, furthermore, that unlike a traditional system where an electrician can isolate the load from the power source, working on a solar panel means working on the power source itself thus introducing electrical hazards.

Gillen and Gittleman (2010) described the increasing interest in “beneficial reuse” of waste materials such as fly ash in construction materials as an example of a green construction activity that could lead to potential occupational concerns. These materials are typically evaluated for environmental attributes. An example would be assessing toxic heavy metals in coal combustion products to determine if they will leach out of the product to pollute water. An evaluation for occupational safety and health exposures and concerns are needed as well, however, because construction practices that use such materials involve airborne dust-generating tasks such as drilling, grinding, cutting, or milling. These tasks could result in exposures to heavy metals such as arsenic, mercury, cadmium, and chromium. Exposure scenarios for construction workers need to be addressed during the product development stage so that appropriate safety and health precautions and interventions can be developed and information disseminated.

In summary, the LEED rating system addresses building occupational health in a limited way. LEED does not address occupational safety; it promotes activities (i.e., installation of skylights, use of green roofs) that may increase exposure to hazards such as falls for construction, maintenance and operations workers. Green buildings, and the voluntary use of rating systems such as LEED, offer important policy insights into how owners, architects, suppliers and contractors can be encouraged to embrace best practices that go beyond compliance with regulatory minimums.

(B) Building Construction, Operation and Maintenance Safety and Health

Problem Statement

Each year in the United States, 5,800 people die from work-related injuries and diseases, 228,000 become ill, and 3.9 million are injured (BLS, 2006). The annual direct and indirect costs of work-related injuries, illnesses and fatalities have been estimated to range from \$128 billion to \$155 billion (Schulte, 2005). A recent study in Australia implicates design as a significant contributor to 37% of work-related fatalities (Driscoll, et al., 2008). Evidence suggests that eliminating hazards and minimizing risks to workers during building design can greatly improve worker health and safety (NIOSH, 2006; Lin, 2008; Schulte et al., 2008).

Buildings link to occupational safety and health because they serve as workplaces over their lifespan. Construction workers build, renovate, refurbish, and maintain them. Building service workers clean, maintain and operate them to provide the offices and workshops for many types of occupants, including workers. Finally, they are workplaces for the construction workers dismantling them at the final stages of their useful life.

Buildings represent a major source of hazards over their lifecycle. For example, indoor air quality is an issue for building worker occupants. NIOSH co-authored "Building Air Quality: A Guide for Building Owners and Facility Managers with EPA in 1991 to provide guidance to prevent and control these hazards [NIOSH, 1991]. Furthermore, the NIOSH Health Hazard Evaluation Program performs numerous indoor air quality investigations each year in response to complaints and requests. Cleaning chemicals can pose hazards for both building service workers and building occupants.

Construction merits attention because it is a high hazard industry sector. The construction industry accounts for the largest number of fatal injuries (816 in 2009) of any industrial sector. Construction workers represent approximately 7% of all workers but experience 21% of fatal injuries. Falls from heights are the leading cause of traumatic injury death in construction. Falls are a special problem for the two construction groupings, Construction of Buildings and Special Trade Contractors,⁶ whose work primarily involves construction or renovation of buildings. These construction workers experienced 44% of all fatal falls nationwide among all sectors in 2009. Construction fatalities represent an important and preventable U.S. injury burden, and while fatality rates in the U.S. have declined over the decade, they remain high in comparison to rates in other countries. For example the construction fatality rate in the UK is 2.0 per 100,000⁷ workers, in comparison to a rate of 9.7 per 100,000⁸ in the U.S.

Fatalities are not the only problem. Construction workers experience a high rate of non-fatal injuries and musculoskeletal disorders. They are also exposed to a number of health hazards, including: paints, solvents, adhesives, silica, asbestos, lead, welding fumes, noise, and diesel fumes. Construction worker exposures are typically multiple orders of magnitude higher than occupant exposures.

As mentioned, hazards do not end once new construction is complete. For example, construction, maintenance, and service workers may be exposed to fall hazards because of the need to access roof areas for repairs, maintenance, cleaning, or renovation. Office workers may be affected by indoor air quality concerns relating to materials, finishes, and furnishings.

⁶ Heavy and Civil Engineering is the third construction grouping under the North American Industry Classification System (NAICS). This group is involved primarily with road building. Only 7% of 2009 fatalities for this group were falls, whereas 49% and 39% of fatalities for Construction of Buildings and Special Trades Contractors respectively were due to falls.

⁷ See <http://www.hse.gov.uk/statistics/fatals.htm>

⁸ See <http://www.bls.gov/news.release/pdf/cfoi.pdf>

Key Groups and Developments

The National Institute for Occupational Safety and Health (NIOSH) is the federal agency responsible for conducting research and making recommendations for the prevention of occupational illness and injury. NIOSH is part of the Centers for Disease Control and Prevention (CDC) in the Department of Health and Human Services.

NIOSH works closely with the Occupational Safety and Health Administration (OSHA), which is the Department of Labor agency responsible for regulation and enforcement of worker safety and health.

The NIOSH Construction Program was established in 1990. The program includes internal researchers along with support for academic researchers and a large external “National Construction Center” designed to interact with construction industry stakeholders. The Center is operated currently by CPWR – The Center for Construction Research and Training. CPWR maintains relationships with numerous construction groups including various construction trade associations and the AFL-CIO Building and Construction Trades Department (BCTD). The NIOSH Construction Program also works closely with OSHA’s Directorate of Construction, academia, and professional organizations such as the American Industrial Hygiene Association and the American Society of Safety Engineers.

NIOSH and its construction safety and health stakeholders developed national goals under a National Occupational Research Agenda (NORA) initiative that began in 2006. A NORA Construction Sector Council developed 15 construction goals, including strategic goals to reduce falls and to prevent construction hazards through design, an approach called “Prevention through Design” (PtD) (described below) by occupational safety and health practitioners. The use of PtD to address construction safety and health has gained significant traction in the European Union and Australia but is not yet widely practiced in the U.S.

NIOSH initiated a Prevention through Design (PtD) National Initiative in 2007 to address design-related occupational injuries and illnesses by eliminating hazards and minimizing risks to workers across all industry sectors and settings. PtD examines hazard potential throughout the life cycle of work premises, tools, equipment, machinery, substances and worker processes, including their construction, manufacture, use, maintenance, and ultimate disposal or reuse.

Together, the NIOSH Construction and PtD programs are collaborating on efforts to increase the use of design interventions to address safety and health hazards early in the pre-design and design processes.

Recently, interest in green construction, and LEED in particular, has increased among construction safety and health practitioners. A number of developments have contributed to gathering momentum on this topic. Several are summarized briefly below:

1. National Goals that address USGBC

Both the NIOSH Construction and PtD programs have stakeholder-developed national goals that address working with the US Green Building Council. For example, the NIOSH Construction Program goal states:

“Within 4-6 years, develop methods to utilize the U.S. Green Building Council’s (USGBC) Leadership in Energy and Environmental Design (LEED) rating system and the sustainability movement to implement CHPtD (Construction Hazard Prevention through Design)”⁹

The NIOSH Prevention through Design (PtD) Program goal states:

“Work with U.S. Green Building Council to include PtD principles in LEED certification”¹⁰

2. National Workshop findings

In December 2009 NIOSH hosted a *National “Making Green Jobs Safe”* Workshop to discuss the connection between emerging green jobs and occupational safety and health, and to frame the issues for ensuring that *sustainable design* includes elements to eliminate hazards and minimize the risk to workers. The meeting was co-hosted by EPA, OSHA, the National Institute for Environmental Health Sciences (NIEHS), and the National Toxicology Program (NTP), and was attended by 170 stakeholders¹¹. The potential to improve construction safety through linkage with green and sustainable efforts was one of the major areas of agreement among participants. “Sustainability” was viewed as flawed or incomplete without incorporation of occupational safety and health concepts. Participants voiced the view that worker safety and health should be placed at the same level of importance as energy and environment in sustainability considerations. The meeting included breakout sessions to identify compelling activities for follow-up. Participants voted on the list of activities to suggest priorities, and among the top 10 were:

- *Include occupational safety and health into green and sustainable standards as they are being updated*
- *Integrate safety and health into green elements of contractor specifications*
- *Include occupational safety and health into federal sustainability efforts and procurement*
- *Develop, validate, and disseminate a LEED-like safety and health rating system*

3. Las Vegas CityCenter experience

The disconnect between green construction and safety and health was highlighted for many in the construction safety and health community when the Las Vegas CityCenter complex was awarded six Gold LEED certifications in November of 2009 (CityCenter, 2009). The CityCenter project had a high profile because it was the largest commercial construction project in the U.S. at the time, and was the subject of a Pulitzer Prize-winning series of articles in the Las Vegas Sun because of multiple fatalities during its construction. Unfortunately, the construction of this large multiple building project

⁹ See Goal 13.3.2 on page 113 of

<http://www.cdc.gov/niosh/NORA/comment/agendas/construction/pdfs/ConstOct2008.pdf>

¹⁰ See Goal 4.4.2 on page 48 of <http://www.cdc.gov/niosh/programs/PtDesign/pdfs/PtDStrategicPlan2009.pdf>

¹¹ See <http://www.team-psa.com/safeandgreenworkshop/home.asp> for information about the workshop

involved the same number (six) of construction worker fatalities (CPWR, 2008) as the number of LEED certifications. While there was no indication that these environmental certifications had anything to do with the safety record on the project, this example did shine a spotlight on the apparent disconnect between good environmental practice and good construction and safety and health practice.

4. Construction Safety Scorecard under development

Motivated partly by the success of LEED, construction safety and health researchers at Oregon State University developed a “Sustainable Construction Safety and Health Rating System, and are seeking partners to pilot the system (Rajendran, 2009).

5. ACCSH developments

The OSHA Advisory Committee for Construction Safety and Health (ACCSH) is a multi-stakeholder federal advisory committee established, under the Construction Safety Act of 1973, that advises OSHA on construction safety and health activities including construction standards and policy matters affecting federally financed or assisted construction. ACCSH formed a new Green Jobs in Construction Committee in 2010 which began to discuss LEED and federal sustainability Executive Orders. The committee unanimously passed the following motion at its April 2010 meeting:

“ACCSH strongly recommends that OSHA and NIOSH work together to collect information on current federal orders and requirements relating to construction safety and health and develop an Executive Order that clearly directs Federal entities to lead by example on construction safety and health by employing design for safe constructability concepts, including training for workers and supervisors and sub-contractor prequalification based on demonstrated programs and performance.”

6. AFL-CIO Building and Construction Trades Department (BCTD) Resolution

The BCTD passed Resolution Number 11, titled: “*Safe Green and Sustainable Construction*” in August 2010 at their national meeting. The Resolution (Appendix 1), refers to the leadership role being played by the Federal government on green sustainable buildings and mentions the disconnect between environmental best practices and occupational best practices. It states that construction workers are at the forefront of green and sustainable construction, and that true sustainability must include protecting their safety and health. It resolves that the BCTD pursue with the Obama Administration the adoption of a Presidential Executive Order modeled on EO 13514 to call for the federal government to use high performance safety and health practices in green and sustainable construction. Lastly, it resolves that CPWR – The Center for Construction Research and Training work with its federal research partner NIOSH to continue to explore ways in which to incorporate construction safety and health considerations into green and sustainable construction.

These six developments are significant and suggest that the time is ripe for additional discussions and actions about construction, maintenance, and building operations safety and health between the green buildings community and the safety and health community.

(3) DISCUSSION

The importance of green jobs has stimulated national discussion and interest. As green and sustainable practices become more common in the U.S, there is an opportunity to promote worker safety and health as a fundamental dimension of true sustainability. A sustainable product, process, or technology should not only protect the environment and the consumer but also the worker. Green jobs must be safe jobs. (NIOSH Blog, 2010).

Occupational safety and health, energy conservation and environmental protection professionals often work separately from one another, which increases the chances that costs and/or risks will be unintentionally shifted from the environment to workers or vice versa. Working together across disciplines would help better coordinate approaches to sustainability to make sure that workers, the environment and energy resources are all protected.

Sustainable practices and green technologies, products and processes need to be evaluated for worker safety and health just like any other new job, product or practice. Such evaluation can identify work-related hazards that can then be prevented or controlled. It can also help identify those green practices, products and technologies that improve worker safety and health so that they can be widely promoted. (NIOSH Blog, 2010).

In some cases, the fundamental underlying work task associated with a green practice might not differ much from the conventional practice. However, the green practice can lead to an increase in the duration or frequency of a task known to be associated with hazardous exposures. For example, installing and maintaining skylights and solar panels involve tasks that expose workers to fall hazards. Recognizing and addressing these hazards are important unmet needs. Finding ways to integrate safety and health guidance into green and sustainable practices could actually lead to gains in safety and health performance. This is because sustainable practices, with their emphasis on going beyond compliance to high performance and best practice, have the potential to exceed conventional compliance-based safety performance.

Construction is a good place to start. As noted by Chen (2010), “Green construction represents both our greatest opportunity in terms of mitigating climate change but also, because of the dangers inherent to high-hazard construction work, our greatest threat in terms of risks to workers. What we do at the nexus of green construction and occupational safety and health will set the standard for all green jobs.”

There are synergies and benefits to be gained by increasing dialogue and coordination between the green building and occupational safety and health communities. For example, construction tasks create exposures which affect both the construction workers and the building occupants. The LEED system acknowledges this by including a credit for having a “Construction Indoor Air Quality Management Plan – During Construction”. Best occupational practice calls for contractors to control dust at the

source by using powered tools (e.g., such as masonry saws) equipped with local exhaust ventilation. Capturing the dust at the tool before it contaminates the air serves to protect both the construction workers and the future building occupants. NIOSH has supported research to develop and evaluate many types of construction tool controls, and explicit addition of these options would improve the LEED credits for both workers and the environment.

(4) RECOMMENDATIONS FOR ACTION

Information Exchange

Given their unique positions, NIOSH and the USGBC should explore opportunities to encourage exchange of information between green construction practitioners and construction safety and health practitioners. For example, USGBC might include a panel discussion on safety and health considerations in their annual Greenbuild conferences. NIOSH could facilitate similar sessions on green construction at other safety and health conferences. NIOSH is particularly interested in increasing the use of Prevention through Design interventions generally and by the architecture and owner communities specifically. NIOSH and USGBC could collaborate on professional development courses and could share information about both problem areas and effective solutions that effectively address both green and occupational safety objectives.

Pilot credit initiative

NIOSH has examined the USGBC pilot credit program and believes that it offers a number of options for partnering to integrate green and safety and health practice. NIOSH could work with USGBC and various safety and health partners to review existing LEED language to target those provisions that are considered most likely to generate activities that could lead to construction and maintenance worker hazards. Daylighting, waste recycling, and heat island effects (e.g., installing a vegetated roof) are examples of such provisions¹². Working together, draft language could be developed for insertion into new pilot LEED provisions to address the identified hazards.

These “safety and health enhanced credits” would then be added to the USGBC Pilot Credit Library. Building projects looking for LEED “innovation credits” could try out these pilot credits from the USGBC library. NIOSH and USGBC could also encourage partners to try these pilot credits and could evaluate the pilot experience. This would provide USGBC and NIOSH with experience using safety and health enhanced credits through an incremental approach that is familiar to LEED users. It would also help position successful pilot credits for inclusion in future updating of LEED. Such an effort could effectively address the potential issue of increased injuries and illnesses arising out of LEED-related green construction activities.

¹² For example, the credit for daylighting could also alert users about fall hazards and the need to design and plan to prevent fall hazards during installation and maintenance. It could describe options such as specifying non-fragile skylights to using skylight guards or guard rails and anchors. The relevant OSHA standards could be added to the requirement section.

Health and Safety Rating System

NIOSH is interested in developing and testing a comprehensive construction safety and health rating system. This might take the form of a new system under the growing family of LEED systems or as a separate, independent effort. We would like to work with USGBC and various safety and health partners to explore these issues further. This effort can begin using the current “Sustainable Construction Safety and Health” system as a starting point (Rajendran, 2009).

Integrating Occupational Safety and Health into Life Cycle Analyses (LCA)

Life Cycle Analyses tools are used by many environmental practitioners for comprehensive evaluation of environmental and energy impacts. For example, USGBC uses such approaches for weighting LEED credits. However, these tools do not incorporate occupational safety and health impacts. This is an important shortcoming, given that workers in resource extraction, manufacturing and construction can experience significant exposures and risks. NIOSH is interested in exploring this issue further with USGBC and others to better understand the role played by LCA tools in sustainable practice, and to identify options for moving forward to better integrate occupational safety and health considerations into these tools. Insuring that worker exposure impacts are considered during all aspects of a life cycle analysis (supply, fabrication, installation, use and demolition) for green construction materials is a worthwhile longer term goal.

(5) CONCLUSIONS

Green and sustainable practices are critically important and will play an increasing role in the years ahead. A strong case can be made that a truly comprehensive perspective on sustainability must include occupational safety and health. A safe and healthy workforce is vital to the economic prosperity and social wellbeing of our nation.

Occupational safety and health and environmental health share historical roots, as well as many interests, approaches, and values. Both communities aim to protect health and quality of life, and both recognize the important role that design interventions can play. Increased dialogue and coordination between the occupational and environmental communities will improve current sustainability concepts. Buildings are a logical starting point for increased coordination given their importance to both environmental and occupational practice. USGBC and NIOSH are in unique positions to advance this discussion. Several recommendations for action provide tangible ideas on how we can begin to partner to ensure that green buildings are safe to construct, operate, maintain and occupy.

(6) REFERENCES

CityCenter, [2009]. *City of Gold: Vegas' CityCenter earns six LEED® Gold Certifications for Hotels, Residences, and Retail District Opening this December*. Press Release dated November 20, 2009. Accessed at: http://www2.citycenter.com/press_room/press_room_items.aspx?ID=778

Chen, H [2010] Green and Healthy Jobs. Labor Occupational Health Program, University of California at Berkley. CPWR – Center for Construction Research and Training.

CPWR- Center for Construction Research and Training, [2008]. *Worksite Assessment Team Site Visit Report for City Center and Cosmopolitan Construction Projects*, Las Vegas Nevada. November 2008. <http://www.cpw.com/research-sitereport.html>

Driscoss T, Harrison JE, Bradley C, Newson RS [2008]. The role of design issues in work-related fatal injury in Australia. *J Safety Res* 39(2):209-214.

Gambatese, J [2009]. *Don't Leave Safety out of Sustainability*, *Engineering News Record*. 11/18/2009

Gillen, M and Gittleman, J [2010] *Path Forward: Emerging Issues and Challenges*. *Journal of Safety Research* 41:301-306

General Services Administration (GSA), [2010]. *GSA Moves to LEED Gold for All New Federal Buildings and Major Renovations*. GSA Press Release #10691, October 28, 2010.

Lin ML [2008]. Practice issues in prevention through design. *J Safety Res* 39(2):157-159.

Rogers, D [2008]. *Commercial Building Initiative: DOE's Commercial Buildings Program: A Market-Based Approach to Zero-Energy Performance*. Presentation to U.S. Department of Energy Capitol Hill Forum on Sustainability. September, 11, 2008. Accessed at http://sites.nationalacademies.org/DEPS/FFC/DEPS_047402

NIOSH [1991]. *Building Air Quality: A Guide for Building Owners and Facility Managers* DHHS (NIOSH) Publication No. 91-114, EPA Publication No. 400/1-91/003

NIOSH [2006]. *Safe lifting and movement of nursing home residents*. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication Number 2006-177.

NIOSH Blog, 2010 Going Green: Safe and Health Jobs. Considerations for making green and sustainable jobs safe and healthy for workers. Prepared by Gillen, M, Check, P. and C Branche. http://www.cdc.gov/niosh/blog/nsb010410_green.html

Rajendran, S, Gambatese, JA, Behm, M [2009] Impact of Green Building Design and Construction on Worker Safety and Health. *Journal of Construction Engineering and Management*. (135)10,1058-1066

Schulte PA [2005]. Characterizing the burden of occupational injury and disease. *Occup Environ Med* 47:607-622.

Schulte PA, Rinehart R, Okun a, Geraci C, Heidel DS [2008]. National prevention through design (PtD) initiative. *J Safety Res* 39(2):115-121.

Tulacz, GJ. [2010] The Top 100 Green Contractors. *Engineering News Record*. September 13, 2010. P44-46

USGBC [2009] *Green Building by the Numbers*. April 2009 Factsheet. Accessed at http://en.wikipedia.org/wiki/Leadership_in_Energy_and_Environmental_Design#cite_note-Green_Building_by_the_Numbers-0

Wargo, J. [2010]. *The Green Building Debate. LEED Certification: Where Energy Efficiency Collides with Human Health*. Environment & Human Health, Inc. New Haven, Conn.

APPENDIX 1 - August 2010 AFL-CIO Building and Construction Trades Department (BCTD) Resolution 11

Resolution No. 11

Re: Safe Green and Sustainable Construction

Submitted by: Governing Board of Presidents, Building and Construction Trades Department, AFL-CIO

Referred to: Resolutions Committee

WHEREAS, the Federal Government is in the forefront of “green and sustainable” construction, investing billions of dollars in stimulus funding from the American Recovery and Reinvestment Act (ARRA) to finance green construction projects and create green construction jobs; and

WHEREAS, the Obama Administration issued Executive Order 13514, “Federal Leadership in Environmental, Energy, and Economic Performance,” expressly “to create a clean energy economy that will increase our Nation’s prosperity, promote energy security, protect the interests of taxpayers, and safeguard the health of our environment...;” and

WHEREAS, programs such as the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) play an important role in encouraging owners, designers, and contractors to follow best practices for green and sustainable buildings; and

WHEREAS, there is no consideration of the occupational safety and health of workers engaged in green and sustainable construction projects under the LEED program, effectively creating a disconnect between environmental best practices and safety and health best practices; and

WHEREAS, construction workers are at the forefront of green and sustainable construction and true sustainability must include protecting their safety and health; and

WHEREAS, the Federal Government is currently missing out on an opportunity to “Lead by Example” through the use of model high performance safety and health practices in Federal construction;

THEREFORE, BE IT RESOLVED, that the Building and Construction Trades Department and its affiliated National and International Unions pursue with the Obama Administration the adoption of a Presidential Executive Order modeled on EO 13514 that calls for the Federal Government to use high performance safety and health practices in green and sustainable construction; and

BE IT FURTHER RESOLVED, that the Building and Construction Trades Department’s non-profit research and training organization, CPWR -The Center for Construction Research and Training, and its Federal Government research partner, the National Institute for Occupational Safety and Health, continue to explore ways in which to incorporate construction safety and health considerations into green and sustainable construction.