Sustainability and Historic Preservation

Executive Summary 2011

Washington State Department of Archaeology and Historic Preservation

energy efficiency

reuse, repair and renewal

salvage and recycle

healthier environments

improved and reused infrastructure

local products, materials and labor

reduced construction and demolition waste

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INTRODUCTION

HISTORIC PRESERVATION AND SUSTAINABILITY are natural partners. Preservation and reuse of historic buildings reduces resource and material consumption, puts less waste in landfills, and consumes less energy than demolishing buildings and constructing new ones. Over the past decade, advances in high performance or "green" buildings have been numerous, but primarily have focused on new construction. As a result, the preservation and adaptability of historic and older buildings has not always been at the forefront of the 'green' movement agenda. However, this is changing. Historic buildings, often energy efficient from inherent characteristics, can be upgraded with new technologies to maximize energy performance. Historic features such as windows can be repaired and restored for higher efficiency. In addition to saving existing resources and historic character, historic preservation means environmental, cultural and economic benefits for Washington communities.

*Once an historic window is removed, it is lost forever;
when repaired and maintained, it can last indefinitely.*

BUILDINGS CONSUME ENORMOUS AMOUNTS OF OUR RESOURCES.

In the United States, 43% of carbon emissions and 39% of total energy use is attributed to the construction and operation of buildings. The environmental impact of buildings is even more significant when we take into consideration the greenhouse gas emissions associated with manufacturing building materials and products. As a key element in sustainable development, the preservation, reuse and "greening" of existing, historic buildings presents excellent opportunities to reduce our nation's energy consumption and carbon emissions.

HISTORIC BUILDINGS ARE A VALUABLE, EXISTING RESOURCE.

A study conducted in 2004 by the Brookings Institution reported that if we continue with national trends of development, by 2030 we will have demolished and rebuilt nearly one-third of our entire building stock – a staggering total of 82 billion square feet (Brookings, 2004). The energy required to do so would power the entire state of California – 37 million people – for an entire decade. Demolishing and rebuilding takes vast amounts of energy and materials, both of which are increasingly in short supply.

One third of our existing buildings - 82 billion square feet - will be demolished and replaced by 2030 (Brookings, 2004).

In addition, demolition and waste have profound adverse impacts on our landfills. Building-related construction and demolition (C&D) debris constitute about two-thirds of all non-industrial solid waste generation in the US (EPA, 2010). The average building demolition yields 155 pounds of waste per square foot, while the average new construction project yields

One-quarter of Seattle's landfill waste is construction & demolition (C&D) waste from buildings.

3.9 pounds of waste per square foot of building area (Monroe, 2008). In Washington State, even with our 45% diversion rate into recycling, an estimated 1,383,998 tons of debris per year ends up in landfills, most of which comes from demolition and new construction projects. This averages an additional 2.2 pounds of garbage to our landfills per day per person in Washington (EPA, 2003). When we reuse our historic buildings rather than replacing them, less debris ends up in our landfills and our environment is healthier.

PRESERVING HISTORIC BUILDINGS CONSERVES ENERGY AND RESOURCES.

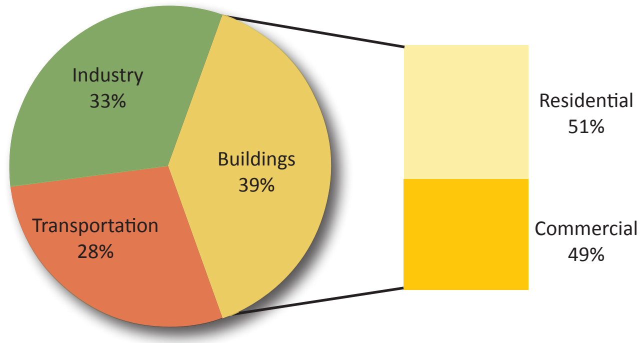
Historic buildings have embodied energy in them that is lost if a building is demolished. *Embodied energy* is a measurement of energy used in the process of building, from the extraction of raw materials - such as harvesting trees - to the final installation of the finished material - such as framing lumber and carpentry. *Embodied carbon* represents the carbon emissions from the actual construction process. According to a study commissioned by the federal Advisory Council on Historic Preservation (ACHP), about 80 billion BTUs of energy are embodied in a typical 50,000 square-foot commercial building, the equivalent of about 640,000 gallons of gasoline (ACHP, 1979). If a building is demolished rather than reused, that expended energy and carbon is essentially wasted, and even more is expended for the demolition process and new construction.

Recent studies have successfully measured the impact of embodied energy and carbon and the implications to historic




preservation. The United Nations Energy Programme estimates it takes 20 years of a typical building's 100 year operation just to offset the expenditure of its construction energy and materials (Caroon, 2008). Another report focusing on the Grand Central Arcade in Seattle's Pioneer Square Historic District concluded the embodied energy it would take to tear down the Arcade and reconstruct it to the same scale would be equal to 730,000 gallons of gasoline (Frey, 2007). While embodied energy and carbon are only part of the picture, they represent tangible measurements of the value of buildings as an existing resource and how preservation contributes to a sustainable future.

"Old ideas use new buildings; new ideas use old buildings." - Jane Jacobs



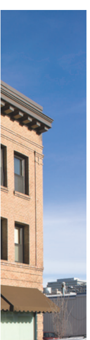
Total Energy Use by Sector
Residential buildings equal 21% and commercial 18% of consumption (DOE, 2008).

HISTORIC BUILDINGS CAN BE ENERGY EFFICIENT TOO.

Buildings accounted for 72% of total U.S. electricity consumption in 2006 and it is predicted this number will rise to 75% by 2025. Fifty one percent of that total was attributed to residential building use, while 49% was a result of commercial building use (EPA, 2009). Although historic buildings are often dismissed as inefficient energy consumers, mounting evidence reaches different conclusions. For example, data from the U.S. Department of Energy (DOE) indicates that commercial buildings constructed before 1920 actually use less energy per square foot than buildings from any other decade up until 2000 (EIA, 2003).

Average Annual Energy Consumption in BTUs (British Thermal Units), commercial buildings. (US Energy Info. Agency, 2003)

WHY? Many historic buildings were designed with passive systems before the invention of electric lighting and powered heating and cooling. As a result, these buildings were designed to take advantage of natural daylight, ventilation and solar orientation - the very characteristics that are being used as "sustainable" design attributes today. In addition, historic structures were often constructed with traditional, durable materials such as concrete, wood, glass and steel. When properly maintained, these materials can have a much longer lifespan. In both residential and commercial buildings, energy consumption is dominated by space heating, venting, air conditioning (HVAC), and lighting (DOE, 2008). In historic buildings - as well as new ones - utilizing efficient technologies can reduce greenhouse gas emissions by reducing energy use.



REPAIR, RESTORE AND MAINTAIN - NOT REPLACE - YOUR HISTORIC WINDOWS, DOORS, SIDING, ETC.

Historic building components, particularly windows, are mistakenly regarded as one of the major sources of energy loss in buildings. However, the U.S. Department of Energy concludes that only an average of 10% of energy loss in every home is caused by windows. In fact, more energy is lost through plumbing openings and uninsulated ducts than through windows (DOE, 2008). While it is common to hear that replacing old windows with new replacement windows will save energy, there is debate whether doing so in historic structures is either energy efficient or cost effective over time. Rehabilitating and maintaining historic windows with appropriate energy saving techniques can be energy efficient. Repair or rehabilitation not only reduces the disposal of the old windows into landfills, but it also reduces new window manufacturing costs and effects on the environment. Newer replacement windows, by comparison, last an average of 10-20 years (Sedovic and Gootef, 2005). Their materials, such as glass, vinyl and aluminum, are not biodegradable or easily recycled. In addition, PVC (vinyl) windows are considered a toxic "red" material by green building standards. Therefore, keeping historic windows is both green and healthy for people as well as the environment. Best of all, historic windows can last indefinitely if properly maintained.

SECRETARY OF THE INTERIOR'S STANDARDS FOR REHABILITATION + ENERGY EFFICIENCY = COMPATIBLE?

Definitely. For decades, the U.S. Secretary of the Interior's Standards for Rehabilitation (Standards) have provided guidance for appropriate rehabilitation of historic buildings that allow for updates and modern amenities while protecting historic design and building fabric. But with the introduction of energy efficiency measures and green building techniques, property owners have questioned whether historic buildings can be rehabilitated according to

In the United States, buildings account annually for:

40% of all extracted energy sources
68% of all consumed energy
60% of all materials used
40% of all nonindustrial solid waste
12% of fresh water use
38% of all carbon dioxide emissions

the Standards while increasing energy efficiency and meeting green building standards. The case studies featured in this report and a growing body of historic rehabilitation work across the nation clearly demonstrate that the Standards and green building technologies are compatible. While some of the principles set forth in the Standards may at first seem to be in conflict, most issues can be resolved by early consultation with qualified preservation designers, understanding the issues, and becoming familiar with the Standards. The most common conflict is energy efficiency (NPS 2007). However, early guidance from qualified professionals with experience in applying the Standards to rehabilitation projects will result in projects that meet sustainability goals while preserving historic buildings and neighborhoods.





TIPS FOR SUSTAINABLE HISTORIC REHABILITATION PROJECTS

- ☑ **INSULATE unfinished areas first**, such as attics and basements where historic fabric is less likely to be altered.
- ☑ **DIAGNOSE existing insulation and infiltration conditions** with technologies such as blower tests, energy audits and infrared thermographic inspections that can detect where improvements can be made.
- ☑ **EVALUATE existing heating, ventilation and air conditioning** (HVAC) systems to ensure they are functioning properly; replace with higher efficiency units if needed. Maintain units properly for best performance. Supplement with **low-energy boosters** like fans and shading devices.
- ☑ **Check with qualified preservation CONSULTANTS to see how renewable energy sources** such as ground source heat pumps, solar panels and wind turbines can be appropriately integrated into the project. Search for rebates for renewable energy sources.
- ☑ **EVALUATE existing lighting conditions** and consult a lighting contractor if needed. Prioritize electric lighting use only when needed and install sensors that switch on and off with occupancy. Look for ways to **improve interior natural day lighting.**
- ☑ **REPAIR and MAINTAIN historic windows**, light monitors and skylights wherever possible. Add new skylights only on secondary facades or screened surfaces to bring in more natural light without losing historic integrity.
- ☑ **INSTALL low-flow plumbing fixture**s and install aerators in existing fixtures to reduce water use by up to 40%. Provide rain barrels at downspouts to catch runoff and use water for landscape maintenance.

IN WASHINGTON STATE, BUILDINGS ACCOUNT FOR:

514,366 billion BTUs of energy consumption annually
89.5 billion tons of carbon dioxide emissions annually
694 million gallons water/day

For more information and resources on sustainability and historic preservation go to **www.dahp.wa.gov**

ACTION AGENDA: NEXT STEPS

The role of historic preservation in sustainability strategies and reducing carbon emissions is rapidly changing. A growing body of research and the completion of green historic rehabilitation projects keeps the topic one of expanding interest and lively debate. However, much remains to be done by the rest of us to make sure that existing buildings and communities, both urban and rural, are fully utilized to reach sustainability goals as well as enriching quality of life. The following are five suggested actions to be pursued:

1. New innovative **BUILDING CODES** should be developed that better integrate preservation with energy efficiency based on performance rather than prescriptive requirements.
2. **NEW PARTNERSHIPS** and collaboration should be established between historic preservation groups, government officials, policy makers and green designers and builders in order to create more successful sustainable historic preservation projects.
3. Expand **EDUCATION** efforts that present preservation technology as sustainability techniques and practices to all levels of educational institutions, including professional continuing education.
4. Historic building energy performance needs **MORE RESEARCH** so that decisions to repair and maintain rather than replace are based on both hard data and historic character.
5. Expand **PLANNING** for sustainable development to include not only rehabilitating historic buildings, but also conservation of existing neighborhoods, commercial centers, and rural landscapes.




Photo Credits: GGLO Architects

Case Study in Sustainable Preservation: The Cobb Building, Seattle

The Cobb Building in Seattle is listed in the National Register of Historic Places for being one of the first commercial buildings in the nation to consist of medical and dental offices. With eleven stories of rich architectural detail, the challenge for the Seattle architecture firm GGLO was to transform the building into residential use and prepare it for the next century in a sustainable manner. Owners used the Historic Rehabilitation Tax Credit Program while also earning LEED™ "Registered" certification for sustainable building. An historic preservation consultant documented the building's character defining features: the window sashes and trim; terra cotta and brick facades; corridor configuration on upper floors, elevator doors and several lobby elements. The historic elements were successfully preserved to meet the Secretary of the Interior's Standards for Rehabilitation, while sustainable features were discreetly incorporated to meet project goals.

features

- All original windows were restored and seals tightened, while a removable, low-e film was applied to increase thermal insulation on the original glazing.
- Large operable windows were restored to preserve day lighting and natural air flow ventilation - just as they did historically.
- Heating and cooling was improved with a hybrid heat pump system that saves an estimated 5% a year over water heat pumps and improves indoor air quality.
- A comprehensive waste management plan diverted 95% of waste from landfills.
- New materials have recycled content, including metals, wallboard, insulation, concrete and ceiling tiles.
- Saving the brick and terra cotta exterior alone equals the embodied energy equal to powering 145 homes for a year.

Case Study in Sustainable Preservation: The Pearl Apartments, Spokane

Built in 1911 of brick masonry, the Pearl Apartments in Spokane contribute to the West Downtown Historic District. SMR Architects of Seattle was hired by the Spokane Housing Authority to rehabilitate the former apartment complex into affordable housing. The project used the Federal Historic Preservation Tax Incentive program, as well as met the criteria for the Built Green® Multi-Family certification. Historic features were maintained and restored while advanced testing informed project needs on moisture protection, insulation requirements and efficient energy system upgrades.

features

- Rigid insulation added to exterior masonry walls for higher performance; blown-in insulation at roof.
- Energy Star™ fixtures and bulbs installed throughout.
- Heat-recovery ventilator and high efficiency heat pumps installed in units.
- Doors + windows weather-stripped to reduce infiltration.
- Spokane bio-based tile and linoleum used for better indoor air quality.
- Light interior finishes add reflectivity of natural light.
- Recycling stations at each floor for occupants.




Photo Credits: William Wright for SMR

Case Study in Sustainable Preservation: Private Residence, Walla Walla

This private residence in Walla Walla was built in 1917 and is listed on the Walla Walla Register of Historic Places. The rehabilitation earned a 4-Star Built Green® certification, which began with a comprehensive plan that was put into place before the project began to ensure that all goals were met. These included blower door testing which determines the airtightness of a building to ascertain where improvements can be made. All new materials were required to be low VOC (volatile organic compounds) that are both healthier for the environment and indoor air quality of the home. All materials on site were either carefully sorted and reused or were used for other purposes off site. The advanced planning paid off in energy efficiency and comfort for the homeowners.

features

- Recycled insulation added to attic, floor and walls.
- Ceiling fans redistribute air on hot days.
- Storm windows restored and weather stripping added around window and trip perimeter to reduce infiltration.
- Ground source heat pump installed in back yard and feeds new radiant floor heating system, so no source fuel is needed (see photo of installation, above).
- Old concrete and 3 gallon toilets crushed and used for fill under new patio.
- All new materials contain recycled content.
- 100% recycling from construction waste to either new uses or recycle plants.
- Indoor air quality emphasized with no formaldehyde and low VOC (volatile organic compound) products.
- New carpet installed with 100% wool pile and jute backing.
- New drought resistant plants and impervious materials reduce storm water runoff.
- Low flow plumbing fixtures such as dual-flush toilets and 18 Energy Star qualified fixtures contribute to reduced consumption.

TIPS FOR HISTORIC WINDOW REPAIR, MAINTENANCE AND EFFICIENCY

- ☑ Most heat loss occurs around the windows' perimeter through infiltration rather than through the actual glass. Therefore, **keep seals tight and in good repair**. Also check sealant at all window muntins.
- ☑ Keep **exterior surfaces painted,** including putty, with durable low VOC [volatile organic compounds] exterior grade paints.
- ☑ Add **weather stripping** to windows to increase efficiency by as much as 50%. To reduce heat loss, weatherstrip doors around the perimeter and in any inset glazing.
- ☑ Use **exterior or interior storm windows** in the winter, as studies show that a window fitted with a storm window can last longer and be just as energy efficient as replacement windows.
- ☑ **Check the lock** on the window; the lock's most important job is ensuring that the rails and sash are held together tightly, reducing air infiltration.
- ☑ If glass in historic windows needs to be replaced, **consider laminated glass**. It can be installed with low-e glazing that has energy and noise reduction benefits, is easy to install, and maintains a historic finish. Low-emissivity (low-e) glazing reduces heat transfer through glass and can be more energy efficient than regular glazing.
- ☑ Remember, **windows are only part of the picture**, so follow other tips for making the **entire building more efficient** through insulating, weather-stripping, and updating heating and cooling systems.

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