Sustainable Heritage: Challenges and Strategies for the Twenty-First Century

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This article, based on the College of Fellows lecture given at APT's 2008 annual conference in Montreal, looks at the intersection of heritage conservation and sustainability and how these two disciplines will together address the challenges of this century.

Changes in Society

In his book *The Clock of the Long Now: Time and Responsibility*, Stewart Brand proposes an "order of civilization," which consists of "six levels of pace and size in the working structure of a robust and adaptive civilization."[1] Starting with fashion and commerce, followed by infrastructure and governance, and ending with culture and nature, these levels are ordered with respect to their rate of change. Fashion and commerce, which together signify the economy, have the fastest cycle of change, with both trend and policy existing at different pace and size scales from everything else. Infrastructure and governance can be grouped together under society because they exhibit similar signs of societal organization and planning, changing slowly with the passing generations. What remains is culture, the product of society, having a longer span of life even than human communities, while nature is the setting for all of human activity and is constant through time. Each level is left to operate at its own pace, safely sustained by the slower levels below and itself kept invigorated by the livelier levels above. The total effect of these layers is that they provide feedback into the system, giving it stability and growth. In considering its place in the "order" of these levels (economy, society, culture, and nature), heritage lies nearer to the bottom of the scale in terms of its slow pace of change.

In thinking about the challenges and strategies that are emerging as the twenty-first century unfolds, it would seem appropriate to set the scene for sustainable heritage conservation through the prism of the last 40 years by highlighting some key developments in society, in heritage conservation, and in our profession. I will illustrate what these changes mean for heritage conservation using the example of the greatest challenge of our time — climate change and how it might affect how we think and practice heritage conservation.

Fig. 1. The Low Energy Victorian House (LEVH), in Camden, north London, is the left half of two semi-detached properties. All photographs by Bob Lowe and Ian Ridley, Bartlett School of Graduate Studies, University College London.

Changes to our Approach to Heritage Conservation

By way of context I will also reflect on how our profession is changing. One of the most significant changes has been the growing strength of the evidence base for our decision-making, ranging from improvements in our scientific understanding of material change to the ways in which we assess risk as part of the operational management of the heritage environment. Our evidence base has not only become deeper within our own fields of practice but broader as we have looked beyond our own disciplines and integrated the work of scientists and practitioners from other disciplines. Now we can better quantify damage to historic materials, such as stone, metal, glass, wood, and paper, in response to environmental change; we manage as well as conserve sites, buildings, and collections; we understand better our impact on the environment (and the mitigation strategies we have to adopt to safeguard air, soil, and water quality) and on cultural heritage (and the adaptation strategies that are needed to balance conservation and access).

We understand the need for a holistic approach to the conservation of sites, historic buildings, and interiors, viewing all three as part of a wider cultural landscape in our efforts to manage wear and tear on all types of surfaces. We have complex issues to grapple with, such as the growth of cultural tourism from the (still comparatively) affluent developed world, the enormity of the threat of climate change, and the extent to which the rapid advance of technology can help us manage natural and anthropogenic effects on cultural heritage. Engaged as we are in a line of work that is both challenging and enjoyable, and some might say even privileged, makes it all the more necessary to picture our work as part of the thoughts and actions that are shaping tomorrow's world.

Climate Change

One of the most profound decisions with which we have yet to come to terms fully and which will be played out in the twenty-first century is the extent to which we should conserve heritage in the face of environmental change. The evidence we provide will influence the value that society places on different types of heritage and could determine society's attitude to safeguarding our heritage.

The United Kingdom's position on climate change provides a clear sense of the direction of travel. In March 2006 the UK government published the UK Climate Change program, which stated that "the scientific evidence is now overwhelming."[2] The periodic reports of the Intergovernmental Panel on Climate Change (IPCC) have been accepted by the UK government as the standard work of reference for policy, based as they are on predictions that are underpinned by peer-reviewed and published scientific and technical data. The UK government funds a technical unit that supports the work of the IPCC Working Group II on "Impacts, Adaptation and Vulnerability" and the UK Climate Impacts Programme (UKCIP), which derives the UK Climate Change scenarios and coordinates research on the impacts of climate change; UKCIP has supported research on climate-change impact on cultural heritage. The UK government Climate Change Bill, which has recently passed into law, makes the UK the first country in the world to enshrine in law climate-change targets.

In October 2008 a new Department for Energy and Climate Change was created in order to implement the UK government's policy on climate change through a number of key initiatives, including:

- the Climate Change Levy, which manages the Climate Change Allowances Scheme
- the Emissions Trading Scheme, which manages carbon offsetting
- the Carbon Reduction Commitment
- the Low Carbon Building Programme
- the Renewables Obligation

The Carbon Trust and the Energy Saving Trust, which began as government initiatives, now largely operate independently of government. The UK has a reputation for rebranding systems, energy labels, and advice-giving, which means that experts and the public have problems keeping up with changes. It could therefore be useful to compare the building stock, climate, and cultural factors in the UK and North America, before looking in more detail at the principles and purpose of these key UK initiatives.[3]

Building stock. There is some comparative information between the UK and Canada on domestic housing, since it is one of the most ubiquitous building types. One-third of English building stock pre-dates World War II (1939–1945), and less than one-third has been built since thermal building regulations came into force. There is very little replacement or demolition of the housing stock in England. By contrast over 40 percent of Canadian buildings have been built in the last two decades. The average Canadian dwelling is 37 percent larger in terms of floor area than the English dwelling. The fact that Canadian houses are generally larger than those in the UK means that the heating and hot-water systems are quite different and physically much bigger.

Climate. Degree-days is one way of comparing the severity of the climate and its impact on the energy consumption of buildings. For example, a building would use almost 50 percent more space-heating energy in Toronto than it would if it were located in London. The climate and the big difference in design temperature — that is, the temperature that a system is designed to maintain inside or operate against outside under the most extreme conditions — highlight why Canada has generally led the UK in terms of its energy-efficiency standards. Temperatures below 14ºF (-10ºC) occur reasonably frequently in many parts of Canada yet incredibly infrequently in the UK, and so subzero temperatures are not a design consideration. Despite the higher levels of insulation, the average energy use of a Canadian dwelling (112.4 GJ per dwelling in 2001) is 40 percent greater than a dwelling in Great Britain (80.8 GJ per dwelling). This difference is clearly attributable to the difference in climate but also to the size of properties.

Culture. Apart from the building stock and the climate, understanding changes in behavior is a key factor in understanding our response to climate change. As external temperature and humidity change and as levels of insulation increase and buildings are made more airtight in order to save energy, internal heat gains will change occupant behavior to limit the rise. The area between behavior change and the deployment and use of technology, such as external shading systems, is still little understood. The U.S. is considered to be at the forefront of much socio-scientific research,[4] while in the UK there is an increasing interest in post-occupancy reviews of buildings and their engineering (Probe) largely stimulated by the results of these studies undertaken by The Usable Buildings Trust.[5] There could be interest in the UK in the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Green Building Rating, especially if existing buildings in future are evaluated for their durability and if cultural/social/conservation metrics are added to the durability metric.[6] On the down side LEED depends on an American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) calculation method that sets not absolute but relative energy targets. If one starts with an inherently poor design, whether it is a glass box or a medieval barn, then a building can claim to be energy efficient even if marginal insulation is added. Furthermore, LEED focuses on matters relating to environmental sustainability to the exclusion of social and economic sustainability; thus, LEED cannot be considered a holistic sustainability tool.

UK initiatives. Against this background, it is worth considering how key UK initiatives will impact heritage conservation. The Climate Change Levy is a tax on the use of energy in the public sector, as well as industry and commerce; it is combined with offsetting cuts in employers' National Insurance contributions and additional support for energy-efficiency schemes and renewable sources of energy. Its intention is to encourage the efficient use of energy, so the levy will play a major role in helping the UK meet its targets for reducing greenhouse-gas emissions. Climate Change Allowances have been set up to reduce the levy by up to 80 percent for energy-intensive industries provided they meet predetermined energy- and carbon-saving targets. With its emphasis on promoting energy efficiency, encouraging employment opportunities, and stimulating investment in new technologies, the Climate Change Levy will affect public-sector cultural institutions including national museums and galleries and historic properties owned by, for example, English Heritage, the public body of the UK government with a broad remit of managing the heritage environment of England.

The rationale behind the Emissions Trading Scheme is to ensure that the reduction of greenhouse-gas emissions takes place where the cost of the reduction is lowest, thus reducing the overall cost of combating climate change. An organization can either reduce emissions on site or trade with other companies that have excess allowances. The environmental outcome is not affected because the amount of allowances is fixed. By allowing participants the flexibility to trade allowances, overall emissions reductions can be achieved in the most cost-effective way. The Carbon Reduction Commitment will apply mandatory emissions-trading to cut carbon emissions from large commercial and public-sector organizations, which could include cultural institutions. It is unlikely, however, that any cultural institution will need to compensate for its emissions with an equivalent carbon dioxide saving by carbon offsetting.

The Low Carbon Buildings Programme provides grants for the installation of microgeneration technologies in the public, private, and nonprofit sectors. The aim is to support a holistic approach to reducing carbon emissions from buildings by demonstrating combinations of energy-efficiency measures and microgeneration in a single site. In 2008 the program awarded a £55,000 grant (US$94,000) to Dunster Castle in Somerset to install solar panels, thus making it the first Grade 1–listed building to introduce renewable energy.[7]

The Carbon Trust provides advice on cutting carbon emissions and energy bills and on developing low-carbon technologies, including efforts to reduce carbon emissions in the existing building stock. The UK government's Department of Culture, Media and Sport was one of the first to be accredited under the Carbon Trust's Energy Efficiency Accreditation Scheme, which recognized its efforts and that of its sponsored departments, including the national museums and galleries, in reducing energy.

It is against this background that a debate has been stimulated among UK national museum and gallery directors on how to reduce the carbon footprint of their museums in an era of energy constraint. A meeting of the Bizot Group of international art-museum directors in May 2008 raised the issue of how to solve the dichotomy between long-term collections care, expensive environmental conditions, and energy use. A group of conservators from across UK national museums and galleries is now collaborating on a project to develop international consensus on the need for standards for the care of collections that are sustainable in the long term. The group is developing plans to work with a wider group of international conservators on a review of international standards for loans of artworks for consideration by international art-museum directors in 2009. At the same time, the UK Science and Heritage Programme has announced funding for a year-long research network to debate appropriate environmental guidelines for cultural institutions.[8]

Fig. 2. At the LEVH, the demand for energy is reduced partly through a reduction in air infiltration. In this case, air infiltration is decreased through the installation of phenolic insulation panels, fixed on battens and sealed together with sealant foam.

Climate Change and Heritage Conservation

Yet concern over climate change and heritage conservation had already surfaced five years ago, when a scoping study entitled *Climate Change and the Historic Environment* was commissioned by English Heritage.[9] The report's recommendations on safeguarding authenticity and historic integrity in the face of climate change encompassed not only physical adaptation and sympathetic management, but also local community involvement and good governance, with a strong recommendation that research needs to provide quantitative evidence for changes in policy, as well as practice. Since then there have been two other scientific research projects, *Engineering Historic*

Fig. 3. Air infiltration was reduced at the LEVH through a complete rebuild of the roof; silicon sealant was used at the joints between insulation panels and roof joists.

Futures[10] and the European Union's Noah's Ark Project,[11] which led to an invitation by the European Parliament Temporary Committee on Climate Change (CLIM)[12] to submit evidence and also led UNESCO to launch a project entitled Climate Change and World Heritage focusing on policy changes and adaptation issues.

Because so much of our heritage exists among people and communities and is bound up with social interactions and cultural identity and cohesion, it is clear that climate-change impacts are not only physical phenomena. The complex relationship between physical, social, and cultural impacts of climate change on heritage conservation has to be considered when assessing threats by the most significant climate parameters,[13] such as:

- Atmospheric moisture change poses the risk of flooding, changes in rainfall patterns, water-table levels, soil chemistry, groundwater, humidity cycles, and increases in the wetness time of materials and salt chlorides. Not only are the impacts visible as damage to cultural heritage, such as loss in stratigraphic integrity, but also unstable subsoil affects people directly. Ground heave and subsidence cause structural damage to buildings, and penetrating damp not only causes physical changes to porous traditional building materials and finishes: they make people's lives miserable and their dwellings uninhabitable, and at worst they can pose a health risk from foul water and a threat to life.
- Temperature change poses the risk of extreme events such as heat waves, changes in freeze-thaw cycles, and an increase in wet frost. Its impact is not only on materials, such as the damage to facades due to thermal stress, but also on the "fitness for purpose" of some assemblies. Furthermore, seasonal overheating within buildings can drive up the demand for installing mechanical cooling systems that are not only unsympathetic in a historic building but also equally damaging to the environment due to the increase in carbon emissions from burning fossil fuels.
- Sea-level rises, which present the risk of coastal flooding and sea-water incursion onto archaeological and historic sites, illustrate most starkly that the impact of coastal erosion and loss is not just physical but social and cultural as well, from the intermittent introduction of large masses of "strange" water to a site, which may disturb the meta-stable equilibrium between artifacts and soil, to permanent submersion of low-lying areas and coastal loss, to population migration, disruption of communities, and the breakdown of social networks.
- There are other impacts, for example, from the effect of wind and from desertification and also from the interactions between natural and anthropogenic factors, such as climate and pollution acting together, causing surfaces of buildings and other structures to blacken. Other examples of impacts range from the biological effects of climate change, such as a reduction in native species of wood for repair and maintenance of buildings, and changes in the appearance of landscapes and buildings through changes in vegetation and lichen cover.

We are only now beginning to understand the synergistic effects of two or more climate parameters working together, such as wind-driven rain, because these are some of the more complex and difficult interactions to unravel. Adaptation to climate change must be based on understanding these effects; while our knowledge is still limited, mitigation has been helped in Europe by effective legislation such as the CAFÉ (Clean Air for Europe) directive, which has reduced the concentration of the most damaging acidic pollutants — sulfur dioxide and nitrogen dioxide; in the longer term, ozone, a secondary photochemical product, will also be effectively reduced. This is a good example of how scientific research has provided evidence for informed regulation. But because gathering scientific evidence takes time, using scientific evidence alone to influence policy on the protection of cultural heritage from climate change is not enough. It makes sense to advocate for the protection of the physical, social, and cultural environment as an integrated whole, not only because the weight of qualitative and quantitative evidence is greater but also because the effects are inseparable.

Waste Not, Want Not

One of the strongest sustainability arguments for heritage conservation is that material conservation is an inherently waste-avoidance activity. This argument is entirely consistent with a common definition of sustainability as the reduction of environmental impact by not consuming nonrenewable resources. Our awareness of the fragility of old materials mirrors society's concerns with the fragility of the air, land, and water and with fossil fuels as a finite resource. Championing the continued use of old buildings extends their productive life through new uses; it reduces material waste, conserves embodied energy, and preserves the human skills and creativity that went into producing them. The benefits of reuse are different from but complementary to recycling:

- Reuse locks in more carbon, embodied energy, historic-design and engineering value (90 percent of value is often in the design), and craft skills. Historic buildings were designed and constructed with lower impact on the environment. Surplus materials were used for the remanufacture of buildings, fixtures, fittings, etc. Today heritage conservation is the engine for the creation of real jobs and vocational-training opportunities.
- Recycling uses significantly less energy than making a new product, and

it generates significantly less waste in the extraction of original materials. It reduces the volume of waste, landfill, and the production of landfill gases, e.g., methane, which is 22 times more powerful than carbon dioxide.

Yet environmental double standards, especially those associated with the high use of fossil fuels, persist; as societies prosper, the demand for greater comfort at home, at work, and at leisure increases. In the heritage sector we depend heavily on fossil fuels to heat and cool museums and galleries, to drive our cars to visit historic sites, and to transport international exhibitions around the globe. Therefore, we must exercise caution when we defend the protection of heritage materials by comparing them to nonrenewable fossil fuels, which we still consume in large quantities.

English Heritage describes the contribution of the historic environment to environmental sustainability in the following terms:

- *The historic environment is itself an environmental good that needs to be sustained for the future.* If we accept that the natural environment is the shell within which social and economic activities take place, our actions will be restrained by limits that should ensure that our footprint on the environment is as small as possible. The historic built environment is a finite and nonrenewable resource, and like other environmental resources it needs sustaining for the benefit of future generations.
- *Historic buildings are a reservoir of embodied energy and carbon dioxide.* Historic buildings represent embodied environmental capital in the form of bricks, tiles, glass, timber, and metal. Some of these materials, such as tropical hardwoods from nonrenewable sources, are also irreplaceable and often represent craft skills that are no longer available. Research by the Building Research Establishment in the UK in 2003 compared the embodied energy of a "typical" nineteenth-century English terraced property with 15,000 litres of petrol, enough for a Ford Fiesta 1.3 EFi car to drive five times around the earth.
- *Old buildings are not necessarily inefficient in their actual use of energy, and their energy efficiency can be improved in ways that are not damaging to historic buildings.* However, a distinction must be made between historic buildings constructed with thick walls and traditionally sized windows and buildings of lightweight modern construction, which is often the least energy efficient.

Although these arguments are incredibly compelling, it would be wrong to use them to resist change. The heritage environment must engage fully with the process of adaptation to climate change that the whole of society is undergoing; otherwise the real risk that historic buildings become redundant and the price of environmental obsolescence — demolition — in future will be high. In London, England, 50 percent of the building stock is historic nineteenth-century Victorian buildings; there is an acute shortage of affordable accommodation in the southeast of England. We must engage with legislators in decisions on what can be done with the historic building stock. There is a practical necessity to access the adaptive potential and the adaptive capacity of the built heritage. This should happen for every individual historic property as an integral part of conservation management, emergency planning, and civil contingency planning. Adaptive potential is normally high when the political, institutional, and technological policies and the support systems of a region, nation, or state are well developed. Substantial adaptive capacity exists when there are well-developed economies and scientific and technical capabilities. Major challenges will still arise from high exposure to extreme events, and considerable constraints will still be imposed on adaptation measures in very sensitive sites. While adaptive capacity is expected to increase with time, the magnitude of this capacity may continue to be greater in the West than in the East, and in the North compared to the South. Nevertheless, early-stage avoidance of environmental impact is often difficult for organizations to justify economically and politically. However, policy action in the UK is now driving changes in behavior in a way similar to the ways in which persuasion, regulation, and enforcement changed attitudes to health and safety.

Fig. 4. The internal insulation panels are placed through the floor/ceiling interface to form a continuous, airtight barrier.

The Low Energy Victorian House

A practical example reveals the tensions that can exist between our wider obligation to adapt the historic building stock and our responsibility for its conservation. A pilot project to future-proof energy use in a nineteenth-century Victorian semi-detached dwelling — one of only three intensively monitored projects in the UK — was completed in Camden in north London in summer 2008. Known as the Low Energy Victorian House, it has been renovated and fitted with energy-efficient measures that are projected to reduce its carbon emissions by 82 percent (Fig. 1). These measures include:

- Reducing the demand for energy by improving the thermal insulation of the roof, walls, and floors; replacing windows with traditional-style double-glazed replacements; and reducing air infiltration by making the building airtight (Figs. 2 through 5).
- Using energy more efficiently by setting targets for energy-use reduction and reducing the demand for electrical power by using low-energy appliances.
- Generating renewable energy locally by using solar water heating and photovoltaic solar panels (Fig. 6).
- Using water sparingly and more efficiently by installing efficient appliances, including aerated hand-basin taps, flow valves, low-bore supply pipe work, and a low-water-consumption toilet.
- Harvesting rainwater for nondrinking purposes.

Since first occupied by tenants in autumn 2008, the performance of the

Fig. 5. Detail showing the fixing of internal insulation to the solid brick wall.

house has been robustly monitored under normal living conditions. Energy-performance data, along with information on how tenants use the house, will add to an emerging evidence base for design and construction professionals, policy makers, energy experts, academics, heritage organizations, and sustainability campaigners. In order to achieve carbon reductions of 82 percent (with the UK government calling for reductions of 80 percent by 2050 to meet proposed EU targets), the team chose to prioritize energy efficiency over a strict heritage-conservation approach. The heritage aspects of the house were assessed in the initial stages of the project by English Heritage, which favored a scheme that could reduce carbon emissions by up to 60 percent while preserving many of the period qualities of the house, including saving the original windows and shutters, arguing for secondary glazing and night shutters instead. Yet English Heritage also acknowledged that there is currently little data on energy usage in older homes to inform effective strategy; it has therefore launched the Hearth and Home research project, which aims to compare the predictions from models with the actual performance of traditionally constructed homes in order to test the assertion that such buildings are inherently energy inefficient.[14] The Hearth and Home project will monitor the energy usage of a group of occupied Victorian terraced homes to work out best practice in measuring energy efficiency, to evaluate the cost-effectiveness of energy-saving options, and to provide guidance on measures to reduce domestic fuel usage and carbon emissions.

However, Chit Chong, the Camden Council project coordinator, is adamant about the need to improve traditional buildings:

> We need to get to grips with issues of technical feasibility, of heritage and critically of the way we use buildings. What is important is that accurate information is available and that it flows between all parties — information on performance, economic viability, process, supply chains and conservation. Decisions about the design of wall insulation should not be made by heritage consultants without involvement from those with expertise in building physics and engineering. Conversely the views of conservationists shouldn't be overlooked.[15]

Long Life-Loose Fit

The integration of conservation, design, and operation is a radical approach to future-proofing historic buildings; it can succeed only if we accept a "long life-loose fit" strategy to managing historic buildings. While historic buildings — or at least their appearance in the landscape — continue to be valued, changing work patterns and lifestyles, higher occupancy densities, dwell times, and activities are leading to growing demands for increased comfort and convenience while at the same time we are exhorted to meet new environmental and energy-performance requirements.

We need the research that will help us understand how traditional buildings behave as environmental systems, even as we take steps to improve their performance. If we are to lose original features in order to make historic buildings more energy efficient or to increase options for reuse, we must quantify and compare the performance of old and new measures, such as the effect of external and internal insulation on different building assemblies in different climates. Since the measures that we take will increasingly affect the integrity and therefore the meaning of historic buildings, we need evidence to justify the inevitable changes in significance and value to the public that major interventions to reduce and improve energy use entail. The Low Energy Victorian House and the Hearth and Home projects in England are beginning to contribute data for evidence-based decision-making.

While climate change has a global impact, the size, diversity, and variability of places means that these challenges must be addressed regionally, with responsibility for adaptation taken locally. This approach is recognized by the Intergovernmental Panel on Climate Change (IPCC), which states that:

> Natural and social systems of different regions have varied characteristics, resources and institutions, and are subject to varied pressures that give rise to differences in sensitivity and adaptive capacity.[16]

It is everyone's responsibility to develop robust systems for monitoring change at the local level; it is the responsibility of professional bodies to engage with the science and the policy of environmental change that are currently lacking. Climate and heritage scientists and heritage professionals should agree on international monitoring protocols so that we can share data and cooperate more easily at an international level on one of the greatest challenges to human society.

Influencing Policy

Engagement with policy makers is vital and never easy, so we must communicate a vision of conservation that is socially and environmentally responsible. The tension between values, ideology, and beliefs on the one hand and sound scientific evidence on the other is the essence of contemporary politics in open democratic societies, and it will not disappear simply because we have discovered evidence-based policy. To make progress, we must accept and more importantly understand the range of other influences on government and policy-making apart from evidence, including the experience, expertise, and judgment of policy officials, advisers and Cabinet Ministers, values and ideology, available resources, habits and tradition, lobbyists, pressure groups and the media, and the pragmatic contingencies of everyday political life. While research is important in its own right, it is also vital because it conveys cultural-heritage value to others and to policy.

In the United Kingdom and in the European Parliament, there has been some progress in recognizing the threat of environmental change to cultural heritage. The U.S. has given the world Al Gore, and we must wait to see whether congressional views will change or whether presidential and cabinet-level views are going to be altered by the election of Barack Obama. Canada has given the world the Montreal Declaration, the Global Municipal Leaders Declaration on Climate Change signed in December 2005.[17] Building on these developments, we must all take concerted action to persuade the IPCC that its next report should make an explicit reference to cultural heritage as an area that is vulnerable and threatened.[18] It has not done so thus far, so the best we can do at the moment is to adopt references to the human environment, habitats, or settlements as surrogates.[19]

Sustainable Solutions

While material change lies at the heart of one of our concerns over environmental change, socioeconomic pressures and demands on heritage demand that we locate contemporary stewardship within a sustainability framework. This position is the result of a growing realization that it is impossible to control everything and that standards, such as the way we manage risk, can be challenged by methodologies and procedures that are transparent and consistent. Universal solutions are no longer the answer because deterministic approaches and an eagerness for standardization oversimplify the complex reality we face today. Other challenges to sustainable heritage conservation include changing societal needs that require us to explain conservation in terms of improved quality of life for citizens and communities; while heritage conservation is typically valued for its own sake by society, it is increasingly required to sustain public interest and public good. For these reasons The National Trust for Places of Historic Interest or Natural Beauty, which operates in England, Wales, and Northern Ireland, has developed a sustainability framework at the heart of which is the Triple Bottom Line approach, which enables improved conservation and environmental performance to be evaluated from three points of view — conservation and social benefits and financial costs — so one activity generates several objectives with sustainable outcomes.[20]

It is relatively easy to measure access in the form of visitor or membership numbers and financial income. It is less easy to measure conservation success or damage resulting from access that causes irretrievable loss of significance and aesthetic or evidential value. The National Trust has also developed the Conservation Performance Indicator (CPI) based on a methodology developed by the U.S. Biodiversity Support Program in 1988–2001. All features present in any single property whether built, natural, cultivated, or created and the objectives describing the desired state of the features are covered by the CPI. Three criteria are used to prioritize the objectives: significance, the consequences of not carrying out the work, and the urgency of the work; a numerical score is derived to describe how well the entire property is doing. It is the measure of the change in the annual score that is significant, rather than absolute figures resulting from each CPI assessment. This exercise requires truly integrated work across the range of natural and cultural heritage and workforce development in order to deliver a balanced view of performance according to wider benefits:

- conservation benefits, in which standards are implicit
- social benefits, in which access is implicit
- environmental benefits, in which reducing the environmental footprint is implicit, and
- economic benefits, in which funding and reputation are implicit.

A sustainability approach helps achieve a deeper understanding of the material/cultural interface, recognizing not only that heritage originates from resources that, once removed from their natural environment, may be considered to be “dead” or nonrenewable but also that human skills and creativity imbue artifacts fashioned from nature with a cultural “life” embodied in attributions of significance, meaning, and value. These cultural/social attributions transform materials into artifacts that are reinterpreted and renewed by each passing generation, thus maintaining the all-important relevance of cultural heritage to contemporary society. This symbiotic relationship begs the question: how are values affected by material change?

Fig. 6. The LEVH has photovoltaic panels installed on the roof for on-site generation of renewable electricity, as well as solar thermal panels for domestic hot water.

Linking Values and Material Change

Various agents change heritage; change affects valued elements of heritage; valued elements affect how change is perceived; what is perceived as damage affects decisions about conservation interventions; conservation affects which valued elements are most likely to be preserved; preserved elements influence how heritage is represented; and new forms of representation will affect future conservation decisions. These are familiar individual concepts. It is what connects them that is important, the relationship they have with one another and how each one contributes context to the next.[21]

So the way in which we intervene is changing for different reasons. In 1988 the late Bernard Feilden categorized different types of intervention that affect condition and value in different ways:

- Prevention of deterioration is intended to reduce change, but certain kinds of value may be given priority, so values change at different rates.
- Conservation of the existing state retains many values, but utility and possibly aesthetic and information values slowly decrease.
- Consolidation of the fabric increases utility, but information decreases, e.g., DNA information may be compromised during conservation work.
- Restoration may increase utility and aesthetics, but information and material authenticity may decrease.
- Rehabilitation increases contextual value, but potential uses may decrease.

- Reconstruction decreases material authenticity, but information may increase.
- Reproduction is different, since the original object is not necessarily irreversibly affected by this intervention.[22]

Heritage survives in the form that it does due to its "best fit" with the qualities that are valued at that period of decision-making. The qualities that ensure its survival or demise are those that are preserved and prioritized and that guide its future material state. Heritage must adapt to changes, physical and intellectual, within its environment, and we must be aware of this evolution.

Educating Reflective Practitioners

It is incumbent on all of us, in an age of uncertainty and change, to equip the next generation of heritage-conservation professionals with the knowledge and skills needed to enable them to face the challenges and to develop sustainable strategies for heritage conservation in the twenty-first century. My own career and experience have taken me into historical research, conservation and material science, environmental design, and engineering, and I learnt early to appreciate the challenges and benefits of interdisciplinary work. What has sustained me, and what I strive for in our Master's program in Sustainable Heritage at University College London, is reflective practice, the process of developing knowledge and skills through identifying the present situation, asking how the situation can be changed or improved, implementing and monitoring the change, and evaluating the evidence. Many students embarking on the program are professionals for whom reflective practice is unfamiliar: their organizational culture might not embrace reflection; they might be too busy to think; there might be a fear of analyzing their practice.

It is therefore our responsibility to develop reflective practitioners who are able to respond to the changing demands of their profession and to initiate change. We need reflective practitioners because heritage conservation needs entrepreneurs who are able to take risks and can respond to the changing requirements of the sector. Entrepreneurs need to be innovative and proactive. Reflective practitioners are able look at current practice and understand what change is required in response to external drivers and what skill sets need to be developed. Reflective practitioners might be risk takers, but they are not gamblers. Learners in the twenty-first century need to be adaptable in the face of new pressures and new demands. Graduates of programs where reflective practice has been encouraged and where students have been involved in their own learning will be the ones who are able to recognize the need for this change and then initiate and lead it most effectively.

Conclusion

These last two decades have been like the slow movement of tectonic plates. The Athens Charter of 1931 and the Venice Charter of 1964, with their focus on buildings, monuments, and sites, have been augmented by the APT New Orleans Charter for the Joint Conservation of Historic Structures and Artifacts of 1991, with its focus on interdisciplinarity, minimal intervention, and the maintenance of continuity. The amendments to the Burra Charter in 1999 overtly recognized that heritage value and significance may be embodied in the uses, meanings, and associations of a place, in addition to the physical fabric. These paradigm shifts in conservation thinking have been occurring while sustainability principles have been developing.

Yet the world will change much faster and in radically different ways compared to the last four decades. Instead of driving technological change, we will have to adapt to uncontrolled change. Constrained resources could lead to the development of completely different sociopolitical systems. The end of cheap energy will be just the tip of the iceberg. It will result in massive societal shifts that place major pressures on existing infrastructures; we will have to adapt in ways which we have yet to fully understand. Like inherited natural resources, cultural assets will need to be used more sparingly, because we have borrowed them from future generations. Cultural as well as natural resources must be maintained, if they are to retain their future value.

So the next step for heritage conservation is an obvious one, to align the principles and practice of conservation in the twenty-first century fully with sustainability principles. Subsequent steps may be harder to gauge as we endeavor to align heritage conservation more closely with delivering an acceptable quality of life for the world's population, combining our work with economic growth of communities, and conserving heritage without depleting or damaging the natural resources needed to sustain future generations. Realigning conservation with sound principles of sustainability is an engaging if challenging contemporary definition of sustainable heritage conservation.

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Notes

1. Stewart Brand, *The Clock of the Long Now* (London: Weidenfeld & Nicholson, 1999), 35.

2. HM Government, *Climate Change, The UK Programme 2006*, Prime Minister's Foreword (The Stationery Office, March 2006), iii.

3. Tadj Oreszczyn and Paul Ruyssvelt, "Report on Carbon Vision Visit to Boston, Ottawa and Vancouver" (report to the British High Commission, EPSRC and Carbon Trust, 2006).

4. Two of the world-leading quantitative sociologists researching domestic energy use since the 1970s are Loren Lutzenhiser, at Portland State University, in Oregon, and Paul Stern, study director of the Committee on the Human Dimensions of Global Change, U.S. National Research Council.

5. Classic Probe post-occupancy studies and Probe strategic-review papers can be found at http://www.usablebuildings.co.uk/ (accessed Dec. 8, 2008).

6. Details of the USGBC's Green Building Rating can be found at http://www.usgbc.org/Displaypage.aspx?categoryID=19 (accessed Dec. 8, 2008).

7. Details of the Dunster Castle project can be found at http://www.nationaltrust.org.uk/main/w-global/w-localtoyou/w-wessex/w-wessex-news/w-wessex-news-dunster_solar_panels.htm (accessed Dec. 8, 2008).

8. Details of the Science and Heritage Programme can be found at www.heritagescience.ac.uk (accessed Dec. 22, 2008).

9. May Cassar, *Climate Change and the Historic Environment* can be downloaded at

http://eprints.ucl.ac.uk/archive/00002082/01/Published_Climate_Change_Report_05.pdf.

10. *Engineering Historic Futures Stakeholders Dissemination and Scientific Research Report* can be downloaded at http://www.ucl.ac.uk/sustainableheritage/ehf_report_web.pdf.

11. Cristina Sabbioni, et al., "Global Climate Change Impact on Built Heritage and Cultural Landscape. The Noah's Ark Project. Atlas and Guidelines" (in press, 2009).

12. To follow developments of the European Parliament Temporary Committee on Climate Change (CLIM), go to http://www.europarl.europa.eu/comparl/tempcom/clim/default_en.htm (accessed Oct. 1, 2008). Note that the thematic session on September 10, 2007, included a presentation on climate-change impact on cultural heritage.

13. World Heritage Reports 22, "Climate Change and World Heritage Report on Predicting and Managing the Impacts of Climate Change on World Heritage and Strategy to Assist States Parties to Implement Appropriate Management Responses, Following a Meeting of Broad Working Group of Experts, UNESCO Headquarters, 16-17 March 2006, UNESCO World Heritage Centre, in cooperation with the UK Government," http://whc.unesco.org/documents/publi_wh_papers_22_en.pdf (accessed Oct. 4, 2008).

14. Details of English Heritage's Hearth and Home project can be found at http://www.climatechangeandyourhome.org.uk/live/eon_landing_page.aspx (accessed Dec. 8, 2008).

15. UrbanBuzz autumn update, *Project Profiles: Low Energy Victorian House (LEVH)*, University College London, 2008, 36.

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17. The Montreal Declaration can be found at http://openpolitics.ca/Montreal+Declaration (accessed Oct. 4, 2008).

18. Intergovernmental Panel on Climate Change, WGII Report, "Impacts, Adaptation and Vulnerability." To read the Summary for Policy Makers and the technical report, go to http://www.ipcc.ch/ipccreports/ar4-wg2.htm (accessed Oct. 4, 2008).

19. May Cassar, "Towards Evidence for Policy Development in the Area of Climate Change and World Heritage" (paper given at 7th European Conference "SAUVEUR" Safeguarded Cultural Heritage: Understanding & Viability for the Enlarged Europe, Prague, Czech Republic, May 31–June 3, 2006). The presentation can be found at: http://www.arcchip.cz/ec-conference/presentations/Session%20V/0955-1005%20Cassar.ppt#256 (accessed 20 February 2009).

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