

Strengthening the Sustainability of Built Heritage in Scotland

Branka Dimitrijević

Department of Architecture, University of Strathclyde, Glasgow, United Kingdom

Abstract

The paper informs on the emerging innovative solutions and practice in strengthening the resilience of architectural and urban heritage in Scotland in the context of key global risks such as peak oil, climate change, growing global population and species extinction. It informs on the recent policies of the Scottish Government and the actions of its agencies in enabling climate change mitigation and adaptation, as well as community engagement in identifying most appropriate local solutions with regards to the responsible use of natural resources and the preservation and sensitive reuse of the built environment, including heritage buildings. Key outputs of two collaborative projects of researchers, industry and communities are presented to inform on novel approaches to the development of innovative solutions for sustainable building design and refurbishment, integration of low carbon infrastructure systems in the built environment and community engagement in decision-making.

Keywords: *built heritage, sustainability, community engagement*

1. Introduction

The need for strengthening the sustainability of the built heritage arises from several global risks whose management requires innovative and sensitive solutions. The research that is undertaken in Scotland to address key risks as well as the policies and actions for engaging with communities in tackling global risks are presented below.

As the aging buildings and structures are more vulnerable to the impacts of climate change than most recently completed buildings, Historic Scotland (the Scottish Government agency responsible for safeguarding the nation's historic environment) has responded to this challenge by undertaking research which informs its actions and advice to the owners of heritage buildings. The Historic Scotland Technical Research Plan 2014 – 2015 [1] outlines key research themes such as climate change impacts and adaptation, physical effects of climate change and increasing resilience, the effects of future climate patterns on traditional elements and structures, performance of traditional coatings and surfaces, performance of traditional mortars and binders, drainage systems and durability, and augmentation and enhancement. Their scientific research will include the response and resilience of building materials, i.e. susceptibility to environmental and other factors (e.g. extremes of weather/climate change, biological growth, pollution, fire etc.). The Historic Scotland current research projects on adaptation of historic buildings to climate change [1] focus on the effect of climate change on Glasgow's sandstone buildings, loss of lime binders through water penetration, stone decay in cleaned sandstone and granite buildings, flooding advice, moisture monitoring, development of the climate change risk assessment methodology, and the project "The Resilient House" in collaboration with Building Research Establishment (Scotland) at the Ravenscraig Innovation Park in Central Scotland.

The threat of obsolescence due to the economic and population decline has been present throughout the history of human settlements. Glasgow's built heritage has been especially affected by the population decline since the closure of ship-building yards on the river Clyde and other industries after the World War I. The emigration of its citizens started then and

continued after the World War II, almost halving the city's population of around one million at the start of the 20th century. Scotland's total population has been slowly declining since the peak recorded in the 1971 census. Glasgow has seen the population decline of 35% during 1961-1981 and 24% from 1981 until 2001 [2]. Despite the economic recovery since 1970's, many buildings from the turn of the 20th century remain vacant in the Glasgow city centre. The rescue, repair, restoration and rehabilitation of significant historic buildings at risk is undertaken by the Glasgow Building Preservation Trust (GBPT) which was established in 1982 [3]. Its projects are supported by Glasgow City Council, the Heritage Lottery Fund (HLF), Historic Scotland and the Architectural Heritage Fund (AHF). Glasgow City Heritage Trust, established in 2007 and supported by Glasgow City Council and Historic Scotland, provides building repair grants to the specific areas of Glasgow [4]. General public has been engaging in rescuing obsolescent heritage buildings across the United Kingdom through Building Preservation Trusts (BPTs). A survey of BPTs in Scotland [5] revealed that 90 trusts have been established since 1985 and that at least 49 of these are believed to still be active, involving at least 500 volunteers. Since 1984, over 110 buildings have been successfully restored by Scottish BPTs and since 1990 they have removed at least 43 buildings from the Buildings at Risk Register. The BPT projects have been supported by funding from Historic Scotland, HLF, AHF and a wide range of alternative funding sources.

The peak oil and the need to mitigate climate change by reducing carbon emission have instigated a transition to low carbon infrastructure systems whose integration in heritage buildings and sites requires a sensitive approach which should ensure that the authenticity of the built heritage is not unnecessarily compromised. Research undertaken by Historic Scotland on reducing carbon emissions in heritage buildings [1] focuses on improving their energy efficiency. One of the recent research projects is on energy use and carbon emissions from traditional buildings in Scotland, while another one identified and quantified energy use per m² by house type and occupation pattern. Performance of various energy efficiency improvement interventions has been evaluated *in situ* through a series of refurbishment case studies in locations across Scotland. Historic Scotland is a partner in the EC FP7 funded project EFFESUS (09/2012-08/2016) which is investigating the energy efficiency of European historic urban districts and developing technologies and systems for their improvement [6]. The Glasgow case study within the EFFESUS project will demonstrate the use of adapted aerogel insulation solutions, blown into existing cavities behind existing internal wall finishes, typically plaster on laths. Historic Scotland has completed a research on evaluation of some emerging technologies and techniques, and published a short guide on 'Micro-renewables in the historic environment' [7].

Species extinction is another global risk caused by the expansion of human settlements into the natural environment in order to meet the needs of the exponentially growing global human population for housing, industries and transport. In the last 500 years, human activity has forced 869 species to extinction [8]. The escalating loss of biodiversity, i.e. the reduced variety of species and their habitats, can have negative effects on people and the environment because of the reduced ecosystem services such as nutrient and water cycling, soil formation and retention, resistance against invasive species, plant pollination, climate regulation, and pest and pollution control. Preservation and enhancement of biodiversity within historical settlements and sites contribute to the quality of life of people and sustain ecosystems and habitats. The Historic Scotland guide for owners, occupiers and managers of historic gardens and designed landscapes highlights that they offer outstanding nature conservation value for wildlife [9]. In the face of climate change impacts, which can include changes in biodiversity, several agencies of the Scottish Government - The Scottish Environment Protection Agency,

Scottish Natural Heritage, Forestry Commission Scotland and Historic Scotland - have recognised the need to work more closely and published a joint statement on their collaboration [10].

The Scottish Government's policies that recognise the need for public engagement in decision-making that affects communities have gradually widened the scope of public engagement in decision-making related to the built environment. The first important step in formalising wider public participation in planning in Scotland was the advice on community engagement in Planning Advice Note PAN 81, which indicated that 'the only type of community group with a formal role in the planning system is community councils who are consulted on planning applications' [11]. PAN 81 was developed because 'many people believe there are barriers to engagement in the planning system including: lack of awareness of available opportunities; inaccessibility of documents; complex procedures and practices; lack of expertise; consultation fatigue; belief that views are not taken into account and distrust of local government' [11]. Some of those barriers can be removed by providing online information that will raise awareness of local resources, capacities and opportunities, and assist in raising interest of the residents to engage in decision-making about their community.

Following the support for public participation in planning, Scottish Government developed a strategy for public engagement in Scotland's transition to low carbon economy [12] aiming to inform about Scotland's Climate Change targets for reducing carbon emissions by 42% by 2020 and by 80% by 2050, to encourage Scottish people to contribute to the achievement of those targets and to identify actions they may take. One of the principles of the strategy states that 'much of the engagement will be led and delivered by others' and that 'the Scottish Government cannot, and would not wish to centralise engagement'. As the strategy supports different forms of decentralised engagement, it offers the opportunities for developing innovative forms of public involvement in local communities such as the use of digital technologies to collect data and inform decision-making. The Scottish Government's digital strategy indicates that digital technology 'not only allows greater scope for people to do things themselves, but also to contribute opinions, access information and interact with others' [13]. This approach is also evident in the Scottish Government's consultation on Community Empowerment (Scotland) Bill that aims to make the most of the talents that exist in Scottish communities, deliver high quality and improving public services, and support strong local democracy and local decision-making through community empowerment that will enable communities 'to do things for themselves and have their voices heard in the planning and delivery of services through community engagement and participation' [14]. The Bill was introduced to the Scottish Parliament on the 11th June 2014 [15].

Since 2008 community activism aiming at more sustainable and resilient development of communities worldwide in the context of peak oil, rising carbon emissions and climate change has been boosted by the concepts outlined in 'The Transition Handbook' by Rob Hopkins [16]. Hopkins suggested various ways in which communities can become more resilient such as local generation of energy and food production, different organisation of healthcare, use of local building materials, reduction and reuse of waste, and other activities that communities might initiate according to their social, economic and environmental context. In Scotland, there are 11 'official groups', over 35 'active communities' and over 25 communities that 'show interest in this area' [17]. These community groups, along with BPTs, are key links for community engagement with local authorities and university researchers.

2. Collaboration between universities, industry and communities

Two examples of the collaboration of universities with industry and communities on the development and testing of innovative solutions for a sustainable built environment are presented in this section.

CIC Start Online was a joint project of seven Scottish universities, led by Glasgow Caledonian University in collaboration with Edinburgh Napier University, Heriot-Watt University, Robert Gordon University, Mackintosh School of Architecture (The Glasgow School of Art), University of Edinburgh and University of Strathclyde [18]. The project was funded by the European Regional Development Fund and Scottish Government from the 1st September 2009 until the 28th February 2013. Scottish Enterprise provided funding for academic consultancies. The project supported collaboration between university researchers and industry in developing innovations for sustainable building design and refurbishment, including heritage buildings. By the end of the project, 48 feasibility studies and 13 academic consultancies were completed. Studies undertaken through the project were completed in collaboration with 23 architectural practices (35%), 8 housing associations (13%), 8 environmental consultancies (13%), 7 manufacturers of technologies for renewables (11%), 5 software developers (7%), two waste recycling businesses (3%), two timber manufacturers (3%) one supplier of renewable technologies (1%), one off-site construction manufacturer (1%), one contractor (1%), one insulation manufacturer (1%) and one supplier of building materials (1%). The studies either contributed to the further development of existing products or processes or tested new products or processes, often developed for a specific project with a potential for application in other projects. There were several interdisciplinary studies. The outcomes were disseminated through interactive online webinars and/or the quarterly online magazine Innovation Review. Following free registration at the project website www.cicstart.org, they are accessible to everyone. The project attracted over 2,400 members nationally and internationally from 50 countries.

During the CIC Start Online project it became evident that there was an interest not only from the industry but also from communities in testing low carbon technologies and infrastructure systems. The project Mainstreaming Innovation obtained funding from Scottish Government from the 1st April 2013 until the 31st March 2014 to support collaboration on testing the integration of low carbon infrastructure systems in the built environment. It was a joint project of nine Scottish universities. The consortium of seven universities involved in the CIC Start Online project was expanded to include the University of Aberdeen and the University of Abertay Dundee. The systems within the project scope were the natural environment (land, waterways, biodiversity); technologies for improving energy efficiency of buildings and for energy generation from renewables (including storage and local distribution); low carbon transport infrastructures (electric vehicles, cycling, walking); water harvesting, saving and reuse; waste reduction, reuse and to-energy; and information communication technologies for linking, monitoring and management of low carbon infrastructure systems.

Through the Mainstreaming Innovation project, assistance was provided to the community group Transition Linlithgow, based in a town of approximately 15,000 people and located in Central Scotland, between Glasgow and Edinburgh. The town has an exceptional natural and built heritage. The imposing stone walls of the Linlithgow Palace (built in 1424 and later extended, but destroyed by fire in 1746) stand on a hill above the Linlithgow Loch. The St. Michael's Church, at the Palace gates, was also built in the 15th century. The main thoroughfare through Linlithgow, the High Street, is lined with historic buildings.

Preservation and sustainable reuse of built heritage require a sensitive approach in integration of low carbon infrastructure systems in Linlithgow. The assistance for identifying an optimal solution for a district heating scheme in Linlithgow was provided by the University of Aberdeen. A workshop on other potential low carbon infrastructure projects that could be developed in Linlithgow was organised by Transition Linlithgow and Mainstreaming Innovation in November 2013. The proposal for developing a portal for Linlithgow, which will provide information of interest for the development of a more sustainable community, facilitate decision-making and enable interaction with the residents, was one of the ideas suggested at the workshop. A digital 3D model of Linlithgow’s natural and built environment systems was developed by the University of Abertay Dundee. The portal framework was defined in collaboration with the Transition Linlithgow. The discussion was initiated by consulting the framework developed for the Future City Demonstrator project in Glasgow, funded by Innovate UK [19]. The proposed framework of the Linlithgow portal defines who the intended users are, who will provide data, the community objectives, desired outcomes and local priorities (Table 1).

Table 1. Framework of the proposed information portal for Linlithgow

Communities / Users	Residents; Community Groups; Public Sector; Private Sector; Local Council
Data Community	Data Providers (Local Council, Energy Saving Trust, power companies, Scottish Environment Protection Agency, citizens, Scottish Government’s heat mapping project, other public bodies); Data Developers
Objectives	Access Data; Share & Visualise Data; Create Value; Maximise Opportunities; Highlight Challenges
Outcomes	Informed citizens/Data users; Asset maps: built environment, heritage buildings, infrastructure systems Least energy cost/consumption/energy savings; Optimise renewable energy potential (solar, hydro, geothermal); Smart Towns, efficient use of public buildings, car-pool opportunities, town economics; Optimise land use: who owns what, for what purpose, food production (breakdown by food types, dairy, arable, cereal, etc.), housing, greenspace, commercial, sports and leisure; Community input and outputs - £, energy, waste, food, travel, employment; Modelling of transport: bypass, 4-way motorway junction, closed High Street, pressure from out of town development and increase in commuters/parking; Core paths, safe routes to school, cycle, walk, including danger zones; Air quality mapping; Water flow, use, conservation, treatment, energy potential
Local Authority / Local Priorities	Economic Strength and Sustainability; Sustainable Towns and Region Zero Fuel and Food Poverty; Regional travel dynamics; Public Health; Modelling impacts on education capacity vs. development demand.

The above listed desired outcomes clearly indicate the interests of the citizens of Linlithgow and the areas about which they would like to be better informed and in which they would like to participate in decision-making. In addition to data gathering, the proposed portal has other functions that assist in decision-making and participation of citizens. The key functions of the portal will provide the following:

- (a) sharing and visualisation of data required for decision-making on sustainable living and development
- (b) related decision-making tools
- (c) opportunities for citizens' interaction.

In order to achieve the outcomes desired by the citizens of Linlithgow, a wide range of data will have to be provided, and this will take time and require collaboration of data providers. However, the first step in data collection is to indicate on the portal what data will be sought, as outlined in the above framework. As one of the listed objectives is data visualisation, University of Abertay Dundee has developed a digital 3D model of Linlithgow (Fig. 1).

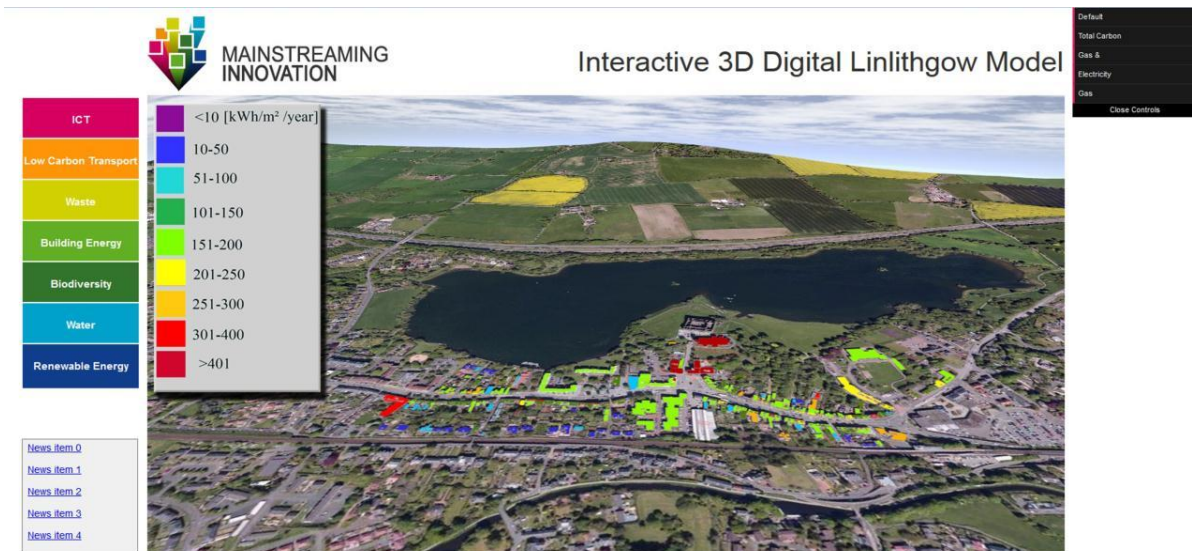


Fig 1. A digital 3D model of Linlithgow developed by the University of Abertay Dundee) which includes information on energy consumption in the town centre collected by the University of Aberdeen

Various forms of citizens' interaction can be enabled within the portal and developed as required. Some examples of citizens' interaction are as follows: continuous survey on the portal development, other surveys as required, input of local knowledge on different topics, voicing opinions on specific issues, real time information of interest to the community, etc. The proposed concept of the portal was presented to the citizens of Linlithgow in collaboration with Transition Linlithgow in March 2014. A webinar on collaboration of the University of Aberdeen and University of Abertay Dundee through Mainstreaming Innovation project was delivered on 24th March 2014 and a video recording of the webinar published on the project website www.mainstreaminginnovation.org. The access to video is possible following free registration on the website. The portal concept will be presented to the local council to explore how it can be used to support the council's activities related to sustainable development.

3. Conclusions

The need for addressing global risks and developing more sustainably has been acknowledged by the Scottish Government and integrated in its policies and in the collaborative work of the government agencies responsible for their delivery. It has also been understood by many communities worldwide, which have been initiating Transition

Movements and planning a range of activities to make their settlements more resilient to different types of external economic pressures and potential environmental threats, including climate change. Residents' participation comprises a range of communication methods aiming at including as many people as possible in the collective plans and actions. Along with meetings, Transition Movements often set up websites to keep the residents informed about local actions for more sustainable development. The Scottish Government recognises the value of joint efforts of local communities directed towards more sustainable development and supports citizens' participation through its policies and the forthcoming Community Empowerment (Scotland) Bill. As sound decision-making can only take place if information required is provided, availability of data related to the settlements for which decisions need to be made is crucial. Information required for decision-making about a settlement and a set of decision-making tools related to sustainable development are key to the empowerment of residents to understand and evaluate potential local development options. Data and tools can be provided on an online portal and accompanied with an area for voicing residents' opinions and contribution of data. Local data collection and 3D online presentation can raise awareness of communities about the local natural environment and built heritage, and empower them to participate in decision-making about the responsible use of resources and the protection and sensitive reuse of the built heritage. The increased awareness should lead to a wider, active involvement of citizens in the activities of the groups such as Building Preservation Trusts and a long-term community care for their built heritage.

Acknowledgments

The CIC Start Online project was funded by European Regional Development Fund and Scottish Government. The project Mainstreaming Innovation was funded by Scottish Government. The assessment of the energy consumption of buildings in the centre of Linlithgow was undertaken by the team led by Dr. Mohammed Imbabi, University of Aberdeen. The 3D model of Linlithgow was developed by the following academics of the University of Dundee Abertay: Professor David Blackwood, Dr. Ruth Falconer, Juliette O'Keeffe, Daniel Gilmour, John Isaacs and Vladeta Stojanović.

References

1. *Historic Scotland. Technical Research Plan 2014 – 2015*, 2013, <http://goo.gl/9y4FOa>, accessed on 20 Nov 2014
2. *The Scottish Government. Review of Scotland's Cities - The Analysis*, 2003, <http://goo.gl/C3N7Kf>, accessed on 20 Nov 2014
3. *Glasgow Building Preservation Trust*. <http://gbpt.org>, accessed on 20 Nov 2014
4. *Glasgow City Heritage Trust*. <http://glasgowheritage.org.uk>, accessed on 20 Nov 2014
5. *Ecotec. Study of Building Preservation Trusts in Scotland*, 2010, <http://goo.gl/1ikzgL>, accessed on 20 Nov 2014
6. *EFFESUS*, <http://www. effesus.eu>, accessed on 20 Nov 2014
7. *Historic Scotland. Micro-renewables in the historic environment*, 2014, <http://goo.gl/vnn171>, accessed on 20 Nov 2014
8. *The International Union for Conservation of Nature. Species Extinction – The Facts*, 2007. <http://goo.gl/it6636>, accessed on 20 Nov 2014
9. *Historic Scotland. The Inventory of Gardens and Designed Landscapes in Scotland: A guide for owners, occupiers and managers*, 2012, <http://goo.gl/CUNisp>, accessed on 20 Nov 2014.

10. *Scottish Natural Heritage. Action on Climate Change*, <http://goo.gl/cDg3IA>, accessed on 20 Nov 2014
11. *Scottish Executive. Planning Advice Note PAN 81: Community Engagement – Planning with People*, 2007. <http://goo.gl/3OeyxO>, accessed on 9 Jan 2014
12. *The Scottish Government. Low Carbon Scotland: Public Engagement Strategy*, 2010, <http://goo.gl/IQo4AT>, accessed on 9 Jan 2014
13. *The Scottish Government. Scotland's Digital Future: A Strategy for Scotland*, 2011, <http://goo.gl/d1hGR7>, accessed on 16 Feb 2014
14. *The Scottish Government. Consultation on Community Empowerment (Scotland) Bill launched*, 2013, <http://goo.gl/7WZVJj>, accessed on 9 Jan 2014
15. *The Scottish Parliament. Community Empowerment (Scotland) Bill*, 2014, <http://goo.gl/isYWK2>, accessed on 20 Nov 2014
16. *Hopkins R. The Transition Handbook: From oil dependency to local resilience*, 2008, Foxhole, Green Books Ltd
17. *Transition Scotland. Active Transition and affiliated groups in Scotland*, <http://goo.gl/ClRKFx>, accessed on 13 Feb 2014
18. *Dimitrijević B. Innovations for Sustainable Building Design and Refurbishment in Scotland: Outputs of CIC Start Online Project*, Cham Heidelberg New York Dordrecht London, Springer, 2013
19. *Future City Glasgow. City Technology Platform: Technical Architecture Context*. <http://open.glasgow.gov.uk>, accessed on 16 Feb 2014

Corresponding Author

Branka Dimitrijević
Department of Architecture
Faculty of Engineering
University of Strathclyde Glasgow
Scotland, United Kingdom
e-mail: branka.dimitrijevic@strath.ac.uk