Cardiff Futures Forum

Towards a More Sustainable Built Environment

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1 Introduction

In 1987 the Brundtland report defined sustainable development as ***'meeting the needs of the current generation without compromising the needs of future generations'***. It is now some 20 years since this statement was produced and very little has happened in terms of 'operationalising' sustainability. The so called future generation referred is now the current generation, and the predicted impacts of non-sustainable development is becoming a reality. We are now living the prophesies of the last 20 years, in relation to climate change, the consequences of depletion of resources, and health impacts due to poor air and water quality and the spread of infectious disease in our increasingly dense urban cities where a predicted 60% of the global population will inhabit by 2030. Kofi Annan, UN Secretary General, was quoted as saying ***'our biggest challenge in this new century is to take an idea that seems abstract - sustainable development - and turn it into a reality for all the world's people'***. The world has been talking about sustainability and sustainable development for over 30 years in one form or another, and has done very little about it. Already it is too late to avoid the impacts of climate change and we must now look to adaptation as well as mitigation to reduce further harm in the short and long term futures.

The findings of recent the IPCC report that there is know a 90% certainty that climate change is a direct consequence of human action and that global warming needs to be kept below 2oC to avoid dangerous' climate change. This is equivalent to less than 450ppm Carbon dioxide levels, and even then the chance of minimising serious ham is 50:50. Mankind has only ten years to avoid this chaos point. The Stern Report stated that 'climate change is the greatest market failure the world has ever known.

The performance and quality of built environment is a central issue for sustainable development and governments all over the world are seeking the best ways in which to promote sustainable development in relation to the urban built environment. Buildings are one of the major users of energy from fossil fuels for cooling, heating, ventilation and lighting. They also consume large quantities of materials and create mountains of waste during their construction and refurbishment, throughout their operating lifetime, and in their eventual demolition. Added to this the world (and Cardiff) is undergoing an unprecedented programme of building and infra-structure construction. Cardiff has declared itself a 'Carbon Lite' city, and the Welsh Assembly Government aspires to all new building being zero carbon by 2011, in line with its commitment to sustainable development.

Of course, sustainability has a wider remit than reducing carbon emissions, including minimising material use and waste, reducing water use, ensuring the health and well being of people, and generally designing and maintaining a quality built and natural environment. Yet many, if not the vast majority, of Wales' and Cardiff's new

developments pay little attention to sustainability, and short term market forces still dominate in decision making. The problem still appears to be one for the future generation to sort out, if there is one!

2 Issues

Sustainability is primarily aimed at maintaining a good quality of life for people. The environments created in and around buildings are where people spend the majority of their time, and these environments need to be healthy, comfortable and safe. In addition to environmental factors, sustainable design should also address social and economic factors that also impact on quality of life. It is not just buildings by themselves that impact on the environment and quality of life, their relationship with the urban infrastructure also contributes to overall sustainability. Transport systems, water and sewage treatment, green/blue structures, and energy supply systems all play a part. However, the individual building has focused attention on issues of sustainability, and the main approach to sustainability, and in particular low energy design, has been through the design of new buildings. Now, the approach must be broadened on the one hand, in relation to the associated infra-structure, and on the other, to maintain a buildings efficient and effective operation throughout its life-time.

So, the sustainable performance of the built environment needs to take a **holistic approach** to provide: sustainable **infrastructures**, sustainable design for **new buildings**, and sustainable operation of the **existing building stock**. It must also be broadened from energy efficiency to considering the so-called triple bottom line of: **environment** factors, **social** factors, and **economic** factors. The impact of sustainability is manifest on a number of scales, resulting in: **global** impacts, **local** impacts, and **indoor** impacts.

These above elements can be conveniently placed in a three-dimensional sustainability matrix, which can be applied to built environment projects.

Sustainable infra-structure	**Environment factors**	**Global impacts**
Sustainable design	**Social factors**	**Local impacts**
Sustainable operation	**Economic factors**	**Indoor impacts**

Sustainable development is not just a question of innovation in technology, and in many cases the required technology is well developed. It is the management and application of the technology through the various decision-making processes that is usually where problems and barriers to take-up lie. The above matrix indicates the complexities involved in achieving the best reduction of impacts for a particular project. In many cases the traditional design, construction and operation processes create barriers to innovation and a culture change is needed in the construction industry and its public and private sector clients.

Issues that need to be addressed when considering sustainability in the built environment include the following:

- ***Demand versus Supply approach***: Urban projects are predominantly of a supply nature, that is, they are focussed on the supply of the service rather than reducing the demand for the service. This can encourage the excessive use rather than efficient use of services which is counter to sustainable development, for example building more roads encourages a greater volume of traffic. The future approach to sustainable development should therefore be to reduce demand and then provide efficient and effective supply.
- ***Mobility versus accessibility:*** Related to the previous issue, the emphasis is generally to increase mobility rather than improve accessibility. Future cities should adopt an accessibility approach that would embrace not only the objective of reducing current needs for travelling but also a further exploration of the full potentials of IT.
- ***Central versus local*****:** The trend towards centralised infra-structures may be changed in future to a more balanced mix of local and central systems. Local systems offer greater resilience and are less prone to major failures. The economic disadvantages of central systems include high maintenance costs and distribution losses. These disadvantages are often hidden or pushed into the future. There is a need in future for a greater recognition of the economics of local systems, for example, buy-back of localised renewable energy by the central utilities, which is not always possible or economically attractive.
- ***High density versus low density*****:** There are advantages in high density urban developments, such as more efficient public transport systems, improved access to services, and higher energy efficiency and lower distribution losses. However there are also disadvantages, for example, urban heat islands (higher cooling loads), health impacts of dense living (spread of infectious disease), lack of blue/green space and difficulties in dealing with run-off water. In particular blue/green space is crucial to reducing high urban summertime temperatures, hot spots of pollution and giving access for leisure activities. An optimum ratio of a high density built environment coupled with allocation of blue/green space is needed to maximise the benefits of urban living within an efficient and healthy surrounding.
- ***'Splinter planning':***The concept of uncontrolled 'splinter planning' occurring through the lack of integration in municipal planning could give rise to a layering of infra-structure services, especially new IT related infra-structures. Splinter planning is in danger of generating 'gated communities' and a layering of social as well as physical infra-structures in cities, reflecting social groupings and security issues, and the expense of maintaining equable services for all citizens. The powers of municipal planning could be seriously eroded in future if this trend develops.
- ***Low material technologies*****:** Future technologies need to be focussed on minimising material use. This involves designing out waste, reusing and re-cycling waste and a greater emphasis on a material life cycle approach to the built environment. A life cycle approach to material use should consider the source and manufacturing associated with particular materials, their durability throughout their life and maintenance requirements and their disposal at the end of their useful life. A low-volume high-value approach to design must be

explored. This will require lifestyle changes to parallel to the development of the concept of immateriality.

- ***Economic drivers*:** Economic drivers have been developed around a non-sustainable development approach to buildings and urban infra-structures. Therefore it is difficult to realise a cost savings from sustainable design. In addition, innovation is focussed on improvements to non-sustainable systems, and reducing their economic costs. This makes it even more difficult to justify in current economic terms more sustainable options. Also, economics is sector focussed, so social and cross-sector benefits are not accounted for. Economic drivers favour reducing capital costs to a life cycle cost approach. Economic costing is based around a supply mentality and reducing demand is counter to most economic thinking. It is also increasingly based around overseas cheap labour which directly increases transport needs to service the expanding global economy.
- ***Lifestyle changes*:** A sustainable built environment can only encourage a sustainable lifestyle – it cannot determine it. There needs to be lifestyle changes on both an individual and company/municipality level. The ownership of sustainable development has to be recognised at both levels. Some companies already reflect sustainability in their projected image, and some recognise cost savings in certain areas, for example, waste management. However, the global generation is not collective in its thinking. Privatisation places the individual as a client, which can be a good thing, but it is based on the ability to pay and is therefore in danger of producing a layered society. Companies need to develop social corporate responsibilities. Also organisations need to escape from the silo approach to urban planning. All projects are and should be considered to be holistic, involving cross sector activities. Short term-ism 'low cost quick delivery' is a feature of society whereas sustainability is generally perceived as a 'high cost slow (next generation) delivery'.

3 Priorities

Priorities for sustainable development of the built environment include new and existing buildings, and the infra-structures that support them.

3.1 Urban Infra-structure and a sustainable built environment

For an urban development project the decisions taken in relation to the design of the infra-structure can impact on the design of individual buildings in relation to their long term sustainability. In many cases the infra-structure is decided before the site design has been finalised, and often well in advance of any building design. Because an infra-structure has been put in place, there are often economic disadvantages to the adoption of more sustainable options at the later building design stage. Such infra-structure decisions relate to water and sewage systems, transport, green/blue structures, waste management and localised energy systems. It is therefore important that issues of sustainability are considered at the infra-structure design stage. For example, these might include the following:

- Water and sewage systems, such as innovative systems for surface run off, rainwater harvesting, local sewage treatment, and the use of bio-gas.
- Green/blue structures, such as access to green and blue facilities for leisure.
- Transportation, such as good access to public transport systems, safe cycle and pedestrian routes, to encourage a model shift away from private transport.
- Localised energy generation distribution, such as district heating and cooling systems with CHP, and renewable energy systems, such as wind, photo-voltaic and bio-mass.
- Waste management systems, which include efficient collection and recycling.

In a number of the above options there are opportunities for integration across sectors, for example, such as the use of bio-gas for transportation. There is a need for environmental tools that can be used to assess the full benefits of sustainable infra-structure projects, considering the social, economic and environmental factors specific to the location. This will also provide robust information for replication to other sites. Holistic planning procedures should involve participation from all stakeholders including the general public.

3.2 Design of new buildings

The design of new buildings is perhaps where most of the effort is being focussed on issues of sustainability. The current encouragement from environmental groups is to design buildings that have a zero carbon impact, which will includes a combination of energy demand reduction and building integrated renewable energy systems. There are a range of innovations being developed in relation to design, methods of construction and environmental systems. Some examples are given below:

- To achieve near zero carbon performance is not really practicable with traditional building construction types and processes. To achieve high levels of thermal insulation, thermal stability, and the use of passive design methods, requires innovation in the choice of materials, their combination into construction components and their holistic integration into the final built form. New construction systems are being developed, and although they work technically they often are slow to be accepted by the traditionally ‘conservative’ construction industry and end users.
- New environmental systems are being developed which are responsive to building form and construction, and the requirements of the occupants. For larger buildings, façade engineering integrated with thermal mass cooling and efficient and effective ventilation systems, are providing buildings that are comfortable and healthy, simpler to control and more efficient in their energy use.
- Environmental systems are being energised by alternative and renewable sources of energy, such as, biomass CHP, building integrated renewables, wind turbines, and ground source heating and cooling.
- Buildings are being designed to be adaptable and flexible to accommodate re-use and change of use, which will potentially extend their useful lifetime. Buildings should also be easily disposable and their components ready for recycling and the end of their useful life.

- There is increasing emphasis on considering construction as a manufacturing process, with increasing off-site operations, which provide a more efficient construction process, and improve quality control and performance.
- A whole life costing should be carried out on building projects, to include design and construction costs alongside operating costs. This should encourage up-front investment in good design, including energy efficiency, flexibility and adaptability, to reduce long term operating costs and environmental impact. A relatively small investment in design and construction costs can yield large returns over the lifetime operation of a building.
- Buildings should be aesthetically pleasing and contribute to a good quality environment. Therefore good architecture should be synonymous with sustainability.

3.3 Operation of existing stock

In the UK buildings are replaced at about 1% per annum, which means that if the built environment is to be made more sustainable then the problem of how to improve the existing building stock must be addressed. It is generally accepted that considerable energy savings can be achieved by upgrading the existing building stock but currently there is little incentive to do so. Energy is still regarded by many to be relatively cheap. There are therefore a number of issues and barriers to address when considering the sustainability of the existing built environment, including the following:

- Organisations, such as municipalities and local authorities, who are responsible for large numbers of buildings, need tools to help them manage improvement schemes, to identify where best to invest their limited resources to make the most gains. Such tools are being developed and used, for example the Energy and Environmental Prediction (EEP) model developed at Cardiff University, which is able to analyse energy saving and environmental measures associated with large building stocks, alongside environmental predictions associated with transport, industry and socio-economic factors.
- A major barrier to applying energy saving measures to buildings is the landlord/ tenant leasing arrangement, whereby the landlord does not receive returns on any investment in energy efficiency, and the tenant does not want to make capital investments in a property that he dos not own. There is therefore the need for new leasing agreements, which provide mutual benefits for both landlords and tenants from sustainability investments.
- Heritage buildings are often difficult to upgrade in terms of energy and environmental performance because this affects the need to conserve them in their near original form. Therefore many older buildings are expensive to operate and fall short of occupants expectations for comfort. This is an area where compromise is needed between building conservation and building control.
- There is the need to be able to benchmark building performance against indicators. In order to do so, buildings should be able to be monitored on a regular basis. On-line monitoring and targeting systems should be developed to provide building managers with easy access to assess their buildings performance on a continual basis.

- Regular building checks should be carried out by an independent authority to ensure that the building meets its performance targets. It may be necessary to derive mandatory targets, which can be improved over time.

4 Outputs

In order for the city to promote a more sustainable built environment it should consider the following:

- To review its internal decision making and place sustainability in a central role with clear responsibilities at senior level.
- To promote sustainability through the planning process.
- To ensure that all future projects are carbon neutral and have a low waste strategy.
- To promote the improvement of the existing built environment in a sustainable way and to aim for carbon neutral for its own building estate.
- To develop renewable and low carbon energy supply systems.
- To investigate more sustainable ways of dealing with waste and water sewage systems, considering an appropriate balance between central and localised systems.
- To establish a long term sustainable public transport system, and to carry out a feasibility study for a tram system for the city.
- To maintain and extend its green / blue structures and resist the temptation to further erode them with building projects.
- To maintain the public realm and to provide good quality paving: this is looking ‘tired’ as a consequence of the increasing number of events in the city.
- To promote whole life costing for future projects, with a greater emphasis on quality.
- To promote sustainable design through demonstration projects.

5 Engagement

In the near future there are likely to be increasing pressures on the construction industry to adopt energy efficiency and sustainability measures, both in new and existing building projects. These pressures will more than likely be a mix of regulatory and economic incentives, perhaps coupled with a greater awareness and demand for sustainability by end-users and the general public. The **city should engage with all stakeholders in the built environment** and develop appropriate partnerships.

The city should clearly state its sustainability agenda in relation to all projects in the built environment. Buildings and infra-structures have a long lifetime and poor performance will continue well into the future – an unsustainable built environment will reduce the marketability of the city in the future. It is important that he city should **engage with developers** to promote a more sustainable development agenda for the future.

The city should enter into a **dialog with large public sector organisations** such as Cardiff University, and health estates that have sustainability agendas.

The city should **collaborate with WAG in areas of common interest** such as: the devolution of building regulations and their consideration of sustainability in addition to energy use; the promotion of renewable energy systems and 'two-way' flow mechanisms; grant aid for sustainability and zero carbon applications; sustainability awareness campaigns.

The city should set clear targets and programmes for achieving a more sustainable future. It must recognise that action is needed immediately on all projects.