What is the 'Carbon Challenge'? - English lessons on integrated design and carbon neutral development.

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Summary

Carbon neutral urban development has a number of complex and interrelated challenges for designers, developers and home-owners. In the context of the current 'Carbon Challenge' being set by *English Partnerships*, we suggest that the largest challenge remains that of changing individual lifestyles. Using examples from the Peterborough Carbon Challenge, the idea of hypothesised market testing linked to individual 'agent' carbon foot-printing is described as one possible means of producing design responses that understand and support this challenge of sustainable lifestyles.

What is the Carbon Challenge?

The 'Carbon Challenge' is a public sector initiative; set by English Partnerships, the national regeneration agency; to provide large-scale exemplar schemes of carbon neutral development but delivered by volume house builders. In effect there are several overlapping challenges for the house building industry, the house buying public and for public sector agencies and these are set within a wider context of required changes to the development and volume house building industry within the United Kingdom.

Design for Manufacture: The £60K House

> "All 2016 house building will have to aspire to achieve what Design for Manufacture has set out to do; Design for Manufacture has built some relevant capacity in the house building system through the competition"[2].

Some of the core challenges of building carbon neutral housing are based on those initially set by the former Deputy Prime Minister, John Prescott in the £60K challenge. This was aiming to change the structure of the house building industry and the meet the significant challenges of high volumes of construction, at reasonable cost and to a high quality standard.

The £60K challenge was based around off-site production process, what was being called modern methods of construction. Modern methods of construction [MMC] is understood as construction that differs significantly from traditional masonry construction but refers to a degree of off-site construction, and pre-fabrication - classified as *volumetric* [three-dimensional fully fitted factory units[3]], *panellised* [factory produced flat panel units for on-site assembly], *hybrid* [mix of panellised and volumetric systems], *sub-assembly*

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[1] The authors are partners with **Studio UrbanArea LLP** the urban designers for the competition winning submission for English Partnership's Carbon Challenge site at Peterborough; in collaboration with Browne Smith Baker Architects, Ethical Partnership, Barnes Walker Associates. The views expressed are of the authors and do not necessarily represent the views of the pPod consortium or project partners.

[2] Recorded views from one of the successful Design for Manufacture developers.

[3] Generally used in small flat block development and / or hotel use.

[prefabricated large building components / pods] and *site-based* MMC[4]. There is a long history of pre-fabricated homes, off-site manufacture / MMC that has strong links to the use of pattern books by certain architects and manufacturers[5].

Motivations on the use of MMC are varied[6] but relate to guaranteeing build quality control and to a lesser degree addressing speed[7] / overcoming skills shortages[8] in traditional constructions methods. Much of the incentive for MMC was initially raised in *Rethinking Construction*[9] and has since been generated by the *Design for Manufacture* competition and extended in the *Carbon Challenge*[10] competition. The use of MMC and choice of system should not be a limiting factor on design variety and quality[11].

Several public-owned housing sites were put forward to meet this £60K challenge. This was introduced alongside a new national set of design and quality standards[12] – the rationale behind the collection of independently validated standards is the development of sustainable community[13].

> "Close examination of recent housing quality standards … indicates a tendency to adopt a piecemeal approach that relies on outdated data sources and references … [a] process of cobbling together existing standards".[14]

Since the inception of the *Design for Manufacture* Competition, minimum spacing standards have also been adopted by *English Partnerships* and devolved regions have incorporated spacing standards clearly within building regulations[15].

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[4] Adapted from construction classification system used by the *Housing Corporation*. Promotion of MMC within the *Housing Corporation* has focused upon Housing Growth Areas and their *Challenge Fund Programme* and *Partnering Programme Agreement*.

[5] Arieff, Allison and Burkhart, Bryan [2002] *Pre Fab* [GibbsSmith, Utah]; Kieran, Stephen and Timberlake, James [2004] *refabricating ARCHITECTURE: How Manufacturing Methodologies Are Poised to Transform Building Construction* [McGraw Hill, New York]; Anderson, Mark and Anderson, Peter [2006] *Prefab Prototypes: Site-Specific Design for Offsite Construction* [Princeton Architectural Press].

[6] Recorded in; Gaze, Christopher; Ross, Keith; Nolan, Eanna; Novakovic, Oliver and Cartright, Paul [March 2007] *Modern methods of construction [MMC] in housing: Drivers and barriers to their use IP 3/07 Part 1* [BRE, Watford]; Department for Communities and Local Government, English Partnerships [June 2006] *Lessons Learnt: Design for Manufacture – The challenge to build a quality home for £60K* [English Partnerships, London]; and Wei P, Gibb A and Daintry A [2005] *Offsite modern methods of construction in housebuilding: Perspectives and practices of leading UK housebuilders* [Loughbrough University].

[7] Herbers, Jill [2004] *Prefab Modern* [HarperCollins, New York].

[8] On-going issue affecting a broad range of design and construction professions as highlighted in; Academy for Sustainable Communities [September 2007] *Mind the Skills Gap* [ASC, Leeds].

[9] Egan Report [1998] *Rethinking Construction* ?? Insert Reference details.

[10] English Partnerships & Department for Communities and Local Government [February 2007] *The carbon challenge: the challenge to build quality sustainable homes* [English Partnerships, London]. Available from www.englishpartnerships.co.uk/publications

[11] Gaze, Christopher; Ross, Keith and Nolan, Eanna [May 2007] *Modern methods of construction [MMC] in housing: Designing for manufacture IP 3/07 Part 3* [Building Research Establishment, Watford]; and Lusby-Taylor, P; Morrison, S: Ainger, C and Ogden, R [2004] *Design and modern methods of construction* [Commission for Architecture and the Built Environment, London].

[12] www.englishpartnerships.co.uk/ Best Practice/Quality and Price Standards

[13] Sustainable Community as defined in; ODPM [2005] *Homes for All* [Office of the Deputy Prime Minister, London].

[14] p739 in; Milner, Jo and Madigan, Ruth [2004] "Regulation and Innovation: Rethinking 'Inclusive' Housing Design". *Housing Studies* 19[5] pp 727-744.

[15] Building Regulations ["Technical Standards" in Scotland] are used to enforce minimum space standards and accessibility in design regarding circulation widths, future adaptation to facilitate the inclusion of a stair lift, accessible shower / wc and drying space. The full standards have been operating from June 2007 and are available at; http://www.sbsa.gov.uk/tech_handbooks/tbooks2007.htm#1

Integrated Design

The launch of the carbon challenge coincided with the publication and national promotion of the *Urban Design Compendium*. This was the second volume that had a specific focus on procedural aspects of sustainable urban design. It had the idea of integrated design as its central message. This goes beyond multidisciplinary design into areas of supply chain, manufacturing, financing and management.

Thinking about integrated / sustainable systems requires different ways of collaborative and interdisciplinary working between professionals, politicians and community stakeholders [local ownership and involvement]. It requires early involvement of key professional skills in areas such as energy strategy, materials and specifications[16], supply chain considerations, long-term management issues [protocols and policies for the management of public and semi-public buildings and spaces]. The supply chain concerns are significant where the design process has to be based on requirements and understanding of the construction, materials, and the full range of factors impacting on manufacture, assembly, management, repair and adaptation.

Code for Sustainable Homes

Yet, the main aim of the *Carbon Challenge* is to test in practice, the definition of carbon neutral development as established within the *Code for Sustainable Homes*[17].

While the national government is committed to the code, there are several detailed issues that have already arisen from the testing of the higher levels of the Code for Sustainable Homes within the first few *Carbon Challenge* development sites.

One is the **definition of zero carbon**. The UK Green Buildings Council [UKGB][18] Task Group Report "Definition of Zero Carbon" proposes a more flexible definition of zero carbon homes than the one used for the current code level 6 of the Code for Sustainable Homes[19]. The current definition of the zero carbon home is for all energy demands from the home, including the use of energy for cooking and appliances, to be supplied from electricity supplied from renewable sources and generated on site, or near site provided the electricity supplied is fed directly to the development through a private wire.

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[16] Halliday, Sandy [2007] *Sustainable Construction* [Elsevier, Amsterdam].
[17] Department for Communities and Local Government [December 2006] *Code for Sustainable Homes: a step change in sustainable home building practice* [DCLG, London]. Available from www.planningportal.gov.uk
[18] The UKGB is the body responsible for the review of this new standard.
[19] The UKGBC proposes that new homes should meet a minimum level of energy generation on site – broadly equivalent to level five of the Code for Sustainable Homes – this means that all energy demand from the SAP assessed items ie heating, hot water and lighting must be met from renewable energy sources on site or through a private wire. However the energy demand from cooking and appliances should be in effect, carbon neutral, rather than on a strict zero carbon basis. This may allow for offsetting. and the UKGBC proposes two ways of offsetting: [1] The developer could pay into offsite generation. This would have to be shown to be additional to what is already being supplied, and sufficient to mitigate the energy which will be used on the development for cooking and appliances. However if it becomes the case that payment by the householder can be required into one of the green tariff schemes, then this cost would not have to be borne by the developer; and [2] The developer could pay into a Community Energy Fund and this money could be used to pay for energy saving measures in the local area. The exact mechanism for estimating the payments would have to be worked out, but again it would have to be sufficient to mitigate the amount of energy used for cooking and appliances on the new development.

The government now recognises that the requirement for all new homes to be zero carbon by 2016 is unrealistic under this definition, and this will impact on the delivery of the government's targets for new house building.

Thus, we would also suggest that some of the most pressing 'technical' issues are regarding on-site versus off-site generation of renewable energy and the decisions surrounding cost effective means of electricity generation.

Lifestyle Issues

While these are all significant concerns, they are essentially technical solutions with some requirements for more holistic project management. We have chosen to concentrate on what is perhaps the biggest of the challenges, the 'soft' elements of the sustainable community.

Within the confines of the CSH the major implication of stepping from Code Level 4 to Code Level 5 or 6, are the requirements to adapt the behaviour of the building end-user. The type of behaviour change broadly relates to energy management and consumption; particularly the number and type of appliances within the property; the reduction in the consumption of water, and the use of green travel options. Many of these lifestyle are already well known through much of the research material and evidence gained for the construction of Passiv Haus standards throughout northern Europe. So, any successful carbon neutral development will clearly have to address 'soft' interventions that meet the challenges of sustainable lifestyles.

This success is being defined against post-occupancy survey [a requirement of English Partnerships and their public sector partners enforced through the development agreement].

In effect we were being asked to test both technical and management solutions in the design and delivery of a sustainable community.

Who is the carbon challenge actually for?

> Non-architects have berated the … "failure for design processes to become consumer led and better informed by the emerging needs of the customer. It is often difficult to persuade companies in this sector to invest in the creation and application of social and consumer insights … [t]he hope is that this type of sociologically-based thinking"[20].

Our understanding of 'community' is one composed of a series of niche products [or generic units that have been designed to be flexible in terms of personalisation and customisation]. Each of these adapted and subtly personalised units [physically, financially, management] creates diversity within the volume housing market.

> "Without diversity, without weirdness, without difference, without tolerance, **a city will die**. … Cities don't need shopping malls and convention centres to be economically successful, they need eccentric and creative people"[21]

[20] Howard, Melanie [2007] "The homes that the future built" in the introductory essay to the 2007 Housing Design Awards
[21] Florida, Richard [2002] *The Rise of the Creative Class* [Basic Books, New York].

"The mass market is turning into a mass of niches"[22]

Our understanding of the changes within the mass / volume housing market; and a reinterpretation of the traditional urban transect; is one potentially made up of a large series of niche products – an example of the dominance of the 'long-tail' within place-making.

As a result we have begun to identify a series of 'potential' niche markets that are appropriate to the Peterborough context. These are different from a statistical understanding of demographic and / or income groups in that they are attempting to describe different attitudinal groups. These are identifiable groups that have some shared values and attitudes. We have described these hypothesised agent profiles. This will be an ongoing process of recording and reviewing emerging niches markets throughout the life of the development.

The information used in this is old fashioned qualitative data, derived from mixed and multiple sources, including significant primary data[23] collected through video, semi-structured interview, email survey and focus group. This is complementary data and understanding to the existing and on-going quantitative work on housing market assessment and reports that are prolific within the working of the regeneration sector.[24] Together they demonstrate 'mixed scanning' – reading, talking, filming, researching - to add qualitative detail to our future clients and design briefs.

This was intended; and has proved to be; the starting point for the qualitative aspects of housing design and the basis for architectural design briefs for different housing 'products'.

The aim has been to add detail to the development of agent profiles for Peterborough in the following survey areas …

- Review of the 'profiles' … Are these recognisable people? Do they reflect real views, social attitudes and behaviour?
- What are the implications for housing design? … What is their dream house? Questions on how they use space, need privacy, behave in communal areas, flexibility for both internal and external private space. Requirements for car parking? Issues of personalisation?
- Neighbourhood issues … What elements of 'added value' for community provision will make the area more attractive?
- What are the typical financial constraints influencing the household? … Can these help us design specific financial offers and products?

… and most noticeably for the purposes of this project …

- Carbon footprinting … Are we able to estimate individual / household carbon / eco footprints?

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[22] p5 Anderson, Chris [2006] The Long Tail: How endless choice is creating unlimited demand [Random House, London].

[23] We have based our initial descriptions on approximately 300 individual sources from the city and surrounding region from work undertaken by members of UrbanArea LLP and MSc [Design for Sustainability] post-graduate students from Cranfield University, Bedfordshire.

[24] Fordham Research [December 2007] *Peterborough Sub-Regional Strategic Housing Market Assessment 2007*. Third draft report for the Peterborough SHMA Group.

The issues emerging from these Peterborough personalities relate to the different scales of the masterplan [regarding issues of location, community, facilities] and the individual properties [both internal and external spaces] and provide guidance for the design brief for both masterplan / neighbourhood and dwelling scale.

For each of these typologies, we have attempted to attribute a range of lifestyle attributes and financial implications that can be tested as assumptions against a number of neighbourhood issues.

Each of the Peterborough Personalities is explained and presented through their … **profile** [something about them, their background, career and attitudes], **neighbourhood aspirations** [what elements of added value do they value within the wider community] and elsewhere in this submission, their … **housing aspirations** [what they are ideally looking for in terms of space, rooms, privacy, flexibility according to how they anticipate the use of the residential unit] and **assumed Carbon footprint** [personalised [aggregated by household] carbon and eco footprint based on a number of clearly established assumptions. It is these lifestyle and behavioural assumptions that those being tested as the carbon neutral strategy for the site is developed].

An example of a possible 'agents' is …

The Peterborough Dolls

Profile

Sarah is a professional journalist who has worked in the city since her graduation, over ten years ago.

She has developed an interest in the housing offers for the single professional female following a successful series of articles she penned for *Woman and Home*. This highlighted the subtle gender imbalances in some locations where there is a higher number of service and creative jobs – an example being her own profession that is 57% female. She feels there should be recognition of the growth of single women entering the property market independently of husbands and partners[25]. She thinks this is a trend that will raise the profile of sustainable design as her work unearthed research showing women are significantly more aware of environmental issues and the links with climate change. She even anticipates her employer publishing a carbon-free version of *heat*[26] at some point in the future in response to this.

Her cultural references are 'loose women' mixed with 'Ali McBeal'.

Neighbourhood aspirations

Like her cultural references, Sarah's social life is important as it is so tied up with her line of work. Some days she would like to live within easy reach of several casual dining venues and other days she wants to be close to a gym and spa. She believes in community – but on her own terms; access to existing social networks is key.

Beyond the house, the area has to be safe - well lit and busy. She is most interested in green issues where it helps with her work – the home office was essential. She is independent and as a result likes her personal transport but is aware of the negative environmental impact so is attracted by the idea of a car-pool, with some-one else responsible for maintaining and servicing the vehicles.

[25] Evidence suggests that single women are the second largest group of house buyers, demonstrating parallels with other areas; Calvert, David [2006] "Dream House, Sans Spouse: More Women Buy Homes". *USA Today* 14th February.
[26] 'Heat' is currently one of the key women magazine brands produced by locally based *emap*.

We have used the identified 'agents' as the basis for testing elements of a supposed sustainable community.

Work at the national level is beginning to highlight the idea of physical capital. CABE has described this as 'potential value'[27] where we are describing it as 'hypothesised value'. We understand there is added value for different physical and social components of a community that changes for each different communities and individuals. Our approach is allowing us to test some of the more general assumptions made regarding the masterplan components, or structural elements, to find out what will really add value to a specific place like Peterborough.

> "The fact that new homes sell is no guarantee that the development will succeed. It is also no guarantee that the experiences of residents living there will be good …"[28]

The most up to date qualitative research looking at volume housing within the UK has indicated a level of dissatisfaction with residential neighbourhoods … and negative responses to detailed design issues. We want people moving to South Bank, to value not only their property, but many of the elements within their immediate neighbourhood. We want people to perceive the community facilities as part of the 'package' they are buying into. So we need to understand what people within Peterborough actually 'value' within their neighbourhood. In testing these 'agent' typologies we are suggesting that some of the neighbourhood requirements will provide added value to the future community and commercial advantage. These personalities suggested a range of added value elements that are external to the individual property but presented / marketed and understood as part of the 'place marketing' of the carbon challenge site.

As part of this exercise, we created a set of cards and split them into 'suites' [management – financial services – public realm etc] as a basis for testing options and interactions within the masterplan. The scope was based on the criteria used within the Excellence Framework[29] and a record of the ideas has been used to inform some of the strategic decisions over the masterplan elements. In particular it helped progress our understanding of some of the views on housing design. We looked specifically at different forms of live – work examples that included garden shed offices, convertible units within apartment blocks. These ideas have set some of the parameters for the brief[s] for the development of the pattern book for sustainable housing. This sets out the challenge of creating a sense of place through the appropriate level of innovation, variation and subtleness in housing design[30].

Diversity within a Pattern Book - Building Hierarchy, *Diversity and Continuity*

The Victorian core of Peterborough, from which several design cues for South Bank can be drawn, is typified by a liberal mix of house types [terraced, semi,

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[27] CABE [April 2005] *Physical capital: How great places boost public value* [Commission for Architecture and the Built Environment, London].
[28] p3, CABE [2007] *A Sense of Place: What residents think of their new homes* [Commission for Architecture and the Built Environment, London].
[29] On-line tool available at … www.inspire-east.org.uk
[30] Building for Life [March 2008] *Evaluating Housing Proposals Step by Step* [Housing Corporation and Commission for Architecture and the Built Environment].

detached]. As would be expected the avenues tend to be lined by grander villas with the roads off them largely reserved for terraced workers housing and / or semi detached white-collar housing. In the main the vernacular is much like any other town although certain local materials [i.e. London yellow/red brick with some dressed stone] and design details [banding courses, recessed doorways, bay windows] do exist. Interestingly what does distinguish the housing is probably the lack of consistency with seemingly only ever a handful of houses built by the same builder to the same style – often each house in a street is slightly different in terms of design and/or materials. Entire streets of the same house type/style are uncommon. This variety creates interest and adds a quality to the street scene that should be replicated at South Bank.

So for many of the central housing areas in the city, there is no dominant style, rather a diversity of treatments broadly based upon similar typologies [the terraced street and the semi-detached villa]. The scale, the set-back and building line, the plot coverage and footprint for each of these typologies are similar and yet the dominant characteristic is one of a diversity of forms and details.

The level of architectural variety has been achieved [planned or unplanned] through developments being undertaken on a plot-by-plot basis and by default appearing as bespoke. While some of these early 20th century units have been produced for specific 'clients', desk top research suggests that most was undertaken by small local developers on a speculative basis and that there was a meeting of local demands on a very gradual timescale.

To achieve this level of flexibility and responsiveness to the local housing market we are seeking to promote diversity through a high level of personalisation.

Peterborough is a city that celebrates diversity of all sorts and much of the built environment is a manifestation of this. It has a strength within a long established liberal democracy and how this appears 'culturally' within the built environment – what some people have described to us in our soft market testing as having a 'quiet spirituality', a place that has diversity and where diversity is accepted, tolerated or understood as a strength.

We have found that Peterborians what to live in a house that looks like a house. It should not look like an 'eco-machine for living'. This does not always mean that it has to look old or conventional and borrow elements, proportions or something obscure from Victorian or Edwardian styles. We think the city has enough of this type of property anyway and that the development should provide a sense of *continuity* rather than a pastiche.

There is sensitivity over the dangers of simply following a form of eco-vernacular without understanding and providing some elements of continuity with the history and with people's ideas regarding housing design. There is a similar danger that modular and modern methods can create a new vernacular. The danger is one where generic standards and demands; including those set out within the code for sustainable homes; will create a different form of living but something that is not rooted in place and / or time.

So, we proposed a brief for a pattern book of housing type to deliver diversity and continuity - that provides a level of diversity throughout the site, and also understands popular housing design as part of a cultural continuity that would benefit from taking small aesthetic and design steps. It should be understandable as part of an historic progression of housing design. We think this can be achieved through the up-dating of some of the best elements of traditional housing design.

The traditional of pattern books has the link to MMC and even for Code for Sustainable Homes level 6, has the potential for personalisation 'at the point of sale' as well as significant future-proofing. We have developed the idea of the Pattern Book for Sustainable Homes[31] to link local identity with performance standards. The principle of integrated design led us to produce this in collaboration with architects, house builders, financial / mortgage providers, off-site manufacturers, building fabric supply chain, the potential energy supply company and management company.

> "Short of requiring the builder to copy specific prototypes, it is impossible to legislate good design. No set of rules can anticipate all the situations and conflicts that will eventually surface, and there is a tendency that rules designed to prevent something bad will also prevent something good from happening. At best, we stack the odds against the worst and hope for the best. *However cleverly the controls have been structured, designers have demonstrated an uncanny ability to technically meet every requirement and still evade the spirit of the underlying design objectives*."[32]

> "… we are learning a lot, which is the whole purpose of the Challenge. The best work is being taken by developers who are taking an open approach, sharing mistakes and successes."[33]

Emerging Lessons from the Carbon Challenge

There has to be an acceptance that the best way to learn is by doing – the use of heuristic knowledge. Thus, at this stage we have begun to capture some of the common lessons learnt from our consortium experiences of working on the Carbon Challenge. The surprise is the common experiences from the different disciplines relating to 'how' rather than 'what'.

- Integrated working has the need to set out some of the common values for all of the consortium members at the outset of the project. These could be in the form of a charter and / or heads of terms and to use facilitators to work with all of the egos and personalities within the necessary team. The importance of a shared value system and acceptance of sustainability issues for critical for the team and for the future community. This is a challenge for all regional and local scale projects. It has difficulties being a long-term problem being deal with within short and medium term political timescales. This is set within wider concerns over risk taking. These values are potentially best placed within the statutory spatial planning process and systems.

[31] www.patternbookforsustainablehomes.co.uk
[32] p136 in; Hedman & Jaszewski [1984] *Fundamentals of Urban Design* [Chicago, Planners Press].
[33] Lomas, Jane [September 2008] "Carbon Challenge: Testing Level 6". *Carbon Challenge Bulletin*, English Partnerships.

- Some things that can be developed as relatively generic elements in advance of site-specific work. Ideally these could be packaged around the emerging pattern book. This is matched with the need for creativity in localised and bespoke solutions to these sustainability challenges. This creativity is set within a broader range of regeneration skills that has consistently been identified by national and regional organisations.
- It has been reassuring within the current credit crunch to work up ideas for **financial incentives, products and partners**. Preliminary contact with lenders; individually and through the council of mortgage lenders; to discuss some of the potential innovative financial products. This has to become more than targeted contact, but integral to the integrated design team.
- Operational Manual. It is already a requirement to produce a building user guide to accompany all Code Level 6 homes. We also recommend the development of a combined neighbourhood / home user guide. The idea would be to extend the remit of any user guide to cover the wider community issues and highlight some of the connections, where a **neighbourhood manual** would include personalised travel plans. Much of this guidance / manual could be tailored through the links with 'agent' based marketing, web surveys or similar to ensure that operational issues do reflect aspirations and incentives of the future residents.
- We have a recommendation regarding the simplification [rather than standardisation] of the use of benchmarks and standards within the development process such as the production of **'model brief';** the use of mechanisms [such as design codes / smart codes] of dealing with **'layers' of standards** provided from a variety of funding bodies, project stakeholders at national and local levels, and integrating a range of potentially conflicting standards; as well as managing process / project plans through a standard **protocol.**
- There has to be better understanding of the **requirements for community**, as the end-users of the buildings and developments, to adapt their own personal / family lifestyles and behaviours to achieve the sustainable benefits with the use of appropriate technologies and management arrangements. Until this happens, the use of renewable energy and other sustainable technology systems only has a 'potential' to achieve carbon reductions. They have significant impact through consumer preferences. Preference for privacy [c.f. higher density living implications arising from national planning policy and the Code for Sustainable Homes], and design conventions [recognisable domestic architecture with understandable materials] where the policy seems to stress communal living, urban density and architectural innovation.

We have been on a sharp learning curve regarding the 'how' to design carbon neutral developments. These thoughts are presented as our initial reflections on learning through this *Carbon Challenge*.

> "If you have brains in your head and feet in your shoes, if the street isn't nice, you'll go where you choose' *Dr. Seuss*