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Umea, March, 2014

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NEES:
Natural Energy Efficiency and Sustainability:

THE COLLECTION

Papers of the Final NEES Conference
Umeå, Sweden
March 2014

Editors: D. Bond and G. Fischl

NATURAL - ENERGY EFFICIENT - SUSTAINABLE

Northern Periphery Programme 2007–2013

Innovatively investing in Europe's Northern Periphery for a sustainable and prosperous future

European Union
European Regional Development Fund

Cataloguing Details:

Typeset by D.Bond using LaTeX, June 2014 at the
Ulster Business School, University of Ulster at Coleraine for:
The NEES Consortium, and funded by the European Union's INTERREG
IVB Northern Periphery Programme.

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All papers are in the public domain and can be freely quoted as long as acknowledgement is made to the fact that the work was funded by the ERDF INTERREG IVB, Northern Periphery Programme.

Acknowledgements

The NEES Project was funded by the European Union's ERDF INTERREG IVB Northern Periphery Programme (NPP).

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Contents

The NEES (Natural Energy Efficiency and Sustainability) Project - background, achievements and repercussions

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Abstract

The NEES (Natural Energy Efficiency and Sustainability) Project is a trans-national partnership comprising 8 agencies from 5 regions in the Northern Periphery of Europe. The Project began in 2011 and finishes in 2014. During this time the Project has set up a criterion for selecting 15 best practices in products and services that use renewable and recycled materials, have implemented 6 Pilot Projects to demonstrate these best practices in different regions, have developed a Vocational Training course, aimed at training stakeholders in the application of this approach, and will provide a Project Results web site, where complete information and a short film explaining the project can be accessed. NEES Partners have also hosted over a dozen public events, and input into regional and European policies regarding energy efficiency and sustainable construction.

1 Background

The Project was initiated by the Cork Centre for Architectural Education in 2010. The main motivation was an interest in the development of sustainable architecture, in particular the potential use of renewable and recycled materials in achieving it. This interest arose from the practical experience and previous research of CCAE staff, including participation in a number of social housing developments involving the use of low-impact timber frame construction, cellulose insulation and green roofs in the UK. , as well as more recent research projects in Ireland that explored a similar approach The support programme selected was the Northern Periphery Programme (NPP).

2 Partnership

Having been initiated in Ireland, most of the partners were drawn from this region. Cork Centre for Architectural Education (CCAE) , whose interest in low-impact, sustainable design has been mentioned. South Kerry Development Partnership is a regional partnership promoting a range of social, economic and environmental community initiatives in Kerry, with keen interest in sustainable development. Northside Community Enterprise is similarly a community based employment project that was implementing the Government's Warmer Homes Scheme for energy retrofit of low-income housing. From the north-west of Ireland the project included Clar ICH (Claremorris Irish Centre for Housing), a community housing association based in Co. Mayo, aiming to develop more sustainable social housing. The Ulster Business School at the University of Ulster provided support in the area of business feasibility. The Centre for Energy and the Built Environment of the Glasgow Caledonian University (GCU) brought in expertise in energy and carbon measurement and sustainability. The School of Architecture the University of Umeå brought the Scandinavian experience, and ARTEK (Arctic Technology Centre) in Greenland provided the arctic expertise. In addition to this over a dozen Associate Partners, including several local authorities, public bodies, housing associations and private producers and service providers contributed to the activities proposed.

3 Work Programme and Activities

NEES had a "life" of three years, from May 2011 to end of April 2014. During this time Partners organised and participated in many activities, regional and trans-national, corresponding to the Project Work Programme (WP). This included 7 Full Partner meetings (WP1), 11 Study Visits (2 x Cork, 2 x Umeå, 1 x Down 2 x Claremorris, 4 Sisimiut) (WP1), the development of a 5 point Criteria for identifying best practices (WP2), 3 Calls for NEES Best Practices, 3 Expert Evaluation meetings and the selection and profiling of 15 Best Practices (WP3), the production of business feasibility studies of best practices (WP4), bids for continued support made to NPP Programme and the Horizon 2020 Programme (WP4), 6 main Pilot Projects and over half a dozen smaller training pilots on Best Practices (WP5), the development of Vocational Training Modules and a Training Guide (WP6) and over 12 public events and presentations in all Partner regions (WP7). During this time the Project Web Site received over 150,000 visits and several thousand e-newsletters were sent out, and coverage was secured from multiple media outlets (WP7)

4 Criteria for Selecting Best Practices

One of the key tasks of the Partnership was defining Criteria on which to identify and promote Best Practice in the region, a Work Package that was led by GCU. Partners were aware that there were a large number (around 600) of different types of accreditations, ranging from Energy Ratings based on the Energy Performance in Buildings Directive, to Energy Label and Eco-Labels, to more specialised procedures for accrediting entire buildings as well as materials. The Partnership decided that all these systems served very specific functions that did not necessarily reflect the particular aims of NEES, and so decided on a generic system for selection and accreditation of Best Practices, based on specific criteria defined by the Project. The NEES Evaluation Criteria was grouped into five broad and equally weighted categories, summarised below:

4.1 Resource Efficiency

This covers the energy efficiency improvement made by using the product / service, lifespan and maintenance, and life-cycle issues such as the use of recycled materials, processing and disposal at end of life.

4.2 Environment and health

This covers the use of 'natural' materials sourced from environments in the NPP, the impact on climate change of their production (their embodied energy - i.e. their cradle-to-gate / site carbon footprint), and any other environmental or human health impacts from production, installation and use - such as pollution and the use of hazardous materials.

4.3 Sustainability

This category covers the longer term sustainability of supply and distribution networks, 'bioregionalism', how the use of the product / service reflects regional architecture, and compliance with conservation legislation. This will allow experts to reward products or services that meet the broader NEES objectives but could be made more sustainable in the long term (for example by improving the efficiency of the supply chain) if demand were to increase as a result of involvement with the project.

4.4 Enterprise

This category covers the current status of the product / service (and, if applicable, the range of products / services) on the market, including costs of installation and maintenance, current turnover of the company / organisation, and the status of any existing competitors.

4.5 Scalability

This covers the future market potential of products and services in light of current opportunities or barriers to achieving a greater market share, and allowing for the assessment of the likely benefits of promoting the product or service through NEES. It serves as a counter-balance to 'Enterprise' by rewarding products or services with a high potential to grow their market share through involvement with the project.

5 Evaluation Procedure and Role of the Expert Panel

In order to apply this Criteria and select Best Practices from the entire region, the Partners opted to hold a series of Calls (totalling 3) asking for submission of a completed questionnaire by any producer or service provider who felt they might qualify as a Best Practice. The evaluation of these submissions was carried out by a Panel of seven independent Experts nominated from each region. These Experts had recognized experience in their field (architecture, engineering, energy, etc.) and evaluated the products or services submitted on the basis of the NEES Criteria. Experts were required to declare any financial or commercial interests with the applicants at the outset of the meeting and excuse themselves from the relevant discussion(s).

6 Selection of the Best Practice

The 3 Calls held produced over 100 submission, that were first screened for eligibility (e.g. being in the NPP region, using renewable or recycled materials, etc.) The short lists were then eventuated by the Expert Panel, first remotely, then by 3 meeting to secure agreement on results. This process concluded at the end of December 2013, with the selection of a total of 15 Best Practices.

The following were finally selected:

1. EcoCel (Cork) - recycled cellulose multipurpose insulation.
2. Green Roofs Ireland (Cork) - Soil and sedum insulating roofs and walls.
3. FH Wetland Systems (Galway) - integrated constructed wetlands for water treatment.
4. Mud and Wood (Sligo) - training on the use of cob and other natural materials for construction.
5. Advanced Timbercraft (Northern Ireland) - Construction company specialised in the use of timber for construction.
6. Locate Architects (Scotland) architectural; practice specialising in the use of timber and other natural materials.
7. Ecological Architecture (Scotland) architectural practise specialising in the use of local timber and other natural materials.
8. Enviroglass (Scotland) Local community trust manufacturing paving elements from recycle glass locally sourced.
9. Inzievar Woodlands (Scotland) company managing local native woodland, and sawmill for timber construction.
10. Martinsons Gluelam (Sweden)- timber based construction element manufactured from wooden local timber glued together for strength.
11. Martinsons Xlam (Sweden) - timber based construction element manufactured from local timber glued across the grain for extra strength.
12. Masonite Beams (Sweden) - Timber based construction elements made from timber beams/posts and intermediate resin board cross member for strength.
13. SWECO (Sweden) - major architectural practice specialising in construction in timber, including larger structure like bridges, office blocks.
14. The Hollies Centre for Sustainability (West Cork) - training centre giving practical training and demonstration of use of natural materials in building, including straw bales and timber construction (Segal System).

15. MAKAR is an architect-led design and builds company based in Scotland, who have completed over 60 buildings using primarily local and renewable materials.

These Best Practices selected were highlighted in the NEES Web Site and promoted a various press releases, public and brokerage events and exhibitions for the duration of the Project.

7 Pilot Projects

In parallel to the section of Best Practices, the NEES Partnership undertook the development of 6 Pilot Projects that would reflect the use of NEES products and services, or similar products and services that for whatever reason had not been specifically selected but generally fit the NEES Criteria. These Pilot Project were mostly funded from external resources, and were very much dependant on the specific circumstances of the Partners who prepared and implemented them. Given the limited funding available, it was not always possible to thoroughly evaluate the results obtained.

The Pilot Projects developed were:

1. The Blue House, Sisimiut, Greenland:

   This was the deep retrofit is a post and beam timber house owned by the Municipality of Qeqqatta. It is a typical wooden building standing on concrete foundations, with minimal internal insulation. The Pilot retrofit consisted in the external cladding of the house with cellulose insulation, with an aluminium envelope. The results of this retrofit are being monitored during the life of the house.

2. The Wooden House, Skibbereen, Co. Cork, Ireland.

   This was a passive solar extension and conservatory plus external cladding of a kit-built log cabin in West Cork, Ireland. The works including the construction of a timber extension and solar conservatory, insulated with cellulose, and with a solid and sedum roof. Also triple glazed windows, skylights and a ceramic tiled floor for thermal mass. Two of the walls were also clad externally with hempcrete.

3. The Mayfield Community Centre, Claremoriss, Co.Mayo, Ireland

   ClarICH has designed and build a Community Centre as part of its social housing project at Mayfield in Claremoriss. Co. Mayo. This Centre is incorporates renewable energies via a district heating system, and is designed to very high levels of energy efficiency. The NEES input is specifically in the celling insulation, which used recycled paper.

4. The Parnell Cottage, Cloyne, Cork. Ireland

   This project is described in the article “Education, Research, Practice” by Kevin Gartland and Orla McKeever in this publication, and is both a comprehensive pilot incorporating more than 7 examples of NEES Best Practises, as well as providing the basis for training in their application. The impact of this Pilot Project will be measured by a comprehensive Life-Cycle Assessment.

5. The Passivehouse Hedluna House, Umeå

   This involved the design and construction of a Passive House incorporating renewable and recycled materials by Best Practise SWECO architects. The building is a school, and constructed to BREEAM standards, as well as being a certified Passive House.

6. Integrated Constructed Wetland, Valencia Island, Co. Kerry

   This Pilot Project involves the construction of integrated wetlands to treat the waste water from the Valencia Lighthouse in Co. Kerry, a popular tourist attraction on the Western Coast of Ireland. The waste water treatment consists of a series of ponds where waste water if filtered thorough a selection of plants, that effectively remove all pollutants from the water, allowing them to flow clearly into the sea.

8 Vocational Training

Based on the Best Practices selected and the Pilot Projects undertaken, Partners designed and commissioned the writing of a series of Vocational Training Modules, aimed at FETAC Level 6 or CPD Certificate level, which will document the use and benefits of the NEES approach and the various materials and services identified. The NEES Certificate Course and the accompanying Training Manual will be made available to interested Partners and other Colleges and Universities for future deliver as ether a FETAC Vocational or a CPD Professional Course.

9 Results Website

The Partnership is also developing (in addition to the current project web site) a Results Web Site, aimed at highlighting the outputs and deliverables of the Project into the future. This Results Web Site will be on line in addition to the current Web Site (which already contains information gathered during the development of the Project). But the Results Web Site will aim to give a more concise and accessible summary of the key results and deliverables of the Project. In addition to details of the Best Practices selected and the Pilot Projects completed, the results web Site will include a short film explaining the Project, and details of the Vocational Training developed.

10 Impact on Regional and European Policy

The NEES Project has tried to have some impact on both Regional and European Policies relating to sustainable construction and energy efficiency. Results have been patchy, with some regions showing a lot of interest, and others very little. Notable is the verbal submission made to the All Party Parliamentary Group on Sustainable Construction in the UK. UK NEES Partners made the case for more support from the use of renewable and recycled materials as part of a green construction approach. In Ireland the NEES Best Practise, Mud and Wood, made a detailed submission to the Sustainable Energy Authority of Ireland (SEAI) in September 2013, recommending the incorporation of life-cycle thinking into the BER Assessment. Further presentations were also made to the Scottish Parliament. NEES also participated in the consultation held by the Northern Periphery Programme regarding the proposed objectives of the 2014-2020 Programme. Here we emphasised the regional importance of energy efficiency in the region, to go side by side with the current focus on renewable energy sources. This issue has now been given prominence in the Programme. In addition to this the various public events and presentations made have strongly highlighted key issues at regional and European levels.

11 Prospects for the Future

The NEES Project approaches its official termination date, Partners have been active in identifying sources of support for continuing the work of the Partnership. A submission for a Preparatory Project to the Northern Periphery Programme for the new 2014-2020 Call was, surprisingly, not successful. This has not deterred the Partnership from continuing to develop proposals to take the project to a new level and a comprehensive proposal has been submitted to the Horizon 2020 Programme, under Call EeB1 - 2014 Materials for the Building Envelope. The Proposal is titled NATLOW CO2 (Achieving naturally low embodied carbon and energy over the life-cycle of Buildings), was submitted in March of 2014. This new Project aims to continue and consolidate the work of NEES by identifying a further 15 renewable and recycled materials that contribute to energy efficiency in buildings (this time from the whole of Europe) and which can achieve targeted reductions in energy use and carbon emissions during their life-cycle, as well superior energy efficiency in use and other sustainability benefits. The NATLOW CO2 Partnership comprises 14 organisations, including 4 current NEES Partners. The Project is currently undergoing evaluation and a decision is expect for August 2014.

12 Conclusions

Activity has been intense during the 3 years of the Project, aiming at achieving the objectives of the Project. We have had our ups and our downs. Partners have been surprised at the low level of official support currently given to the use of renewable and recycled materials in most regions, and the difficulties involved in securing accreditation and recognition for products and services. However, we have also been impressed at the committed and consistent work carried out by producers and services providers, and some grass roots organisations and lobby groups, to promote this important alternative.

Partners are satisfied that we have achieved what we set out to do in terms of demonstrating the viability of products and services of this type in the NPP region, and of the kind of mechanisms that could be put in place to support these. We have concluded that much work is still needed to make this sector economically sustainable and technically advanced. We believe that both these factors are necessary for the main-streaming of a more sustainable approach to construction, based on organic architecture and circular economy principles. Partners share the conviction that the best way to ensure this continued development is by the resourcing and continuation of the work carried out in NEES, one the basis of future related initiatives.

Scoping of ‘Best Practices’ in natural, energy efficient and sustainable building products and services

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Abstract

A plethora of sustainability assessment methodologies exists but incomplete coverage of the triple bottom line appears the norm. In this paper we present our experience in developing and operationalising a set of assessment criteria for the selection of ‘Best Practices’ (BPs) that promote natural and sustainable building products and services for enhanced energy efficiency in retrofitting existing dwellings in the Northern Periphery Programme Region.

1 Introduction

The now critical importance of realising sustainability and the central role of the built environment in achieving this is recognised at the highest levels (UNHabitat, 2008,European Commission, 2007, and WCED, 1987). However, current sustainability assessment protocols are largely confined to assessing the environmental performance of buildings and fail to address their impact on quality-of-life and the interrelationship between the two and thus are not optimally aligned with the principles of sustainable development. Even within the current environmental focus, the emphasis is often on a narrow range of issues such as energy performance (for example, The Energy Performance in Buildings Directive European Commission, 2002) and material use (“Environmental Product Declaration” EPD, 2008). Sustainability in its widest sense, delivering quality-of-life while improving environmental performance at an affordable cost, is yet to be operationalized.

In this paper we present the philosophy behind the criteria development and discuss the results obtained in selecting and operationalising sixteen BPs as part of the Natural, Energy Efficient and Sustainable Building Products and Services for Retrofitting of Existing Dwellings (NEES) Project (www.neesonline.org).

2 Background

Despite their short comings, a plethora of sustainability assessment methods (SAMs) have emerged recently. As early as in 2005 Walton et.al. (2005) identified that there were over 600 tools dealing with one or more aspects of sustainability in buildings. Despite the abundance of tools, the landscape is incomplete in its coverage of sustainability themes, with no one SAM providing complete

Country	Tool	Initiated	Recent revision	Sustainable Site	Land-use & ecology	Energy Efficiency	Water efficiency	Materials & resources	Environmental loadings	Indoor Environmental	Service Quality	Transport	Social aspects	Economic aspects	Cultural aspects	Regional Priority	Management	Innovation & design	Awareness & education	Life Cycle Assessment	References
1. International	GB/SB-Tool	1996	2007	✓		✓	✓	✓	✓	✓	✓		✓		✓						http://www.iisbe.org/sbmethod [Accessed 19/04/2010]
2. Australia	Green Star	2003	2010		✓	✓	✓	✓	✓	✓	✓	✓						✓			http://www.gbca.org.au/green-star/ [Accessed16/04/2010]
3. Canada	LEED-Canada	2004	2009	✓			✓	✓	✓	✓								✓			http://www.cagbc.org/leed/what/index.php [Accessed 16/04/2010]
4. France	HQE	2004	NA	✓	✓	✓	✓	✓	✓	✓	✓		✓				✓				http://www.assohqe.org/ [Accessed 16/04/2010]
5. Germany	DGNB Certification	2009	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	http://www.dgnb.de/en/certification/the-german-sustainable-building-certification/index.php [Accessed 16/04/2010]
6. Japan	CASBEE	2001	2007/08	✓	✓	✓		✓	✓	✓	✓										http://www.ibec.or.jp/CASBEE/english/index.htm [Accessed 19/04/2010]
7. Malaysia	GBI	2009	NA	✓		✓	✓	✓		✓								✓			http://www.greenbuildingindex.org/ [Accessed 19/04/2010]
8. Portugal	LiderA	2005	NA	✓	✓	✓	✓	✓	✓	✓	✓		✓					✓		✓	http://www.lidera.info/?p=index&RegionId=3&Culture=en [Accessed 19/04/2010]
9. Singapore	Green Mark	2005	NA	✓		✓	✓			✓		✓						✓			http://www.bca.gov.sg/GreenMark/green_mark_buildings.html [Accessed 19/04/2010]
10. Spain	VERDE	2005	2009	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			✓				http://www.gbce.es/tools/general-information [Accessed 19/04/2010]
11. Abu Dhabi (United Arab Emirates)	Pearl Rating System	2010	NA	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	http://www.estidama.org/estidama-home.aspx?lang=en-US [Accessed 19/04/2010]
12. United Kingdom	BREEAM	1990	2008		✓	✓	✓	✓	✓	✓		✓	✓				✓				http://www.breeam.org/ [Accessed 19/04/2010]
13. United States of America	LEED	1998	2009	✓		✓	✓	✓	✓	✓		✓				✓		✓	✓		http://www.usgbc.org/DisplayPage.aspx?CategoryID=19 [Accessed 19/04/2010]
14. Canada / USA	Green Globes	2000	2006	✓	✓	✓	✓	✓	✓	✓						✓				✓	http://www.greenglobes.com/ [Accessed 16/04/2010]

Table 1: A comparison of the general assessment categories for key established international Green Building Tools.

coverage and the criteria around which the method is developed often reflecting variations in their interpretation of the concept. (Poston, Emmanuel and Thomson, 2010) conducted a comparison of the thirty most commonly used SAMs to explore the coverage of their criteria against a holistic interpretation of sustainability. The findings of the survey (Table 1) confirms the incomplete coverage of criteria against economic, environmental and social themes and confirms a tendency to focus on environmental impacts often from a technical standpoint, thus failing to account sufficiently for cultural and economic considerations which are important to the aim of the NEES project.

In establishing the basis for an assessment criterion for selecting best practice products and services based on the principles of the NEES project, there was a need to go beyond what is commonly reflected within the criteria used by common SAMs and GBRS (Green Buildings Rating Systems). We therefore considered established criteria within common SAMs and GBRSs, criteria emerging within SAMs reflecting novel articulations of sustainability, and drew on sustainable material frameworks such as NaturePlus for validation.

3 Method

Our approach drew on the experience of the SUE-MoT research project (www.suemot.org) involving Glasgow Caledonian University (GCU), which developed a criterion for assessing sustainability of building projects. The findings were then cross mapped with the criteria displayed in novel articulations within SAMs and drew on a sustainability materials selection criteria developed by GCU with a housing development team and housing association. The materials selection criteria was developed around bioregional principles but was established from the same reductionist approach. The criteria embodied many of the environmental principles reflected in NEES, but a need existed to tailor the criteria to reflect the future potential of the product or service within the market and the context of the NPP regions (geographic, cultural, economic, skills and traditions). The emerging criteria was validated through comparison with the “NaturePlus” criteria (www.natureplus.org) which focused on the technical elements of resource efficiency, environment and health criteria; but were found to lack the wider sustainability, enterprise and scalability criteria important to NEES.

The NEES partners were consulted with a view to ensuring the emerging assessment criteria met with the principles pursued within the project, and to enable regional variations to be reflected. This process aided in establishing a firm understanding of the NEES philosophy and its articulation in the context of the criteria. An expert panel was convened comprising of professionals in sustainable design and construction from the different partner regions. They provided technical input, and ensured that the emerging criteria reflected the latest interpretation of best practice related to sustainable materials within their regions.

Table 3: Five headline criteria for NEES assessment

Criteria	Description
Resource efficiency	captures the more quantifiable impacts of the products and services, including life cycle costs, carbon footprint, and energy savings attributable to use
Sustainability	captures socio-economic impacts as well as cultural issues such as sensitivity to regional architectural traditions.
Enterprise	captures the growth, to date, of the product or service (given that all applicants must be SMEs or smaller)
Environment and health	captures less directly quantifiable impacts such as pollution and any hazards to human health (from installation and use)
Scalability	captures the potential for growth, including the sustainability of the product or service if demand were to grow significantly, as well as the value that could be added by involvement with the project.

4 Assessment criteria for selecting NEES best practice products and services

NEES aims to promote products which "were comprised of a minimum of 85% of renewable raw materials, or mineral based materials which are almost unlimited in their availability". The synthetic or high-tech components of such products were strictly limited and reduced to the minimum level that is technically possible. Harmful emissions were avoided and the use of fossil fuels and limited natural resources were minimised. The origins of the raw materials were carefully checked. NEES aims to promote services if they "were based on the use of such products, and their implementation has no or limited environmental impact".

To ensure that products and services considered for selection as BPs meet this philosophy, three 'gateway' criteria were introduced to eliminate quickly failing submissions from the process:

- Use of natural and / or recycled materials.
- Suitable for retrofitting to improve the energy performance of buildings.
- Sourced from the NPP region, or those with main market in the region.

Those products and services that meet all three of the gateway criteria were then scored against five NEES assessment criteria (Table 2). The first two criteria aligned with the NaturePlus criteria, the findings of the SUE-MoT project and the sustainable building materials criteria developed by GCU. The third expands these to cover a wider definition of sustainability incorporating social, cultural, heritage aspects and wider economic impacts, and the latter two are more blunt assessments of success and future market potential.

5 Selection process for Best Practices

On passing the three 'gateway' criteria, representatives of the products and services were asked to submit an application through the NEES website. The application was in the form of an online survey designed according to whether the applicant provides a product or service. The product survey set specific questions designed to draw out pertinent information that may not be obvious to applicants. The initial version of the services survey was simplified following feedback from respondents and the expert panel. The survey then focused on requesting case studies that address the 'natural / recycled', 'energy efficient' and 'sustainable' aims of the project.

In line with the Delphi Process (Dalkey and Helmer, 1963) the completed assessments were passed to a panel of independent experts (one representing each partner region) to score and evaluate against a standard marking scheme. The results were collated, the highest and lowest marks removed, and the average of the remainder taken. Those scoring above or below 7 (out of 10) under all five criteria are automatically accepted or rejected and the rest were further evaluated at a meeting of the panel, who had the option of accepting, rejecting, or referring a submission back for (specific) information. The whole process was therefore designed to eliminate professional bias, minimise the time needed from experts, and facilitate more detailed discussion where this was needed regarding the characteristics of the NPP regions. The panels were established partly to overcome the research/ information gap surrounding the performance of products and services aligned with the NEES criteria and to ensure professional opinion and experience within the NPP regions was reflected.

6 Outcome and Discussions

The 'NEES Process' has now been used to evaluate over 40 submissions over three call periods with 16 products and services accredited as examples of Best Practice. These range from traditional industries such as timber and timber products to innovative recycled products; and from architects and education centres to specialists in green roofs. The experts found that, once they had familiarised themselves with the process and their role within it, a common set of judgements regarding the submitted products and services could be reached based on the assessment criteria.

The degree to which respondents were able to engage as intended in the survey was observed to display considerable differences. Building professionals such as Architects, and larger organizations were observed to engage favourably at the right degree of detail. However, it was apparent that micro-enterprises often lacked the understanding of their product or service to engage in technical details and consideration of their market potential. In this case, regional partners were required to help the respondent to interpret the questions and information.

7 Regional variations in submissions

In Scotland and Ireland there was observed a high proportion of submissions from small micro-enterprises which displayed limited business skills and resources to grow their product and business. A committed community of architects providing sustainable design services was represented but reported a real challenge finding suppliers within the local area. Both these regions exist close to large urban areas (central belt of Scotland; Dublin and Belfast in Ireland) which can service this market with products and services.

In Sweden, the submissions were mainly from large companies who have invested in developing products with a view to promoting these on the Swedish and global markets. Due to low population levels the potential for commercial activity servicing a local market is limited and this is reflected in the lack of micro enterprises promoting products and services.

In Greenland, the submissions reflected challenges in obtaining submissions from this region. This reflects the reliance on imported building materials from Denmark and limited economies of scale for local products and services. A lack of local training and investment problems associated with investment levels required for research and development of materials suitable for the Arctic climate were observed.

Economies of scale limit the potential for growth in all regions. Low population levels in Greenland and Sweden restricts the market potential for such products and services at a commercial level locally. Sweden relies on large organisations to invest in the region in order to promote these products to the mass market. In Scotland and Ireland, the focus is on mirco-enterprises and two types of organization were observed with 1) lacking the desire to grow due to the local scale of the business satisfying the needs of the shareholders, and 2) those that have the desire to grow but lack the skills and experience to grow their business.

8 Conclusions

The development of an assessment criterion to select products and services reflective of NEES best practice was important for the project to ensure the consistency with the project's philosophy (natural, energy efficient and sustainable) and poses the potential to be scalable to a wider market. The development of the criteria followed a reductionist approach to ensure established best practice in SAMs and GBRSs was reflected and to allow gaps with NEES to be identified and filled through consideration with emerging novel concepts. GCU were able to draw on existing methodologies in criteria development and findings of previous research to aid the rigour of the process. The selection process was also important to ensure that it was rigorous, fair and transparent; and was able to secure the information required from submissions. A two stage online survey to capture information from product and service providers was provided, an expert panel convened to evaluate the submissions against the criteria, and decision making process based on expert conscientious. This process ensured fairness and transparency, and by involving experts that products and services were considered in line with established best practice, regulations as well as reflect regional context. The submissions revealed early indications of contrasts between the different NPP partner regions which provided a path for research within the NEES project.

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A Sustainability Performance Assessment Tool for SMEs

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Abstract

Small and medium-sized enterprises (SMEs) within the construction and design domain are already been provided with several sustainability assessment techniques. This paper presents an easy to use assessment technique for 20 building projects in terms of a sustainability performance assessment tool. Originally, this assessment tool was conceived within the NEES project supported by the Nordic Periphery Programme.

1 Introduction

The aim of this paper is to propose an easy to use sustainable building performance assessment technique within the framework of NEES project that can be used to compare sustainability performances of SMEs, particularly in architectural firms. The NEES project is supported by the Nordic Periphery Program and aims to investigate products and services that is in accordance with its natural (N), energy efficient (EE) and sustainable(S) perspective.

Over the years, it has become obvious that sustainable design imposes new demands on architects and planners to broaden their expertise to embrace environmental engineering, ecological ways of constructions, efficient infrastructure, and unique urban development projects (SAR, 2010). Furthermore, it is also clear that characteristics like how a building's spatial hierarchy is organized, or day lighting, or design affects on indoor climate and energy performances are all important architectural considerations. The building method, materials and construction technology predestinate the carbon footprint of the building and its life cycle. The use of urban space is concerned with the land efficiency; therefore balance between the area of agricultural claims, local climate and livable space minimum is essential. Finally, infrastructure as a whole requires optimization in efficiency and a decrease in waste production.

Professional bodies have realized that sustainable development has implications for the wider relationship between professionals and society. This is particularly the case for the built environment professions, where buildings have a major impact in environmental, economic and social terms (United Nations Environment Programme, 2007). To take one example, buildings are major emitters of carbon, which contributes to global warming: for example, if all the energy used in constructing, occupying and operating buildings is combined then buildings are responsible for 50 per cent of carbon emissions in the UK (Building Research Establishment, 2003). This is also a broader global issue, with the built environment a major contributor to global environmental issues, and with consequent impacts on the natural environment. There have been done several building performance models that are capable to predict an energy performance of a building. The most well-known are the BREEAM (Building Research Establishment's Environmental Assessment Method), or the LEED (Leadership in Energy and Environmental Design), as well as the Greenbuilding and Miljöklassad byggnad. The latter, the Swedish system is based on scientific and measurable criteria, this quality is not as established in the other systems.

The Swedish Environmental Protection Agency argues that to combat climate change, national climate policies must be developed in correlation with international climate agreements. According to Pérez-Lombard, Ortiz and Pout (2008), in the developed countries buildings contribute between 20-40% of the total energy consumption and therefore it has exceeded other major sectors such as industry and transportation. In Sweden, the energy consumption of buildings are approximately 40% and it costs about 150-200 billions of crowns annually (IVA, 2012) which indicates an energy.

Much of the work on sustainability can be characterized by three key approaches. The first is concerned with definitions of sustainability - where they have emerged from, what they attempt to achieve and how they can be compared (Baker et al., 1997; Haughton and Hunter, 1994; Rees, 1999). The second approach is more reductive, thus the focus is on establishing what is unsustainable, how to make practices more sustainable and how to evaluate sustainable outcomes. This operates with checklists, indicators, triple bottom-line accounting and ecological footprints (Wackernagel and Rees, 1996). It is based on the premise that we know enough about the planet as well as the people (i.e. Redclift, 1996). The third approach discusses sustainability as a dialogue - a way of defining and controlling the agenda for change and development (i.e. object management. Sandilands, 1996).

A sustainability performance assessment tool (SUPERASSIST) as a questionnaire was developed to assess sustainability performance in SMEs. This tool has potential in screening SMEs sustainability performance particularly in building projects. The assessment tool consists of items according to ISO TC 59, which describes the minimum performance measures necessary for sustainability assessment (Seo, Tucker, Ambrose, Mitchell and Wang, 2005). Under each main factor (Indoor air quality, energy, resources and materials and finally environmental impacts to surrounding) ratings can be given on a four-point Likert-scale (1=Agree, 2=Slightly Agree, 3=Slightly Disagree, and 4=Disagree) on each item. In addition, questions related to sustainable project management can be included according to Clements-Croome's (2013) recommendation. The items representing relevance to sustainability and its combination can contribute to different factor results. Weighing of the items in the factor measure can also be possible, thus a more quantitative result would be achieved. The SUPERASSIST is presented in Table 1.

Main factor	Sub-factors	Selected items	Scale (1-4)
	Shared vision	The project briefing based on a well-defined mission and vision at the early stage	

Project Management		The project applied adequately a unity of vision between consultants, contractors, manufacturers and facilities managers.
	Information flow	The coordination of information across the whole building process was adequate
		The project applied adequate standardized processes rather than improvisation
		The project applied adequate interoperability of systems and their interfaces
		The project applied adequate documentary evidence on integrated processes
		The project applied adequate proven and tested processes to be adapted and used on other similar projects
	Auditing	The project applied adequate auditing and monitoring processes
Indoor environment	Thermal comfort	Performance of room temperature control is adequate
		Degree of moisture control is adequate
		Vertical distribution of air temperature is adequate
		Air velocity is adequate
	Lighting	Degree of visual access to the exterior & daylight access is adequate
		Performance of access to day lighting is adequate
		Performance of anti-glare measures is adequate
		Illumination levels are adequate
		Degree of lighting controllability is adequate
	Air quality	Degree of sources control is adequate
		Performance of ventilation is adequate
		Performance and quality of operation plan is adequate
	Noise & acoustics	Level of noise is adequate

		Level of sound insulation is adequate Level of sound absorption is adequate
Energy	Operational energy	Total primary energy consumption in operation is adequate
	Efficient operation	Performance of monitoring is adequate Performance of operational management system including commissioning is adequate
	Thermal load	Building orientation is adequate Thermal load of windows is adequate Insulation level of exterior wall and roof is adequate
	Natural energy utilization	Degree of direct utilization of natural energy is adequate Degree of indirect utilization of natural energy is adequate
	Building systems' efficiency	Performance of HVAC is adequate Performance of ventilation system is adequate Performance of lighting system is adequate Performance of water heating system is adequate Performance of elevator system is adequate
Resources and materials	Water consumption	Amount of water consumption is adequate Degree of utilization of rainwater and grey water is adequate
	Resource productivity	Degree of use of recycled materials is adequate Degree of renewable resources is adequate Degree of reuse of existing skeleton is adequate Durability of materials is adequate Performance of waste disposal is adequate
	Avoidance of pollutant materials	Degree of avoidance of hazardous materials is adequate Degree of avoidance of CFCs and halons is adequate

Environmental impacts to surrounding	Pollution	Performance of run-off management is adequate
		Degree of acidification is adequate
		Creation of photo-oxidants is adequate
		Degree of nitrification is adequate
		Degree of emissions of water pollutants is adequate
		Degree of emissions of soil pollutants is adequate
	Load on local infrastructure	Load on traffic management systems is adequate
		Load on waste treatment systems is adequate
	Wind damage related issues	Wind damage evasion measures are adequate
	Light pollution related issues	Light pollution evasion measures are adequate
	Heat island effect related issues	Heat island evasion measures are adequate
	Load on local infrastructure related issues	Load on sewage treatment is adequate
		Degree of access to sunlight of adjacent property is adequate
Quality of service	Service ability related issues	Functionality and workability is adequate
		Pleasantness is adequate
		Complexity is adequate
		Originality is adequate
		Flexibility is adequate
		Privacy is adequate
	Durability related issues	Earthquake-resistance is adequate
		Performance of daily maintenance/updating and frequency is adequate
	Flexibility and Adaptability related issues	Space margin is adequate
		Floor load margin is adequate
		Adaptability to various requirements is adequate

	Ecosystem related issues	This project has an impact on biodiversity
		This project has an impact on cultural diversity
	Townscape and landscape related issues	Accessibility is adequate
Outdoor environment		Urban planning issues are solved adequately
		Landscaping issues are solved adequately
	Local characteristics and culture related issues	Sustainability features are adequate
		Usability issues are addressed
		Supports cultural activities

Note: Scale consists of 1=Fully Agree, 2=Slightly Agree, 3=Slightly Disagree and 4=Fully Disagree.

One of the methods for using SUPERASSIST would include twenty building projects from the north of Sweden. These projects should be expected to perform well on a sustainability related evaluation. Then a panel of experts would evaluate the projects and their results on SUPERASSIST and their results could be compared to the evaluation of the SMEs own design professional. Analysis of the data would include descriptive statistics as well as parametric comparison and differentiation tests. Ratings of the panel and the design professionals would be compared on sustainability performance. Age, gender and years spent in practice would also be taken into consideration.

This sustainability performance tool could be a quick and reliable tool for evaluating design and tackle bottlenecks in design related issues. Furthermore, this tool could be contributing to an open discussion for sustainability awareness and spreading the best practices in the design profession.

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Education - Research - Practice

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Abstract

Through this paper we will look at links between architecture education, research and practice, using a current project as a vehicle to cover aspects of building, pilot and live project. The first aspect, the building project consists of the refurbishment and extension of a Parnell Cottage for a private client and is located near Cloyne, in East Cork, Ireland. The pilot project falls within the NEES Project, investigating the use of materials and services based on natural or recycled materials to improve the energy performance of new and existing buildings. The live project aims to hold a series of on site workshops and seminars for students of Architecture, Architects and interested parties, demonstrating the integration of the NEES best practice materials and techniques within the built project. The workshops, seminars and key project documents will be digitally recorded for dissemination through a web based publication. The small scale of the building project allowed for flexibility in the early conceptual design stages and the integration of the research and educational aspects.

1 Live Projects

The live project aims to hold a series of participatory workshops and seminars for students of architecture, architects, community groups and interested parties, demonstrating the integration of the NEES 'best practice' materials and techniques within the built project.

Previous building projects within the college allowed students the opportunity to develop an appreciation of material qualities, both phenomenological and structural in addition to themes such as design and build, communication and group work dynamics. However there was always the concern of what becomes of these structures on completion of the studio semester? Moving from a studio building project, based on a hypothetical brief, to a live project with a client; allows pedagogical approaches to extend beyond the confines of the design studio.

Anderson and Priest's working definition for the Live Projects Network suggests that;

> "A live project comprises the negotiation of a brief, timescale, budget and product between an educational organisation and an external collaborator for their mutual benefit. The project must be structured to ensure that students gain learning that is relevant to their educational development."

However, as the Cloyne project developed, constraints materialized, raising questions of whether the built project could act as a live project?

Some of our concerns were, (1) should the project be included within the curriculum, aligned with modules and academic credits, or act as a stand-alone activity? (2) Could the building timeframe be synced with the academic year? How are students and H&S legislation dealt with on site, over an extended period of time? And (3) can we put students in a position of responsibility to deliver a certain level of quality in workmanship, when dealing with a real client? Despite our reservations, discussions sparked an interest within the student body. The seed was planted.

2 Sustainability

For us, this project holds most interest in its general approach to sustainability, rather than any specific or technical methods or evaluations which will be adopted. While there is technical investigation into various natural products, their embodied energy, statistics relating to their performance over time, comparisons with everyday materials; it is the basic design strategy that provides the most sustainable impact in our opinion. The underlying simplicity of this approach is the most straightforward for architects to communicate to their clients, and the easiest to educate students of architecture.

By simplicity of approach we mean (1) recognizing the cultural significance of the existing house, (2) persuading a client who has a strong desire to demolish the house to preserve it, (3) analyzing and assessing the opportunities that lie with refurbishing and extending the house, (4) paying careful attention to the creation of sheltered, well orientated outdoor and indoor spaces, and (5) paying attention to achieving the most impact with the least financial investment through judicious use of materials, and efficient design interventions.

Only once these basics are attended to on this project do we feel incentivized to explore the design in a technical manner, by looking closely at potential materials or undergoing detailed evaluations and comparisons.

The above list is in order of priority. The most sustainable aspect of this project, in our opinion, is the preservation and reuse of the existing house. This is because for us, sustainability encompasses the everyday common sense decisions that architects make on a daily basis, as well as heritage, historical and cultural value of existing building stock. It is worth considering why this house is significant.

3 Historical Value

Our client purchased an old three bedroom single storey cottage in a rural location in County Cork on a one acre site. Upon visiting the site, we had a hunch that the house was of value, and resisted direction from the client to demolish the house. Some quick research verified that the house was in fact a Parnell Cottage.

In 1906, the 'Labourers Act' provided large scale state funding for extensive agricultural labourer owned cottages. The cottages were erected by the local County Councils.

This was a major socio-economic transformation in rural state housing it erased many one roomed hovels unfit for human habitation.

In a six year period between 1906 and 1911, over 40,000 Parnell Cotages were built in Ireland, with 7,560 cottages built in County Cork, where they were known as "Sheehans' Cottages" after a local politician.

Under the scheme, land owning farmers compulsory surrendered an acre of choice land to each labourer to provide a family home and vegetable patch.

This scheme had enormous long-term consequences for rural Irish society, including the decline of disease, political stability, and greater agricultural output. It was a form of social revolution, and arguably the first large scale public housing scheme in Ireland.

The scheme is relevant today as an example of how far simple but efficient local solutions can go to address wider problems of national or global significance. It provides reassurance that simple things done well, when replicated, can impact great change for the benefit of the user and society.

4 Interest as Practice Project

The project lies at the intersection of coincidental and unusual circumstances; (1) a client with a modest budget of close to €60,000 to refurbish a 40m^2 cottage and extend by 30m^2, (2) a client who has severe allergies to off-gassing from the majority of commonly used building products and a strong preference for building with natural materials, (3) the simultaneous involvement by CCAE with the N.E.E.S project, with interest in suppliers and providers of natural materials, (4) the availability of grant funding through the N.E.E.S project for natural materials, (5) the interest in CCAE of involvement of students in real projects and (6) the interest in CCAE of involvement with private practice.

5 Evolution of Design

At project inception, the client was keen to introduce constraints which were either unnecessary or unachievable given the modest budget available.

Therefore, at feasibility stage, care was taken to explore a range of design options to clearly communicate the impact of design decisions.

As the client was insistent on demolishing the house, we tentatively explored three site strategies of where and how to position a new dwelling on the site. We drafted a straightforward list of benefits and difficulties to re-enforce the impact of design decisions.

We also explored three site strategies of how to accommodate the client's brief by retaining and extending the existing house. As the site strategy evolved to one that was ethically and professionally acceptable, the list of demonstrable benefits grew while the list of difficulties shrank.

It was significant that the project was to be used as a vehicle for research and education. That allowed us to follow the course which we understood to be best practice, rather than negotiate design solutions with the client and settle for compromise on decisions of strategic importance, such as retaining the house, providing positive outdoor spacial sequences, and achieving a design efficiency.

The benefits of the adopted solution were; (1) consolidation and extension of the existing dwelling which complied with best sustainable practice, (2) best layout in terms of defining sunny and sheltered high quality outdoor spaces,

(3) access to morning, afternoon and evening light, for internal and external spaces, (4) obtaining planning permission for an extension was easier than a new dwelling

Environmental, Value Engineering and Teaching benefits associated with keeping house, (5) compliance with vehicular sight lines was not necessary when retaining the house, (6) less onerous compliance with Building Regulations by extending rather than new building, (7) design strategy was more realistic for the available construction budget, (8) bedroom was bigger than required, and could be adjusted to budget constraints, and (9) cluster development better suited to rural housing

The difficulties of the adopted solution were; (1) the distant view of sea was less pronounced.

The most significant communication tools for engaging the client were (1) as the client grew up in the U.S, explaining the historical and cultural importance of the existing house, and making comparisons with American historical struggles such as Civil Rights movement, (2) explaining impact of design layouts on budget, and intermediate phasing options if money were to run out, and (3) optimization of internal and external spaces.

It is interesting to note that the best design is frequently not the thing that engages the client, and that people are often more incentivized to move away from pain rather then move toward pleasure.

6 How the Project is Funded

The N.E.E.S project has committed to funding of in excess of €10,000 to the CCAE to purchase selected natural products and services from approved suppliers for use in the Live Project.

A rigorous screening procedure was carried out in three separate phases to invite interested parties to be recognized and included for dissemination and promotion through the Northern Periphery Region. On this project, six key construction technologies using natural materials are identified as being worthy of inclusion for grant funding under the N.E.E.S project. These areas are; (1) Timber Frame Construction, (2) Hemp Crete external insulation, (3) cellulose insulation. (4) triple Glazed Timber Framed Windows, (5) green sedum roof, and (6) constructed wetland waste water treatment area.

While natural materials have been selected and will be used in this project, the funding available to the CCAE is not sufficient to fund all of these areas.

However, separate funding made available to the South Kerry Development Partnership, the SKDP, through N.E.E.S, has been allocated to record, disseminate and evaluate the use of these materials under two separate publicly tendered projects, to run concurrently with the construction period.

The first project entails recording the use of the above construction technologies through drawing text and film, collating and editing that information for dissemination on the web. The second project entails the analysis and modelling of the proposed building fabric, and comparing the estimated performance of the adopted natural material based construction technologies with standard materials and technologies which would normally be used.

7 Conclusion

Although the involvement of students in the built project is minimal in the physical sense, the influence has filtrated through the school, in the taught modules of applied technology and history and theory.

A number of fourth year applied technology case studies are investigating the NEES 'best practices' in detail prior to on site workshops. Seminars in History & Theory discuss related topics such as; Empowering Community through Participation; A critical analysis of the perception of the profession and Sustainable Lifestyle.

By creating links between practice, research, education; live, pilot and built projects, a series of collaborative techniques are developed across the academic disciplines that are essential and relevant to future practitioners.

Evaluation of a NEES Demonstration Project at Cloyne, County Cork, Ireland

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Abstract

A demonstration project involving a cottage refurbishment and extension in County Cork, Ireland, was evaluated against a given set of criteria, including mass, energy, carbon and cost. The evaluation considered a design incorporating six NEES best practices against conventional construction practices. Broadly, the materials in the specification for the NEES building envelope, as compared against conventional practice, represent the following 'cradle-to-gate' savings:

- 64% in mass;
- 8% in embodied energy;
- 1.4% in embodied carbon emissions: includes biomass emissions as it was not clear that timber was from sustainable sources (i.e. if chain of custody certificates had been specified and provided, carbon savings were calculated to be 19%); excludes positive effect of carbon sequestration which was calculated separately;
- 20% labour saving which is principally due to the greater ease and speed of construction using timber frame over concrete slab and blockwork on mass concrete trench foundations.

Unfortunately the NEES design did not achieve a high Building Energy Rating (BER), and this was principally due to the architectural form and lack of heating controls. As such, while the building can be considered natural, low carbon and arguably more sustainable, it is not considered to be energy efficient.

1 Introduction

The Natural Energy Efficiency and Sustainability (NEES) project is funded by the Northern Periphery Programme. As part of the project, a demonstration project was used to test six of the 'NEES best practices'. The project involved refurbishing an existing Parnell cottage at a rural location outside Cloyne, County Cork, Ireland, and building a new extension. The six best practices included in the demonstration project evaluation were:

1. Timber frame construction
2. Hempcrete external insulation
3. Cellulose insulation
4. Triple glazed wooden windows
5. Green (sedum) roofs
6. Gravel reed bed for wastewater treatment.

2 Objective

The objective was to evaluate the building project as a whole against current conventional practice in rural Ireland, and to draw conclusions about the sustainability of the project and the above NEES best practices. The evaluation criteria were specified by the NEES Project partners at the outset.

3 Method

The architect provided a set of general arrangement tender drawings and some annotated details for the NEES demonstration project. The evaluation involved comparing the NEES design with a 'conventional' design; and, as no drawings or details were provided for a conventional design, the evaluation team devised a comparable specification by matching the architectural form and U-values of the building envelope (i.e. the thermal performance of the floors, walls, roofs). Conventional construction practices were considered to be external blockwork cavity walls, concrete floors, cut timber roof, and petrochemical based insulation products as generally used in rural areas throughout Ireland. The evaluation metrics included mass, energy, carbon and cost.

Energy consumption and carbon emission arise from:

i) making, transporting, installing and disposing of a material - termed 'embodied' energy or carbon emissions

ii) people living in a house using electricity and fossil or renewable fuels - termed 'operational' energy or carbon emissions

With regard to the building envelope, three types of carbon were calculated separately, namely: those arising from the combustion of fossil fuels; those arising from the combustion of biomass; and the amount of carbon that can be stored in timber and cellulose based materials.

The Cloyne demonstration project was evaluated on a 100 year life cycle basis (tender requirement) and with a second technique called carbon profiling (not a tender requirement, but provided as it is perhaps a better method for illustrating the relative merits of carbon assets against the typical lifespans of different building elements).

4 BER Assessment - 'Operational' Results

A Building Energy Rating (BER) assessment was integral to the analysis of the building in use. Although the NEES design cannot be considered energy efficient as it received a D1 rating, it does however represent a significant improvement before the works commenced (see savings outline in table 1). Principal reasons for the poor D1 rating include having larger than normal ratios of window to floor areas, and external surface area to floor areas, as well as not specifying heating controls. Although the heating system can be considered low-carbon, DEAP[1] bases its energy value calculations on primary energy consumed, regardless of the fuel type being renewable biomass or fossil fuels.

[1]DEAP = Dwelling Energy Assessment Procedure, and is the software used to generate Energy Performance Certificates in Ireland, known as Building Energy Ratings or BERs

Table 1: Energy and Emissions Savings from Improved BER

	Before	**After**	**Savings**			
BER rating	G	D1				
Energy value ($kWh/m^2/yr$)	848.02	256.02	592	70%		
CO_2 Emissions Indicator ($kgC0_2/m^2/yr$)	195.29	14.21	181.08	93%		
Floor area (m^2)	55.01	80.4	-25.39	-46%		
Energy value (kWh/yr)	46,649.58	20,584.01	26,065.57	56%	2.24	toe/yr
CO_2 Emissions Indicator ($kgC0_2/yr$)	10,742.90	1,142.48	9,600.42	89%	9.60	tCO_2e/yr

5 100 Year Life Cycle - 'Embodied' Results

Table 2 below presents the summary results of the NEES design against the conventional design with regard to materials and a 100 year life cycle assessment. The 'cradle-to-gate' impact of materials includes extraction or harvesting of raw materials, transportation of raw materials to a factory, and processing these materials into a building material or product. The 100 year life cycle assessment (LCA) adds the remaining life cycle phases to this including: transportation from factory gate to site; construction; operation (house being lived in); and end-of-life (final disposal of building elements).

Based on the assumptions detailed in the evaluation report (Empey, 2014), the materials in the NEES specification: are a third of the mass of the conventional specification; save 8% embodied energy (cradle-to-gate); save 1.4% carbon emissions including biomass emissions as it is not clear that timber is from sustainable sources (i.e. if chain of custody certificates had been specified and provided, carbon savings were calculated to be 19%), and excluding the positive effect of carbon sequestration; and making a 20% labour saving which is principally due to the greater ease of construction resulting from use of timber frame construction (i.e. less use of teleporter to carry heavy blockwork materials, less excavation for larger foundations, quicker erection of timber frame as against conventional blockwork construction).

The transport impact of the NEES specification is 185% greater than that of the conventional, largely because niche products must be sourced further afield (particularly green roof substrate and hempcrete materials). In this respect, the NEES specification needs more careful consideration.

Table 2: Cradle-to-Gate and 100 Year Life Cycle Savings for the NEES Building Envelope Compared to Conventional Construction

Building Envelope Comparison	**Cradle-to-Gate**				**100yr LCA**
	NEES	**Conventional**	**Saving**	**%**	**% Saving**
Mass (tonnes)	57	157	100	64%	59%
Embodied Energy (GJ)	581.4	630.3	4	8%	1%
Embodied Carbon (tCO_2e)					
Fossil & biomass	36.6	37.1	0.5	1.4%	
Fossil only	27.8	34.3	6.5	19%	8%
Fossil, biomass & sequestration	-6.8	26.1	32.9	126%	
Fossil & sequestration	-15.6	23.4	38.9	167%	
Cost(€)	€72,422	€80,000	€7.500	9.5%	
Labour (man days)	179.2	224.2	45	20%	

6 Carbon Profile Results

Mass, energy and carbon profiles were also generated which illustrate 'hotspots' within the building envelope. The three types of carbon discussed above are illustrated in the carbon profiles in figure 1. Carbon sequestration is shown on a negative vertical axis and is slightly greyed out to indicate carbon storage for the typical lifespan of each building part. On the positive axis the fossil fuel and biomass emissions are summed together and show that 53% of the annual carbon profile is embodied, as by having a wood stove the carbon emissions indicated from the BER analysis are very low. If the reader believes that the timber is sustainably sourced and that biomass emissions should be ignored, the dotted red line shows the reduced embodied carbon footprint due to fossil fuel combustion only.

Most distinguishing between the NEES and conventional carbon profiles is that the NEES design has significant carbon storage, and the area of carbon sequestration on the profile more than cancels out the embodied carbon. Both charts indicate a 'carbon profile' number which is broadly the same, but if the carbon sequestration is subtracted from these numbers then the resulting carbon numbers contrast strongly:

NEES 'net' carbon profile number = 30.61 - 17.37 = 13.24 $kgCO_2e/m^2/yr$

Conventional 'net' carbon profile number = 30.72 - 5.19 = 25.53 $kgCO_2e/m^2/yr$

The PAS 2050:2011 specification notes that carbon sequestration can only be accounted for if the carbon can be considered to be locked away for a 100 year period. While it is possible for timber to last well in excess of 100 years if kept dry and well ventilated, a 100 year life of a house extension conflicts with the

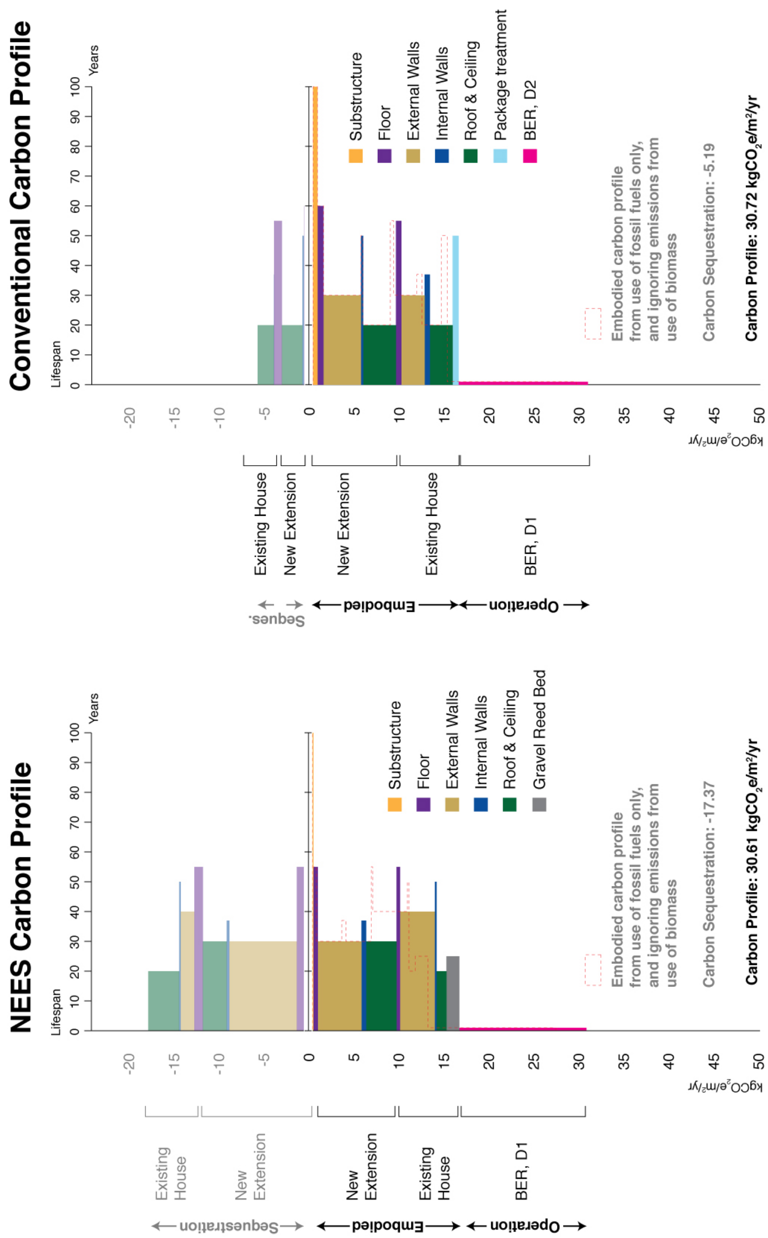

Figure 1: Carbon Profile Comparison of the NEES and Conventional Specifications

typical lifespans used from Building Cost Information Service (2006) [2]

7 LCA versus Carbon Profiling

The Cloyne demonstration project was evaluated on a life cycle basis (tender requirement) and with a second technique called carbon profiling (not a tender requirement, but provided as it is perhaps a better method for illustrating the relative merits of carbon assets against the typical lifespans of different building elements).

Table 3: Comparison of Results (% Proportion Split) from 100 Year LCA and Profiling Methods

	Methodology:			
	LCA		Environmental Profiles	
Proportion split (%):	NEES	Conventional	NEES	Conventional
Embodied Energy	11.3%	11.9%	21%	24%
Embodied Carbon	30.4%	36.1%	53%	54%

Both methodologies give a slightly different perception of the proportion of embodied energy and carbon in the building project: LCA makes difficult predictions about what will happen to the building in the future (i.e. maintenance and end-of-life) whereas the carbon profiling methodology provides a snapshot of the building in time with an infographic which gives explanation of the building as a carbon asset.

8 Biodiversity & Human Health

Impacts to biodiversity and human health were also considered, and while the NEES best practices generally perform well, it is notable that the NEES specification pays no attention to securing chain of custody certificates for timber products, rather, it specifies tropical hardwoods with questionable green credentials (i.e. Iroko for window frames).

With regard to human health, ventilation is considered a disimprovement to conventional practice (which would typically have mechanical extract fans), as moisture build up will increase the likelihood of mould.

9 Wastewater Treatment Results

Due to the extra gravel content, the gravel reed bed has double the mass burden of conventional wastewater treatment systems but compares favourably in terms

[2] PAS 2050:2011, Section 5.5 Carbon storage in products, sub-section 5.5.1: Treatment of stored carbon which notes, Where some or all removed carbon will not be emitted to the atmosphere within the 100-year assessment period, the portion of carbon not emitted to the atmosphere during that period shall be treated as stored carbon.

of cost by presenting a possible 11% cost saving against a comparable biofilter system. Embodied energy and carbon emissions are broadly similar between all options considered. It should also be pointed out that the gravel reed bed requires significantly more space than comparable conventional systems, and the cost of land was not factored into the evaluation.

10 NEES Best Practice Results

In table 4 the main results of the evaluation are summarised.

Table 4: Summary of Results

	NEES Best Practice	Evaluation
1	Timber frame construction	Lower mass, higher embodied energy, lower embodied carbon, esp. allowing for sequestration
2	Hempcrete external insulation	Higher mass, higher energy, higher emissions even if allowing for sequestration NB. The evaluation only considered U-values in accordance with the BER assessment. Hempcrete has other beneficial thermal properties that were beyond the scope of this evaluation, namely thermal mass and thermal inertia (diffusivity)
3	Cellulose insulation	Higher mass, lower energy, lower emissions
4	Triple glazed wooden windows	Lower energy, lower emissions
5	Green (sedum) roofs	Higher mass, energy & emissions as it is an additional building element and not required in a conventional build
6	Gravel reed bed (wastewater treatment)	Higher mass, slightly higher energy, slightly lower emissions

11 Broad Conclusion

In considering the title of the project - Natural Energy Efficient and Sustainable - the broad conclusion to the demonstrator project as against a conventional build is that:

- Yes, the building is more natural

- No, the building is not energy efficient, as it has a low BER rating
- Yes, the building is arguably more 'sustainable' as:
  - People: it attempts to generate jobs locally
  - Planet: it has lower carbon emissions
  - Profit: the cost analysis seems to indicate that the NEES costs are lower than the conventional. In terms of contributing more to the local economy, further consideration is needed to source materials that are required by the NEES best practices more locally

Perhaps a more appropriate title would have been - Natural Low Carbon and Sustainable.

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Vocational Training Based on Natural and Sustainable Criteria

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Abstract

In 1987 the UN World Commission on Environment and Development (WCED) defined the term 'Sustainable development' (WCED, 1987), and nowadays climate change is a great and worldwide challenge. The building industry accounts for 40% of the total energy demand globally (Dixit et al. 2010). Improving building energy efficiency is one of the most discussed topics, but natural materials which have a lower embodied energy have not gained adequate attention. In this paper we presented our work on exploring a training package based on natural and sustainable renewable products and services selected from the NPP regions.

1 Introduction

The NEES (Natural Energy Efficiency and Sustainability) project aims at improving the energy efficiency in existing residential buildings throughout the NPP (Northern Periphery Program) region with renewable materials and natural processes. After 3 calls within the project period, 16 Best Practices (BPs) from the NPP regions were chosen with NEES criteria. In these NEES Best Practices natural and renewable materials, processes or approaches are utilized and synthetic materials and hazard chemicals are minimized. Non-renewable materials can be produced once or develop very slowly over a long period (Berge, 2009). Renewable materials are plant based and therefore can be produced again from the crops. (Berge, 2009). Therefore the NEES Best Practices derived from natural and renewable sources are considered more sustainable than synthetic materials.

To disseminate the knowledge achieved by the NEES project and to ensure the impact of NEES in the long run, to help the producers, installers and service bodies, and the end users of the products and services identified, and to promote the application of NEES Best Practices inside and outside the NPP regions, the NEES vocational training package is developed. The training package can be used to help the above mentioned potential trainees to better understand natural building materials and sustainable design approaches.

2 Survey for training needs

ARTEK designed a survey for training needs to investigate the trainees' needs for training and support. The survey contains 7 questions regarding duration of the training, knowledge contents of the training modules, etc. 5 partners from Ireland, Sweden and Greenland answered the survey.

From the survey it was shown that partners' opinions differ a lot regarding the duration of the training (from 1 day to 3 days). Because potential audience of the training could be from different industries, it is reasonable that their needs are not the same. Trainees' availability for training course could also differ a lot. For instance, self-builders, people working in big companies and small companies, local authorities and housing associations, especially in different countries will have different needs for knowledge and available time for training. Therefore offering training modules with different contents for free choices of combinations of modules is a reasonable solution. Each module should be independent and could be delivered individually.

All the partners who have answered the survey think it is necessary to include some basic knowledge in the training modules. Considering the potential trainees could be non-professionals (end users, people from local authorities and housing associations, etc.), basic knowledge could be quite important for them.

Regarding the contents of the training modules, theoretical introduction, the NEES criteria to choose natural and renewable materials and services, NEES Best Practices and application of the NEES Best Practices are considered necessary to be included in the training modules. Social, technical and business aspects are expected in the training as well. It is shown in the survey that partners with different backgrounds focuses on different aspects, which probably shows potential trainees will also be interested in a variety of knowledge.

In 'other comments', partners suggest the following:

- Financial and state subsidies available in the partner region and financial viability of the products or services should be added.
- The cost effectiveness of using natural materials and the payback time frame, details of what grants are available to install such measures / retrofits, and how the standard can link in to policy approaches (e.g. waste reduction, life cycle assessment, zero waste) and national and EU funding programmes (e.g. IEE, Horizon 2020, LIFE, Interreg) should be added.
- The viability of using local materials and simple technologies available locally to achieve a very high environmental impact, and the fact that this is being already used viably throughout the region (Best Practices) should be included.

It is shown from the survey that since the training could have a wide range of audience; therefore it is not possible that the training is tailored to the needs of specific groups. Thus it is important that the training delivers knowledge in different levels to meet the demand of different groups.

3 The vocational training package

The aim of the vocational training is to promote the technical and business skills of manufacturers and installers of NEES Best Practices and the transfer of the Best Practices within the NPP region with support and training services. In the previous NEES Work Packages the resources available in NPP regions was mapped and the survey results were collected, analyzed and summarized. The NEES external experts reviewed and graded the products and services submitted over 3 calls on the basis of the NEES criteria. During the reviewing process 'natural' and 'sustainable' were always considered. Case Studies of BPs selected showed examples of the application of the BPs. The feasibility of implementation of BPs in each region was investigated and the possible obstacles for implementation of BPs were explored. In each region focus groups composed of experts from local authorities and building industry discussed the possibility to promote the transferability of the selected BPs. The BPs were implemented in NEES demonstration projects (DPs) in each partner region, and the energy efficiency of the DPs were monitored and evaluated. After the selection, transfer and implementation processes, the sustainability and feasibility of the BPs were tested and the scope of the training was broadened. The vocational training package is developed partly based on the BPs and DPs.

The vocational training package includes 6 training modules:

Training module 1: General principles of holistic building and construction design

Training module 2: Housing construction methods and principles, structure and foundations

Training module 3: Housing Envelope 1 Floors and roofs

Training module 4: Housing envelope 2 Walls and Windows

Training module 5: Certification and accreditation

Training module 6: Building Services and water usage

Except for preliminary knowledge such as sustainable material principles and criteria, embodied energy, carbon footprint and energy concepts, etc., house envelope components such as roof, walls, floors and windows using natural and renewable materials and processes are included.

In Module 5, an introduction to the range of approvals, certification and accreditation available for building industry are provided. In module 6, an introduction to building services requirements and options is provided, including low energy lighting, energy efficient appliances, heating systems, renewable options for domestic projects, water recycling and grey water systems and water treatment.

A training manual is designed to facilitate the training modules. The manual contains an overview of each module, a list of the intended learning outcomes, and additional training support material. Principles of sustainable design, NEES criteria and overview of the NEES Best Practices are explained in details in the training manual. The characteristics of renewable materials and the difference between renewable and synthetic materials are introduced. In the training manual along with basic sustainable design principles, knowledge about the natural processes and services selected with the strict NEES criteria is listed, e.g. cellulose insulation which is made from post-consumer newsprint and paper has an embodied energy 8 to 10 times less than synthetic insulations.

4 Conclusions

The work of NEES training is based on the previous NEES work packages, which made the strict sustainable NEES criteria for selecting products and services, and identified products and processes beneficial in each region. To maintain and disseminate the NEES knowledge and technologies, the development of the training package is important for the NEES project. It also ensures the long-term impact of the project achievements. The project criteria ‘environmental, economic and social’ are well reflected in the training package. The survey for training needs answered by partners (mainly university based research institutes who are experienced in training and education) ensured the contents of the training are appropriate and reasonable.

To meet the demand of different audience groups, the integration of preliminary knowledge of energy and building, design principles of sustainability and NEES Best Practice case studies ensured that each target group could follow the training. The idea that training modules are designed stand-alone and can be delivered individually makes it possible for trainees to receive the knowledge they need, and ensures different lengths of combinations of training modules.

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The role of Voluntary Housing Associations in promoting natural sustainable materials in Ireland

Alma Gallagher
Clár I.C.H.

1 Introduction

Community Based Organisations (CBO) such as Clár I.C.H. is a key component of Ireland's social economy. Clár I.C.H. delivers energy efficiency retrofits to low income families at risk of fuel poverty. The primary motivation is not to make profit, but rather to generate benefits for Co. Mayo by targeting interventions to families and individuals are most needed. A key objective of Clár I.C.H. is the provision of social housing to older people and people with disabilities. With a housing stock of over seventy units, Clár I.C.H. is in a strategic position to pilot many of the Best Practices identified by NEES. Clár I.C.H. not only builds houses but seeks to build sustainable communities. By showcasing NEES Best practices. Clár I.C.H. incentivises local communities to experience at first hand the benefits of using natural materials in construction methods and energy conservation. As a delivery agent for labour activation schemes Clár I.C.H. created opportunities for participants to increase their knowledge in using natural materials in construction. These unique training opportunities increased participant's employability. Funding has also been accessed through European programmes, charities, and through leveraging the unique skills CBOs have acquired to run training courses and associated activities. Mayfield Lake Development became a demonstration site for NEES enabling Clár ICH to disseminate the NEES principles to local communities and specifically Voluntary Housing Associations concerned with the provision of social housing in their local communities.

2 Objectives of Clár I.C.H.

Clár I.C.H is a Voluntary Housing Association established in 2000 to develop social housing projects to benefit older people, people with disabilities and those living in London wishing to return home. Clár I.C.H. has two key objectives; to carry on, for the benefit of the community, the provision of housing and associated amenities for persons in deprived or necessitous circumstances to provide for the relief of poverty and deprivation caused by poor housing conditions.

3 Clár I.C.H Services

- Sponsors of a Community Services Programme employing a Manager and 5 full time employees
- Development of a 36 Sheltered Housing Scheme and communal facilities for older people and people with disabilities at Mayfield, Claremorris
- Warmer Home Scheme: Clár I.C.H is contracted by S.E.A.I. to provide attic and cavity wall insulation services to those identified as living in fuel poverty
- Sponsors of the Senior Alert Scheme facilitating the elderly to apply for funding for Socially monitored alarms and associated security and lighting systems
- Clár I.C H sponsored a Rural Regeneration Scheme which provides accommodation for families on the outskirts of Claremorris
- Promoters of the Care & Repair Programme delivering a minor repairs service in the homes of the elderly in the South West Mayo catchment area
- Advocates of the principles of sustainability.

4 Benefits of the Unique CBO Approach to NEES.

Government has identified the need to retrofit one million Irish buildings by 2020. This ambitious goal generates significant opportunities for CBOs to leverage their unique skills to act as a delivery agent of retrofit, but challenges must also be overcome.

The opportunities are as follows:

- There remain over 300,000 vulnerable households “at risk of fuel poverty” who would benefit from a retrofit using natural insulation materials;
- Identify those most in need is a key policy challenge in order to target scarce government resources where they are most needed;
- The launch of Better Energy in 2011 heralds a transition to a more market-driven approach to promoting retrofit activity, opening up new potential avenues of collaboration between CBOs and energy suppliers such as Electric Ireland, BGE, Airtricity; and
- New areas of activity are opening up in the retrofit sector in response to technical developments, and CBOs can increase the range of services they provide. CBOs have the capacity to do more than they are currently doing whilst disseminating the NEES message from a bottom up approach.

- With the worldwide recession, rising fuel prices, and the introduction of carbon taxes, Fuel Poverty has become a priority in Europe. The Irish CBO model can be replicated throughout Europe to address Fuel Poverty.
- Using natural materials in energy conservation and construction can be the catalyst in generating local economic growth, stimulating employment and local development.

CBOs rely on various labour activation and labour intervention schemes to cover the wages and some administrative costs of retrofitting works. The schemes used include:

- The Community Employment Scheme;
- The Tús Initiative;
- The Rural Social Scheme;
- The Community Services Programme.

CBOs do not employ people to retrofit homes; rather they retrofit homes to employ people, and to tackle other social issues. In the region of 60,000 of the households suffering most acutely from fuel poverty are living in warmer and healthier homes as a result. Additional co-benefits have arisen from this unique community based, community led approach to retrofit are as follows:

- Economic benefits and opportunities generated from CBO activity is most pronounced within the local area itself, where it is most needed;
- CBOs are in a unique position to identify households most in need because of their unique network of contracts in local communities and they provide a unique value added when linked to other social services;
- Nearly 3,600 of the most vulnerable in society have been trained by CBOs to deliver retrofits and have therefore been drawn back into the labour markets;
- The CBO approach develops an enterprise culture in local communities by enhancing the capacity and management skills of employees and trainees;
- CBOs undertake retrofits to the highest standards of quality assurance as annual audits of their activities demonstrate; and
- Community retrofits reduce arrears on electricity bills and bad-debts by helping householders manage energy bills; they also alleviate the negative health impacts which are associated with living in poorly insulated housing

At national level, one CBO, Energy Action developed Irish training modules in Insulation, Energy Advice and Building Energy Ratings. This created local training jobs for Irish trainers and significant savings to the Exchequer, as foreign trainers and modules were not required.

5 Mayfield Lake Development - NEES Demonstration Site

Profile:

Mayfield Lake Development is located in Mayfield, Claremorris, Co. Mayo. Located on the shores of Mayfield Lake, the development offers thirty six units of accommodation to local people of Claremorris, older people and people with disabilities, as well as those wishing to return from abroad through the Safe Home Programme. The aim of Clár I.C.H Ltd. is to promote a national showcase in the construction and provision of quality social housing for the people of Claremorris. Onsite support services such as a hot meal, laundry services, recreational and social services will also be delivered from the communal building in due course. Mayfield Lake Development is idyllically located on a circa of 4.5 acres on the Claremorris town boundary and is well serviced by retail, community and local amenities.

6 NEES Best Practice 1: Mud and Wood:

Mud and Wood offers courses an environmentally-friendly, sustainable, natural building and design. Specialising in earth construction (cob) and salvaged timber using natural, healthy and ecologically sound materials and methods. Mud and Wood delivered training in cob building to participants of the Community Employment Scheme, Tus and RSS. Participants used the skills to build a community owned Pizza Oven located adjacent to community horticultural site celled Growing Locally. Participants were up skilled in the following areas:

- Components of Cob
- Straw mixing
- Cost benefits of using cob in construction
- Environmental benefits of using COB
- Cob and Craftsmanship
- Cob as an insulation material

7 NEES Best Practice 2: Ecocel

Clár ICH used Ecocel as the insulation material in the communal building Mayfield Lake Development. Ecocel is cellulose is an insulation product manufactured entirely from recycled newspaper - a natural product designed to minimise energy loss more effectively than mineral fibres. Ecocel is made from natural fibres derived from recycled newspapers which might otherwise end up in a landfill. Ecocel contains some 50% carbon dioxide. As a result, a timber framed house, insulated with Ecocel, acts as a carbon sink, sequestering many tons of CO2. Ecocel has a very low embodied energy. Ecocels components are non toxic, non irritant and environmentally benign. It also requires relatively little energy in production and does not pollute water, air or soil. It can easily be removed and reused, and can ultimately be returned to the earth (i.e. composted).

8 Conclusion:

Community Based Organisations are committed to working together and evolving to meet these challenges and to avail of opportunities for increasing their areas of activities. One such area is to harness the learning from NEES and influence policy nationally encouraging the use of natural insulation materials in the Better Energy Warmer Homes Scheme and construction materials in social housing stock. Government policy is increasingly defining the role of CBO's as a stimulation tool in employment and retrofitting. Natural and Sustainable materials need to be a key principle on the agenda. The following areas may be considered for further discussion:

- Establish a Social Enterprise Unit within the Department of Enterprise, Trade and Employment and ensure that the right support structures are available to CBO's such as County Enterprise Boards, Enterprise Ireland and Business Innovation Centres.
- Modify Procurement guidelines by inserting a social clause in to facilitate a greater role for CBO's; developed a procurement support programme to assist social enterprises, and ensure that CBO's are incorporated into the economic planning and development strategies of local authority.
- Incentivise the social housing sector to consider alternatives to the traditional construction methods by encouraging use of natural material as insulation products and building materials.

Challenges of building in the Arctic

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Abstract

This paper deals with the challenges of building in the Arctic. These challenges are primarily caused by severe climate conditions in the form of heavy winds, snow and ice and a cold climate. In addition there is the very low sun and little solar radiation in the middle of the winter and midnight sun in the summertime. It is also challenging to design your settlements and towns, so that they establish protection against wind. For example, high-rise buildings of course don't protect against the wind, and have long shadows. In addition to the natural challenges there is also a weak and expensive infrastructure also ex by the climate and often with long distances. The Arctic region also have a small market and small populations. And with long distances to other markets.

1 Introduction

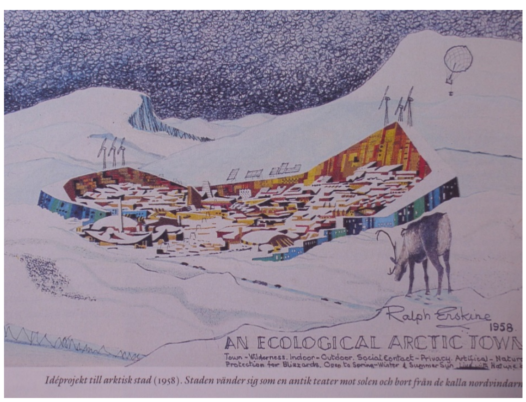

Figure 1: Ralph Erskine An Ecological Arctic Town 1958

Building in the Arctic faces many challenges. These are primarily caused by severe climate conditions in the form of heavy winds, snow and ice and a cold climate. In addition there is the very low sun and little solar radiation in the middle of the winter and midnight sun in the summertime. Settlement and town planning is also challenging as protection against the wind. For example, high-rise buildings of course don't protect against the wind, and have long shadows. In addition to these challenges, there is also the challenge of a short building period each year, as there are winter conditions 8 month of the year. And also during the lifetime of a building it is important that detailing are "climate-responsible". These also affect the frequency of your maintenance and renovating . In many ways every building is created under “Test-conditions”. If you fail in the overall design and detailing, many things can go very wrong. Very fast! It is an extreme climate. With extreme demands. All these conditions and challenges are resulting in often very high building prices. That again often results in a lower standard than would be preferred or recommended. Also in a sustainable context. Thus the insulation thickness is often reduced to a minimum, resulting in higher energy-consumption. This to get lower building prices.

But also other problems occur. Knowledge relating to building-physical rules is very important. Condensation and leaks, where you did not expect them. From a point of sustainability, hydro power is getting more common, replacing fossil-fuel. But because of bad insulation standard, too much of the hydro-power is used for heating. Luckily heat-pumps, taking energy from the rock-underground or from the air have started to get used. Especially where you have waste heat to store, rock-heating is very efficient.

2 Background

Figure 2: Sir Francis Hall 1865: Arctic researchers and life among esquimaux

The challenges will be presented by some examples. Snow is of-course the traditional building material in the high north in the form of the famous igloos. Especially when travelling in wintertime.

In Nuuk we have, like in many other northern winter-cities, for some years used snow for art in form of snow-sculpting.

More traditional buildings such as peat houses are probably known and were more common until shortly after WWII. Even with a modern design.

But with a much higher population and higher demands to your buildings, peat houses are not the solution for today. And from a sustainable point of view, the peat is not suitable as the recovery time for the peat, where it is taken, is many, many years, and are thus hurting the nature, and can in addition start soil-erosion.

When designing a traditional peat house, or igloo as well, the entrance is low and the living room (Illeq=sleepingshelf) is above ground. That is because

Figure 3: A Lego-castle was created in front of Tegnestuen Nuuk

Figure 4: A snow sculpture called "Impact" in form of a snow cube put to balance at its top. Sculpture by Tegnestuen Nuuk.

Figure 5: Une igloo sur l'internet. The first and only igloo in the world with a telephone plug with access to the internet.

Figure 6: Une igloo sur l'internet. Interior. Nuuk snow festival.

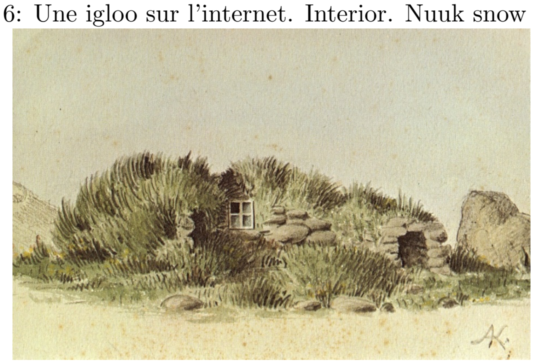

Figure 7: Watercolour of a peat house in South-Greenland. Andreas Kornerup.

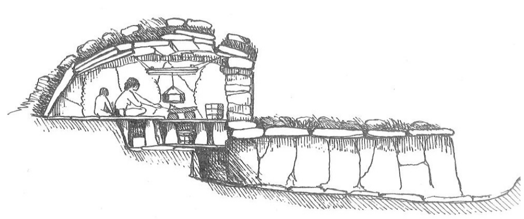

Figure 8: Section of a peathut

the warm air is rising, and the cold air is going down. Therefore the entrance is made to serve as a cold-grave, to catch the cold (c.f. fig 8).

That principle is also working in a modern flat, even if you choose it or not. If it is a semi-detached row-house, living rooms therefore should be upstairs, the kitchen in the middle and sleeping rooms downstairs.

Figure 9: The food pyramid.

The "food-pyramid" (Mad-pyramiden) (fig. 9) are very well-known in the Nordic countries. Especially marketed by Nordic COOP. It is telling what is healthy to eat. Eat little from the top and mainly from the bottom.

A similar pyramid has been made by Husbanken (The housing bank in Norway) concerning energy. Called the Kyoto-pyramid (fig. 10). It tells from the bottom:

1. Reduce the heat loss. Most important!
2. Reduce the consumption of electricity.
3. Use the solar energy.
4. Show and regulate the energy-consumption
5. Chose energysource. Less important!

3 Building components

If you divide your building up into roofs, facades, walls and foundation they each have their own individual challenges:

Concerning roofs, more or less flat roofs are to be recommended in a windy area. Snow will blow away. And choosing between a warm roof or a ventilated roof, a ventilated roof is to prefer, if there will be a risk for snow accumulation at the roof. Snow are insulating likely as well as normal mineral wool insulation.

So it has to be with such a thickness on a warm roof, that it will prevent the snow from melting into water. Because when the snow layer is getting thinner

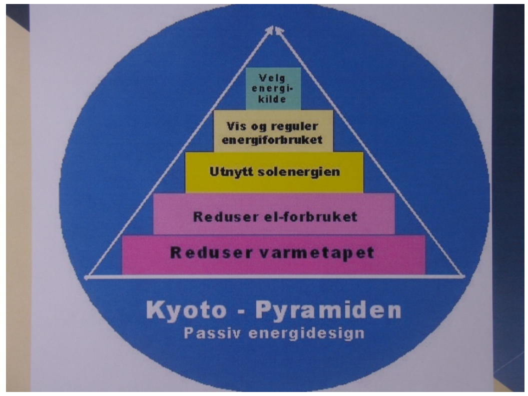

Figure 10: The Kyoto pyramid

Figure 11: Spoiler at roof at hospital in Nuuk to remove snow by wind

at the edges and insulating less, the water will freeze again here and establish an ice dam, filled with water. That could find a leak in the roof construction. Therefore, it is preferable that the roof is cold and more or less flat, so the snow will blow away.

That is safest with a traditional ventilated roof, from where you from the inside in addition can inspect your roof for leaks and mould etc. if the attic are dimensioned for that. But you have to ventilate the attic without allowing drift snow to penetrate into the attic.

In facades it is important to have a wind barrier behind your cladding or panelling to protect your insulation and construction from cold wind and water penetration.

For many years there have been used gypsum-boards for that purpose. Special gypsum-boards for exterior purpose, impregnated with silicone. And the gypsum core protected by a layer of cardboard. But time have shown, that they are not so attractive and useful, as we first believed. In many ways the opposite.

From a point of sustainability gypsum are recycled from waste from another production, among others from power production. But after some year we found

Figure 12: Snow removal from roof of Culturehouse in Nuuk, Greenland

out, that there were big problems with the product. The instruction from the manufacturer is often not followed, but the product itself is also a problem in this climate.

If they are exposed with rain, and with frost right after, the cardboard are loosening gradually, and after some years the cardboard have disappeared. And slowly the gypsum is crumbling away. At many places these boards are now changed to more suitable products.

SBI/ Danish State Building research Institute do not recommend the use of exterior gypsum-boards at buildings close to the coast and at high-rise buildings under Danish conditions. All building sites in Greenland are close to the coast. And in a much more tough climate. Anyway the product is still used. And sold!

Figure 13: Building in Nuuk, where exterior gypsum boards have blown away

Foundations in Greenland are very often made on rocks, with a crawlspace. But very often it is not drained satisfactorily. And therefore, causes mould in the construction. Ideally the crawlspaces should be heated and treated like any other room in the building. It should be considered as a basement, insulated, heated and connected to the ventilation system of the rest of the building. As the Danish Working Environment Authority demand a free height in the crawlspace to be 130cm for working, it should be more convenient to construct the foundations as a ground slab. And also more safe, naturally on the premises, that it is constructed according to the guidelines.

4 Sustainable city

It is a big issue to develop Nuuk as a sustainable city. To obtain that you need short distances in your daily life. Walking or bicycling from your home to work or to school. Or kindergarden. And also during the day you benefit from short distances. When visiting friends or shopping. Or going to the library or culture house.You save time and energy during the day. And in addition to a sustainable town, you obtain a healthy town. To obtain that in Nuuk, you could move the existing airport, that suffer very much from turbulence, already with accidents, to a location 15 km south of Nuuk. And use the existing airport area for housing, business and recreation. Already there are some electrical cars in Nuuk and tests have been conducted with hybrid-buses.

Figure 14: 14. Existing airport area in Nuuk transformed to housing, business and recreation. Proposal by Tegnestuen Nuuk.

Best Practice in The Northern Periphery

Derek Bond, Elaine Ramsey and Norry McBride
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1 Introduction and Background

The submission was based on the experiences of a transnational team of experts working in the northern periphery of Europe. They were members of the European Regional Development Fund (ERDF) INTERREG IVB Northern Periphery Programme (NPP), Natural - Energy Efficiency - Sustainable (NEES) project.

1.1 Background

The triple helix NEES project team were based in the Republic of Ireland, Northern Ireland, Scotland, Sweden and Greenland. The team were supported by a transnational panel of experts. The aim of the NEES project was to explore the challenges and opportunities that adopting sustainable building techniques offers to the various regions of the NPP area. To achieve this NEES was involved in identifying 'best practice' and using pilot projects to demonstrate the viability and benefits of the techniques. The transferability of the 'best practice' was also evaluated. Given the importance attached to knowledge transfer by the NPP, NEES was also involved in developing dissemination and training modules.

2 Best Practice

2.1 Identifying 'best practice'

'Best practice' was identified by using both the expert knowledge within the consortium and by proactively seeking expressions of interest from companies within the NPP region to take part in the pilot projects. Expressions of interest in involvement in the pilot studies were assessed by an independent expert panel using specific criteria which included: resource efficiency, environment and health, sustainability, enterprise and scalability.

2.2 Pilot 'best practice' projects

The first NEES call for Best Practice resulted in six examples of what the experts termed 'best practice' being identified. The projects identified were:

- An architectural practice which specialises in timber design. They use locally sourced and produced timber, (organic and reused) as well as an organic, pre-painted timber cladding, natural paints and hemp.

- A SME manufacturing and assembling highly ecological houses. They supply recyclable and biodegradable products, processed and manufactured within the NPP region, with an expected lifespan of 60 years.

- A company specialising in green roofing and living walls. Their materials are fully recyclable or biodegradable and expected to last a minimum of 30 years.

- A company specialising in cob and salvaged timber construction and associated training.

- A cellulose fibre insulation company. The insulation derives from locally sourced, highly recyclable and biodegradable, recycled paper that has an expected lifespan the same as the building.

- A business who provides a design, consultancy and planting service for constructed wetlands. The solutions the company offer are both natural and biodegradable.

The examples share common attributes. Wherever possible the materials used are natural, recyclable, biodegradable, environmentally friendly, healthy, sustainable, energy efficient and sourced locally. They demonstrate a significant level of enterprise and possess the potential for future expansion, thus creating jobs and contributing to the local economy.

2.3 Identified examples of Best Practice

This section outlines examples of best practice which have been identified by the project partners in their regions.

2.3.1 Scotland

The Galson Business Centre on the Isle of Lewis is seen as nearly 'carbon neutral'. It uses a Scottish-sourced timber frame free of chemical preservatives and organic painted timber cladding insulated using hemp. Natural paints are used throughout the building. Flooring is a mixture of Scottish linoleum and good quality hardwood. The building has high levels of insulation, thermal-bridge-free detailing and a high level of airtightness. Any heat needed is delivered from an under floor system fed by a ground source heat pump, powered by a wind turbine. Inspired by older vernacular buildings, the building uses a clipped and hipped roof form to reduce heat loss and strain from the strong winds. The building was designed using the principles of 'Design for Deconstruction'.

Historic Scotland has found that natural stone is a low carbon building material compared to other construction materials used in the UK. The main carbon impacts associated with stone come from the processing of the stone, transport to site and the volume of waste. The quarrying and processing of local sandstone and granite has a relatively low level of energy intensity. In addition, for stone used to maintain buildings, the different physical properties of using stones from different deposits to the original can result in serious damage to the building as it weathers.

2.3.2 Northern Ireland

In Carnlough, eleven houses were constructed using timber frame, hempcrete walls, PV panels and mechanical ventilation heat recovery systems. To insulate the houses the primary material used was sheep's wool along with cellulose in certain positions.

2.3.3 Ireland

In Sligo, a house has been constructed using monolithic cob (earth) walls for the south and west elevations and insulated timber-frame with straw bale infill on the north and east sides. The roof is insulated with a combination of salvaged insulation and wood-fibre. The windows on the north and north-west elevations and the roof-lights are triple-glazed. The house is naturally ventilated and uses a range of natural materials including local stone, lime mortar, LECA, locally salvaged slate and hemp=lime render. The embodied energy of the building is virtually zero as the cob was sourced on site and was used as a building material in its raw state. All of the timber used in the house is from locally sourced windfall trees or reclaimed from local demolitions and recycling yards.

In Westport a house is being constructed using a range of natural materials and is designed to comply with the energy demands of the Passive House Standard. It is of timber frame construction with cellulose infill insulation and fibre board panels. To comply with the Passive House energy standard, the house incorporates features such as a mechanical heat recovery ventilation system, triple glazed (timber) windows, 'super'-insulation (using natural materials where possible) to achieve fabric U-values of $< 0.15\text{w/m}^2\text{K}$, airtight construction to achieve an air permeability of less than 0.6 air changes per hour and the inclusion of solar panels for water heating.

2.3.4 Sweden

In Sweden many companies are experimenting with sustainable construction. For example, Lindbäcks bygg industrially produce blocks of flats from locally sourced timber. Älvsbacka Strand in Skellefteå is an example of such a construction. The block of apartments was built using a high-tech method of timber construction from locally sourced wood. The method is suited to the Nordic conditions, with a newly developed weather-protection technology that allows construction to take place even in extreme weather conditions. The method of manufacturing the timber frame itself saves 270 tonnes of carbon dioxide compared to conventional concrete frames.

Villa Dario, a two storey villa, is considered 'best practice' though some of the materials used cannot be considered to be natural and sustainable. It is built in a V formation facing south in order to use the sun's heat. The foundation consists of a 400 mm thick layer of foam and the walls have a layer of 370 mm of pine wood fibres. This results in low permeability to air and high heat storage capacity. A 500 mm thick layer of locally sourced, loose pine-wood fibres was placed in the ceiling.

2.4 Greenland

The timber based low energy house in Sisimiut illustrates the problems of extreme climate. It is difficult to construct a fully sustainable building in Greenland due to the harsh climate. The building is equipped with a solar collector that supplies heat to the domestic hot water system and delivers auxiliary heat to rooms in the building. Triple glazed windows were also installed along with ventilation with heat recovery capacity.

3 Barriers

3.1 Key issues

The keys issues identified relate to:

- lack of knowledge transfer;
- inadequate planning regulations and building regulations aimed only at insulation neglecting the role of mass;
- lack of locally available materials;
- lack of support from Enterprise Boards and other development bodies for SME's working with these technologies;
- lack of organisational and business skills on the part of SME's that are working with these technologies;
- transportation costs to acquire sustainable building materials;
- lack of accreditation for some materials (e.g. NSAI Agrement certification for Ireland) that will allow SME's to market them or to secure Government funding for their installation;
- inability to accurately calculate and justify the business case for the use of sustainable low carbon materials in buildings.

3.2 Knowledge transfer

Given the heavy investment in training, technology and research relating to standard methods, such as concrete based products, there is a general bias to using these methods.

Many traditional crafts and trade skills needed for alternative methods have declined and the capacity to train new craftspeople is being lost. The existing crafts and skills are widely dispersed making sharing of knowledge and expertise difficult.

3.3 Lack of information

Uncertainties over the figures for embodied carbon for the end of life phase of the life-cycle of traditional building materials, especially makes it is difficult to compare and justify the business case for the use of alternative sustainable building materials.

3.4 Supply issues

In many remote areas, such as Greenland, all building materials have to be imported and this causes a substantial environmental impact through the high carbon energy consumed by transportation.

3.5 Thermal mass

There is evidence that properly insulated and high mass construction could provide significant heating benefit and, in a warming climate additional cooling load reduction. While the effect is larger in the warmer parts of the UK (i.e. Southern England) than in the northern periphery, future proofing for climate change would greatly benefit from a combination of high thermal mass and insulation requirements.

4 Conclusions and Recommendations

4.1 Knowledge transfer

Knowledge transfer is extremely important but is being hindered by the geographical dispersion of the remaining traditional building industries and those involved in sustainable building. At present there is a lack of independent, reliable advice available. One potential solution is to fund the development of regional knowledge exchange hubs through which to manage support for the sustainable construction industry. Alternatively, agencies that currently support regional development and small enterprises could be encouraged to provide appropriate technical, business and financial support. In addition the development of certifiable educational programmes in sustainable construction will help stimulate interest, raise standards and increase the capacity.

4.2 Policy changes

Updated building regulations are needed which place a higher emphasis on sustainability in conjunction with energy efficiency. Furthermore, to maximise its potential, the UK needs to provide a stable investment environment for sustainable construction such as tax or rate relief.

4.3 Locally sourced materials

Transport of materials over long distances can have high carbon footprints.There is a need to develop the supply of locally-sourced sustainable materials and encourage consumers to select them so as to minimise this carbon cost. Despite the transport costs of alternatives, high quality sustainable local materials may well be more expensive and whether there are fiscal methods to address this needs to be investigated.

4.4 Conclusion

The countries in the NPP region generally face opportunities and challenges similar to those in Northern Ireland and can provide suitable examples of best practice. NEES has pre-existing links in these regions meaning they can help facilitate the transfer of knowledge to Northern Ireland.

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