rethink
recycle
remake
rx3

# Review of Market Potential for Cellulose Insulation Products

*working to create*
***markets for recycled materials***

Comhshaol, Pobal agus Rialtas Áitiúil
Environment, Community and Local Government

# Review of Market Potential for Cellulose Insulation Products

rx3
Floor 2 Block 2,
West Pier Business Campus,
Dún Laoghaire,
Co. Dublin.

Telephone: 1890 RECYCLE 1890 732925
Email: info@rx3.ie
Website: www.rx3.ie

rx3 is funded by the Department of the Environment, Community and Local Government

Review of Market Potential for Cellulose Insulation Products

Published by rx3

Disclaimer

rx3 has taken due care in the preparation of this document to ensure that all facts and analysis presented are as accurate as possible within the scope of the project. However rx3 makes no warranty, express or implied, with respect to the use of any information disclosed in this document, or assumes any liabilities with respect to the use of, or damage resulting in any way from the use of any information disclosed in this document. While care has been taken in the production of the publication, no responsibility is accepted by rx3 for any errors or omissions herein.

This document does not purport to be and should not be considered a legal interpretation of the legislation referred to herein.

# TABLE OF CONTENTS

# LIST OF FIGURES



# LIST OF TABLES

# ACKNOWLEDGEMENTS

rx3 wishes to thank the following organisations that contributed to the study: the European Committee for Standardization (CEN), Central Statistics Office (CSO), Cygnum Timber Frame Ltd., Department of the Environment, Community and Local Government (DECLG), Ecocel, Excel Industries Ltd., National Standards Authority of Ireland (NSAI), Office of Public Works (OPW), Sustainable Energy Authority of Ireland (SEAI) and installers and suppliers of thermal insulation.

# ABBREVIATIONS

| | |
|---|---|
| ASTM | American Society for Testing and Materials |
| BER | Building Energy Rating |
| CE | Conformité Européenne |
| CEN | Comité Europeén de Normalisation (European Committee for Standardization) |
| CIMA | Cellulose Insulation Manufacturers Association |
| CIP | Cellulose Insulation Product |
| $CO_2$ | Carbon Dioxide |
| CPR | Construction Products Regulation |
| DEAP | Dwelling Energy Assessment Procedure |
| DECLG | Department of Environment, Community and Local Government |
| DIY | Do it yourself |
| EC | European Communities |
| ECTI | Electro Technical Council of Ireland |
| EEA | European Economic Area |
| EN | European Standard |
| EOTA | The European Organisation of Technical Approvals |
| EPA | Environmental Protection Agency |
| EPBD | Energy Performance of Buildings Directive |
| EPS | Expanded Polystyrene |
| ETA | European Technical Approval |
| EU | European Union |
| EUEB | European Eco-labelling Board |
| GHG | Greenhouse Gas |
| GPP | Green Public Procurement |
| hEN | Harmonised European Standard |
| ITFMA | Irish Timber Frame Manufacturers Association |
| K | Kelvin |
| Kgs | Kilogrammes |
| kT | Thousand Tonnes |
| kWh | Kilo Watt Hour |
| $m^2$ | Metre Squared |
| MDG | Market Development Group |
| NEAP | Non-domestic Energy Assessment Procedure |
| NNI | National Newspapers of Ireland |
| NSAI | National Standards Authority of Ireland |
| NZEB | Nearly Zero Energy Building |
| OCC | Old Corrugated Cardboard |
| PPE | Personnel Protective Equipment |
| prEN | Proposed European Standard |
| PUR / PIR | Rigid Polyurethane / Polyisocyanurate |
| SEAI | Sustainable Energy Authority of Ireland |
| SME's | Small and Medium Enterprises |
| SR | Standard Recommendation |
| T | Tonnes |
| TAS | Technical Assessment Specification |
| TGD | Technical Guidance Document |
| UNFCCC | United Nations Framework Convention on Climate Change |
| W | Watts |
| WG | Working Group |
| XPS | Extruded Polystyrene |
| UEAtc | European Union of Agrément Institutes for Construction |
| USA | United States of America |

# GLOSSARY OF TERMS

**High Grades** means wood-free recovered paper, typically collected from offices and printing houses.

**News and PAMS** means newspapers, periodicals and magazines.

**Post-consumer Paper** means waste paper produced by material consumers, where waste generation did not involve the production of another product.

**Pre-consumer Paper** also known as post-industrial waste, or industrial scrap, refers to waste generated during converting or manufacturing processes.

**Thermal Bridging** occurs where there is a gap between insulating materials and structural surfaces in a building causing heat loss. This is also known as cold bridging.

# EXECUTIVE SUMMARY

In Ireland there is no major infrastructure for paper recycling and waste paper is mainly exported for recycling and recovery which results in an over reliance on the export market. This means that Ireland is particularly susceptible to any events global or otherwise that impact on the recyclables market. The creation of internal markets for recyclables is a way to offset some of these potential adverse effects.

The rx3 programme identified the development of markets for cellulose insulation products (CIPs) as a key area of investigation for a number of reasons. Cellulose insulation is made from waste newspaper which can be sourced in Ireland and used to make the product in the domestic market. It is a high added value product, makes good use of waste newsprint and contributes to national recycling targets. Cellulose insulation is also an energy saving product; there is currently significant funding allocated to the promotion of insulation in Ireland which is expected to contribute to energy efficiency targets.

A market for cellulose insulation products currently exists in Ireland, however there was limited information for its potential to provide a reliable outlet for recycled paper.

A desk study was carried out to review current literature and technical reports on CIPs to identify the benefits, barriers and opportunities to market development. The insulation market and the share of cellulose insulation were investigated, as was the availability of waste paper feedstock. A comparison of the different properties of a range of insulation products was performed. A review of regulatory drivers for insulation demand was carried out and the impact of standards, eco-labels and green procurement in stimulating confidence in cellulose insulation, as a recycled product. Stakeholder consultation and site visits were also carried out to garner further information for the study.

The study showed that there are a wide range of thermal insulation products on the market in Ireland each with their own particular properties and characteristics. A product should be selected based on its suitability to the building type and on the occupier requirements.

Cellulose Insulation was found to be competitively priced in relation to other insulating materials which makes it an attractive option for installation. The cost of installation of the cellulose insulation may vary as there is the potential to self install (attics only) or to engage a professional installer. The material must be installed correctly to ensure that the required U-value is achieved.

There are instances where insulating materials are specified by depth of material. It is critical that thermal insulation is always specified by U-value rather than thickness in order to gain the maximum benefit from the insulating material.

The green credentials of cellulose insulation were also found to be a benefit when selecting an insulating material to use. Cellulose insulation made from waste newsprint has a low embodied energy, is also considered to be less of an irritant during the installation process and it maintains a long term healthy environment within a building. The increasing trend towards green eco-conscious purchasing decisions puts cellulose insulation in a good position. Cellulose insulation products manufactured in Ireland are available to purchase which provides further environmental and community benefits through locally sourced newsprint and reduced transport impacts.

The study demonstrated that there is sufficient high quality waste newsprint generated in Ireland which could be made available for use in cellulose insulation production. The National Newspapers of Ireland (NNI) and local community may be good sources of high quality pre and post-consumer newsprint feedstock for indigenous manufacturers.

Certification of a cellulose insulation product is important to gain access to markets. European standards are currently being developed for cellulose insulation products and are due to be published in 2014. Draft versions of these standards are available however these can change prior to the publication of the final versions. It would be advantageous for cellulose insulation manufacturers to access the draft standard in order to prepare for the full standard which will supersede any existing national certification systems.

It is a recommendation that cellulose insulation products obtain appropriate third party certification until the harmonised standard prEN 15101-1 for in-situ formed loose fill cellulose insulation products is published. This certification will enable access to the market for the product, and it will ensure ease of transition to the new harmonised standard when it is produced. There are a range of other existing standards which must be met by manufacturers of cellulose insulation products until the harmonised European standard is in effect.

The main applications for cellulose insulation at the current time in Ireland are in the roof, attic and walls of timber frame builds. It is also used in floor applications but less so than in roofs, attics and walls. It is also used in the attics of non-timber frame buildings especially in retrofit applications. However it is predominantly used in the timber frame building market. The requirements of I.S. 440:2009 Timberframe Dwellings should be complied with in timber frame construction.

In Ireland cellulose insulation is installed using the dry blown method. The wet spray wall market is not developed in Ireland and it is considered by industry that this an area which is unlikely to develop as it is a challenging and more time consuming process than dry cellulose insulation installation.

In timber frame builds it is typical that the insulation is installed after the building has been erected. However timber frame walls pre-insulated with cellulose insulation, which are manufactured in Ireland, can be purchased for building construction.

Over 1 million private houses in the current housing stock were built with low levels of thermal insulation prior to the introduction of the building regulations. SEAI data indicates that in the region of 100,000 private houses have upgraded their insulation through the current insulation grant programme. Private households also install thermal insulation outside of the government grant programme; however there is no clear data on the number of households or the degree and type of insulation measures installed. Based on the available data on private households it shows that there are still a significant number of households requiring insulation in order to bring them up to current building standards.

The local authority and voluntary social housing stock which is estimated at 150,000 units is also undergoing retrofit activity. Consideration of cellulose insulation as a retrofit insulating product in line with green procurement objectives would be dependent on products obtaining the appropriate certification.

Additionally there are public and commercial buildings pre-dating 2006 that require thermal insulation to current building standards. With the continued government commitment to drive energy efficiencies to meet EU and national 2020 energy targets of reducing energy consumption by 20% through continued energy efficiency schemes; there is potential for cellulose insulation to take a share of the retrofit of these houses and public and commercial buildings.

The retrofit ceiling insulation market is dominated by the fibreglass market and pre-dating the retrofit grant scheme the ceiling insulation most commonly used was again fibreglass. Due to this fibreglass dominance the cellulose insulation share is very small however this can be increased as consumers become more open to a “new” material such as cellulose insulation and understand the additional benefits such as soundproofing, environmental and health and safety.

The current SEAI insulation grant system is based on policy which encourages deep retrofit of buildings and it is not possible to receive grant aid for attic insulation alone. When the grant system comes to an end and the “Pay as you Save” scheme commences policy will continue to encourage multiple insulation measures, however it is likely that attic insulation will be a key part of retrofit activity.

A properly insulated roof can bring energy savings of 30-35% and financial savings of 20%, this is a significant benefit to homeowners and will help achieve national and EU energy targets. It has been reported by suppliers and installers of insulation that many homeowners request attic insulation only. It is recommended that any “Pay as you Save” scheme introduced would be a flexible system that would allow for single insulation measures in order to bring some energy efficiencies where attic only insulation is required and increase the levels of insulation in Irish homes.

There is also continuing new build taking place, less than 16,000 planning permissions were granted in 2011, these builds must conform to building regulations and will require insulation thereby providing market opportunities for cellulose insulation. The opportunities are in particular, where the new builds are timber frame constructions.

The market for cellulose insulation peaked in Ireland in line with the building boom. The market for cellulose insulation has dropped since this time as it was closely aligned to timber frame new builds. This has left existing manufacturers of cellulose insulation with capacity to produce sufficient quantities for future demands on cellulose insulation. It is for this reason that it is recommended that the future supply of cellulose insulation be delivered through existing manufacturers where infrastructure is in place to process waste newspaper into cellulose insulation.

With the continued interest in green products and public environmental consciousness, combined with the increased uptake of timber frame builds and schemes in place for retrofit insulation it is considered that the market for cellulose insulation will increase. However as a “new” product and with the strong historical dominant market position of other insulating products, it will be a gradual increase with a relatively low overall market share.

# 1 INTRODUCTION

## 1.1 BACKGROUND

rx3 “rethink recycle remake” is a Department of the Environment, Community and Local Government (DECLG) initiative working to create end markets for recyclable materials in Ireland. Paper is a key material of focus on the programme.

Ireland has shifted focus from landfill to recycling and recovery and now has strong collection and sorting systems in place. Ireland recycled 166,684 tonnes in 1998 and 1,202,569 tonnes of municipal waste in 2011. Thus, 14 years has seen a significant improvement in our recycling rates.

However one of the challenges facing the Irish system is the lack of internal markets for recyclables. This was previously identified in the Government policy statement “*Delivering Change*”[1], published in 2002.

This statement identified Irelands' lack of stable and economically attractive markets and outlets for recyclable materials as one of the main barriers to an improved and sustainable recycling performance. This observation led the Department of Environment, Heritage, and Local Government (DEHLG) to establish the Market Development Group (MDG) in July 2004. The Department has changed name since this time and is now the Department of the Environment, Community and Local Government (DECLG).

The MDG published the *Market Development Programme for Waste Resources: 2007-2011* that laid out a 5 year plan to facilitate the market development of recyclables. The Programme officially commenced implementation in October 2008. In late 2009, it was renamed rx3 “rethink recycle remake”.

The rx3 team is tasked with project managing the key objectives and deliverables of the Market Development Programme for Waste Resources 2007–2011. This is being carried out through a number of initiatives working to create markets for recycled materials in Ireland. The team liaises with the Department of the Environment, Community and Local Government, the Market Development Group and stakeholders.

A number of pieces of legislation influence the area of cellulose insulation, such as the Landfill Directive 1999/31/EC and the Revised Waste Framework Directive (Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives). These are target based pieces of legislation that drive the quantities of paper recycled in Ireland. A draft regulation on End of Waste Criteria for Waste Paper has been proposed by the EU Commission and if published may also impact on the quality of paper for recycling. Other legislation which relates to energy savings and use of insulation is S.I. No. 243 of 2012 European Union (Energy Performance of Buildings) Regulations 2012 of Directive 2010/31/EU of the European Parliament and of the Council, S.I. No. 259 of 2008 Building Regulations (Part L Amendment) Regulations 2008 and S.I. No. 259 of 2011 Building Regulations (Part L Amendment) Regulations 2011.

There is no major infrastructure in Ireland for paper recycling. Waste paper is mainly exported for recycling and recovery which results in an over reliance on the export market

[1]Department of the Environment and Local Government, 2002. Preventing and Recycling Waste – A policy Statement: Delivering Change

and means that Ireland is particularly susceptible to any events global or otherwise that impact on the recyclables market. There is a small number of niche paper recycling markets such as the manufacture of cellulose insulation, moulded pulp products and animal bedding.

Heating can account for up to 70% of the energy bills in buildings.[2] The installation of adequate insulation will save money, energy resources and energy security and will provide a more comfortable environment by helping to maintain a consistent building temperature.

Of the 1.7 million private homes in Ireland[3], it is estimated that up to 1 million require some investment to improve their energy efficiency.[4]

There is currently funding allocated to the promotion of insulation in Ireland. The Better Energy National Upgrade Programme is a grant system in place to encourage home owners and businesses to improve insulation in their buildings. This grant scheme will end in 2013. A new Pay as you Save Scheme will be in place when the grant system ends which is based on a loan system to fund insulation upgrade works which is paid off by consumers through savings in their energy bills.

Cellulose insulation, which is made from recycled newspaper and treated with fire retardants and insect protection, can play an important role in achieving high energy efficiencies in buildings. In terms of paper recovery it is a high value application.

The Development of Markets for Cellulose Insulation Products (CIPs) is one of the key paper projects identified in the rx3 programme as it is a high added value product and there is currently significant funding allocated to the promotion of insulation in Ireland.

A market for cellulose insulation products currently exists in Ireland, however it needs to be established if the market share of this product can be increased and developed further thereby providing a reliable outlet for recycled paper.

## 1.2 AIM AND SCOPE OF THE STUDY

The *Market Development Programme for Waste Resources: 2007-2011* project PA002 identified the assessment of CIPs, their market potential and the stimulation of market confidence in the use of these products in the construction industry as one of the key paper projects.

The main objectives of the study are to:

- Establish the insulation requirements in Ireland.
- Carry out a technical review of CIPs.
- Assess CIPs against other comparable insulation materials for each insulation application.

[2] http://www.seai.ie/About_Energy/Energy_Technologies/Insulation/
[3] Source: CSO
[4] http://www.seai.ie/Renewables/Residential_Energy_Roadmap.pdf

- Investigate the current market share of CIPs in Ireland, the availability of cellulose material and the potential market for CIPs in Ireland.

- Consult with suppliers and installers of CIPs to understand their view of Cellulose Insulation and its' place in the Irish market.

- Assess the drivers and the barriers to the development of a viable market for CIPs.

- Make recommendations on the future development of CIPs and a market for their use in Ireland.

# 2 STUDY METHODOLOGY

## 2.1 DESK STUDY

A desk study has been carried out to review current literature and technical reports on CIPs to identify the benefits, barriers and opportunities to market development. The insulation market and the share of cellulose insulation have been investigated, as has the availability of waste paper feedstock. A comparison of the different properties of a range of insulation products was performed. A review of regulatory drivers for insulation demand was carried out and the impact of standards, eco-labels and green procurement in stimulating confidence in cellulose insulation, as a recycled product.

## 2.2 CONSULTATION PROCESS

The consultation process involved engagement with a number of organisations that have an involvement with cellulose insulation. These consultations gave an invaluable insight into the industry and highlighted matters not revealed by the desk study. This information supplements the information obtained in the desk study which establishes potential for market development.

| List of Stakeholders |
|---|
| CEN – Comité Europeén de Normalisation (European Committee for Standardization) |
| CSO – Central Statistics Office |
| Cygnum Timber Frame Ltd. – Manufacturers of Timber Frame Houses and Cellulose Insulation in Ireland |
| DECLG – Department of the Environment, Community and Local Government |
| Ecocel – Manufacturers of Cellulose Insulation in Ireland |
| Excel Industries Ltd. – Manufacturers of Warmcel Cellulose Insulation in the UK |
| Installers and Suppliers of Thermal Insulation in Ireland |
| NSAI (National Standards Authority of Ireland) – Standards |
| NSAI Irish Agrément – Current Certification Body |
| OPW – Office of Public Works |
| SEAI – Sustainable Energy Authority of Ireland |

## 2.3 SITE VISITS

Site visits to Cygnum Timber Frame Ltd. and Ecocel were carried out as part of the study.

# 3 INSULATION & INSULATION REQUIREMENTS IN IRELAND

## 3.1 THERMAL INSULATION

Thermal insulation refers to materials, methods and processes used to reduce the rate of heat transfer. Heat is transferred from one material to another by conduction, convection and/or radiation. Materials used for thermal insulation of buildings are selected on the basis that they are poor conductors of heat. They do not allow heat to pass through easily and therefore heat is retained.

### 3.1.1 Main Properties of Thermal Insulation

**Thermal Conductivity** (*k*) is the most important property of thermal insulation. It is a measure of the ability of a material to conduct heat and is determined by the rate of heat flow normally through the material divided by the area and by the temperature gradient in the direction of flow. The unit of thermal conductivity is watts per metre per Kelvin (W/m-K).

There are a number of other properties that are required to ensure that a material will perform well as thermal insulation and a building material (some are criteria to be met when being assessed for NSAI certification), including:

- Compressive strength
- Density
- Shrinkage
- Temperature limits
- Fire resistance
- Moisture resistance
- Toxicity
- Corrosivity
- Durability

### 3.1.2 Definition of R-Value and U-Value

The **R-value** of a material is its measure of resistance to heat flow, the higher the R-value the greater the resistance and the greater the insulation properties of that material. Thermal resistance or R-value is measured in $m^2K/W$. This is the rate that heat (in Watts) is transferred through a square metre of material multiplied by the difference in temperature (in degrees Kelvin) either side of the material. The thermal resistance of a material is calculated by dividing the thickness (in metres) of the material by its thermal conductivity. Therefore increasing the thickness of an insulating layer will increase the R-value of that material. A high R-value indicates a good insulating material.

The **U-value**, also known as the overall heat transfer coefficient, measures the rate of heat transfer through a material. Thermal transmittance or U-value is measured in $W/m^2K$. This describes how well the material conducts heat. It is the rate that heat (in Watts) is transferred through a square metre of material, divided by the difference in temperature (in degrees Kelvin) either side of the material. The lower the U-value is, the better the insulating material.

The U-value is the inverse of the R-value. In an Irish context, the U-value is the standard measure of insulation values. A low U-value indicates a good insulating material.

### 3.1.3 Building Regulations Requirements

Technical Guidance Document L (TGD L) of Part L of the Building Regulations[5] details the standards required for the conservation of fuel and energy. Table 3.1 of the Technical Guidance Document to Part L sets out the maximum allowed U-values for the different elements of the building fabric for existing dwellings.

**Table 3.1: Maximum Average Elemental U-values (W/m$^2$K)**

| Fabric Elements | New Buildings and Extensions to Existing Buildings | Material Alterations to, or Material Changes of Use of, Existing Buildings |
|---|---|---|
| Roofs | | |
| Pitched Roof | | |
| - Insulation at Ceiling | 0.16 | 0.16 |
| - Insulation on Slope | 0.16 | 0.25 |
| Flat Roof | 0.20 | 0.25 |
| Walls | 0.21 | |
| Cavity Walls* | | 0.55 |
| Other Walls | | 0.35 |
| Ground Floors* | 0.21 | 0.45 |
| Other Exposed Floors* | 0.21 | 0.25 |
| External Doors, Windows and Roof-lights* | 1.60 | 1.60 |

*See conditions in Building Regulations 2011 - Technical Guidance Document L - Conservation of Fuel and Energy

These limits on the maximum allowed U-values are to limit the heat loss through the various elements of the fabric of the house and make the house more energy efficient.

Table 3.2 details some of the different types of materials used for thermal insulation.

[5] Building Regulations 2011 - Technical Guidance Document L - Conservation of Fuel and Energy – Dwellings. Government of Ireland 2011

**Table 3.2: Types of Thermal Insulation**

| Generic Types of Thermal Insulation | Specific Types of Thermal Insulation |
|---|---|
| Organic Sources of Insulation | Cellulose, cork, wood wool, flax, sheep's wool, hemp, wood fibre, straw |
| Inorganic Sources of Insulation | Glass mineral wool, rock mineral wool, cellular or foamed glass, aerogel, recycled plastic fibre insulation |
| Synthetic (Oil) Based Insulation | Expanded polystyrene (EPS), extruded polystyrene (XPS), rigid polyurethane (PUR), polyisocyanurate (PIR), phenolic foam |

# 4 CELLULOSE INSULATION

Cellulose insulation is natural insulation material made from plant-based cellulosic material such as newsprint, cotton, straw, sawdust and hemp, amongst others. However, newsprint is the most commonly used material commercially[6] as it is the most readily available cellulosic material for the manufacture of cellulose insulation. The recycled newsprint content of the insulation is approximately 75-85%. The newsprint is dried and shredded into small pieces in the presence of a dust extractor to produce fibrous particles capable of packing tightly into closed building cavities and this high density packing results in inhibiting airflow. The remaining percentage is comprised of chemicals added to give fire resistance and resist moulds, insects and rodents. The chemicals most commonly used are boric acid and magnesium/ammonium sulphate, which are non-hazardous and are not known to cause health risks. The cellulose insulation is then bagged for delivery to installation locations.

There are 4 main categories of cellulose insulation products:

- Dry, loose-fill cellulose
- Wet, spray-applied cellulose
- Stabilised cellulose
- Low-dust cellulose

Dry, loose-fill and stabilised cellulose are typically used to insulate roof spaces at ceiling level and walls, the wet-spray applied cellulose is typically used in timber-frame walls and low dust cellulose can be used in attic and wall applications.

## 4.1 TECHNICAL REVIEW OF CELLULOSE INSULATION PRODUCTS

### 4.1.1 Dry, Loose-fill Cellulose Insulation

This insulation product is typically used in roof insulation applications, where it is blown in place by a specialised blowing machine or it can also be poured in. Cellulose fibre insulation has a thermal conductivity of 0.040 W/mK (though there may be slight variations of the order of ± 0.002 W/mK for individual products). In order to achieve the current Building Regulations standard, which requires the U-value of a pitched roof insulated at ceiling level to be no greater than 0.16 W/m$^2$K, the cellulose insulation should be installed to a depth of at least 250mm. However, in some instances an extra 10% must be applied in order to allow for settlement of the cellulose insulation material. This would bring the total depth of the insulation to 275mm.

Whilst cellulose insulation contains inorganic fire retardants, which inhibit flaming and smouldering combustion it will typically be classified as a combustible material and therefore the appropriate measures must be taken for flues, recessed ceiling lights, and high-amperage wires etc.

Although more usually used in attic and roof insulation loose fill cellulose insulation is also used for wall applications such as enclosed existing wall or open new wall cavities. A particular advantage to using cellulose insulation is that due to the small particles used in loose fill insulation the material can be applied to any space without disturbing any structures

[6] www.cellulose.org

or finishes. It is good for adding insulation to existing finished areas, irregularly shaped areas, hard to reach areas and around obstructions. This characteristic makes loose-fill insulation ideal for retrofits and for places where it is difficult to install some other forms of insulation.

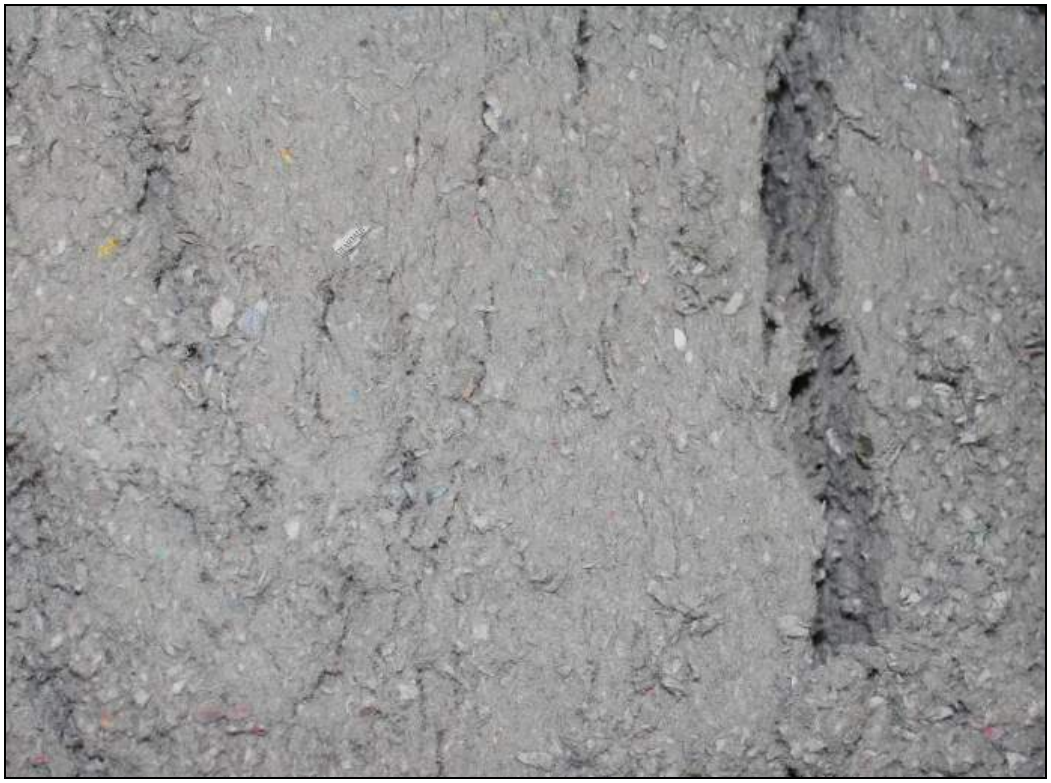

**Figure 4.1: Dry Loose Fill Cellulose Insulation**

*Photo courtesy of Ecocel

**Figure 4.2: Dry Loose Fill Cellulose Insulation Installed in Attic Space**

*Photo courtesy of Cygnum

**Figure 4.3: Timber Frame Panel Filled with Cellulose Insulation Prior to Application of Seal**

### 4.1.2 Wet, Spray-applied Cellulose Insulation

This insulation product is typically used in timber frame applications. The dry, baled cellulose insulation is fed through a machine and introduced to a water/glue solution and sprayed between the wall studs (i.e. timber partitions) until the full depth of the insulation has been installed. The insulation is levelled off and the surplus material may be recycled. For timber frame applications, a depth of approximately 170mm of cellulose insulation is required in order to achieve the Building Regulations standard for insulating an external wall, i.e. a U-value no greater than 0.21 $W/m^2K$. This application is not used in Ireland however it is commonly used outside of Ireland especially in the USA. In Ireland dry loose fill cellulose is used in walls in timber frame applications.

### 4.1.3 Stabilised Cellulose Insulation

Stabilised cellulose thermal insulation is produced with the addition of an adhesive to loose-fill cellulose insulation. The adhesive may be added to the insulation at the time of manufacture and, if necessary, activated by the addition of a mist of water when installed or the adhesive may be added to the insulation at the time of installation.[7] The presence of the adhesive stabilises the material at a lighter density than conventional low density loose-fill cellulose insulation which reduces settling and decreases the amount of insulation required.

The advantage of stabilised cellulose is that it should not settle by more than 5%, as determined in “ASTM C1497 - 04 Standard Specification for Cellulosic Fiber Stabilized Thermal Insulation”, whereas the dry loose fill cellulose could settle by up to 20%. The reduced weight impact makes the stabilised cellulose well suited to sloped roof applications.

Stabilised cellulose is also considered a type of low-dust cellulose insulation owing to the addition of water during the application process.

Some stabilised cellulose products require specialised application equipment, but most can be installed using standard blowing machines, with a water nozzle and water flow controls at the machine end of the hose. The water mist is added at the machine end of the hose so the mixing action that occurs within the hose will distribute the moisture uniformly.

### 4.1.4 Low Dust Cellulose Insulation

Low dust cellulose insulation is loose-fill material especially formulated to produce low dust levels during pneumatic installation. These products typically include an oil or oil-like additive in the formula. This type of low dust cellulose is installed just as any loose-fill insulation would be. No special techniques or equipment are required.[8]

### 4.1.5 Improvements in Cellulose Insulation

In the USA cellulose wall cavity wet spray has in recent years been one of the high growth areas for cellulose insulation, and a number of improvements in application techniques and the products have been introduced in the last five years.

[7] http://www.cellulose.org/userdocs/TechnicalSpecifications/CIMA-TechnicalBulletin05.pdf
[8] http://www.cellulose.org/userdocs/TechnicalSpecifications/UpdateOnCelluloseInsulation.pdf

Contemporary wall sprays are significantly different. The term “damp-spray” is now used because the moisture add-on may be half of what was typically found just a few years ago. The recently published Cellulose Insulation Manufacturers Association (CIMA) technical bulletin “Standard Practice for the Installation of Sprayed Cellulosic Wall Cavity Insulation” calls for a moisture add-on as low as 30%.

There have recently been significant improvements in wall spray installation equipment. One of the most important developments is two-hopper blowing machines designed especially for cellulose wall cavity spray. These machines overcome a major problem that occurs with conventional single hopper equipment.

For efficiency and economy most installers recycle oversprayed material by collecting it and running it through the installation equipment again. Since water has already been added to this recovered material maintaining the correct moisture level is a difficult task that requires considerable experience and judgment. The new machines eliminate this problem by providing a hopper for dry insulation right from the bag and a separate hopper for recovered overspray that already contains moisture. Thus, the operator does not have to make constant adjustments to compensate for the water-containing insulation that is being recycled.

## 4.2 COMPARING CELLULOSE INSULATION WITH ALTERNATIVE INSULATION PRODUCTS

For the purposes of this section, a comparison with the realistic alternatives in both attic and wall applications is carried out as opposed to all other available insulation products. The reason for this is that some insulation products are only used where very specific requirements apply. Ultimately the type of insulation that may be used is determined by the type of construction.

Table 4.1 details the properties of all insulation materials under consideration in this section.

**Table 4.1: Properties of Insulation Materials**

| Insulation Material | Thermal Conductivity[9] (W/mK) | Installation Method | Key Raw Materials | Expected Lifespan (years) | End-of-Life Options |
|---|---|---|---|---|---|
| Cellulose | 0.040 | Manual/ Mechanical | Recovered newsprint | 60 | Recycle or Disposal |
| Fibreglass | 0.040 | Manual/ Mechanical | Silica sand | 30-50 | Recycle or Disposal |
| Mineral wool[10] | 0.044 | Manual/ Mechanical | Mineral rock | 50 | Recycle or Disposal |
| Thermafleece | 0.039 | Manual | Wool, polyester | >50 | Recycle or Disposal |
| Sheep's wool | 0.042 | Manual | Sheep's wool | 50-100 | Recycle or Disposal |
| Eco-wool | 0.0425 | Manual | Recycled Plastic (PET) | >50 | Recycle or Disposal |
| Hemp | 0.038 | Manual | Hemp | Lifespan of building | Recycle or Disposal |
| Polystyrene | 0.037 | Manual/ Mechanical | Expanded Polystyrene | Lifespan of building | Recycle or Disposal |
| Polyurethane | 0.023 | Manual | Polyurethane | Lifespan of building | Recycle or Disposal |
| Polyisocyanurate | 0.023 | Manual | Polyisocyanurate | Lifespan of building | Recycle or Disposal |
| Phenolic | 0.021 | Manual/ Mechanical | Phenolic | Lifespan of building | Recycle or Disposal |

The lifespan of the different materials according to technical specifications and agrément certification indicates that the materials will last for indicative lifetimes providing that the materials are installed correctly and are not damaged during their lifetime. It is also important to note that externally applied insulations have shorter lifespans than internal insulation applications.

[9] These are guideline values. There may be specific products within each type with a slightly different thermal conductivity value

[10] e.g. Rockwool – Rockwool also has a take back recycling programme however other mineral wools may need to go for disposal

In principle an insulation material may be recyclable but there may be no infrastructure in place to facilitate the recycling process. The above insulation materials may also have an element of recycled content and in the case of organic sources will be made of natural renewable resources. The specification for each material type must be checked to verify the proportion of recycled content.

### 4.2.1 Attic Insulation[11]

In this instance, dry, loose-fill cellulose insulation is compared with fibreglass, mineral wool, natural wool, recycled polyester fibre and hemp. The reason for this is that these are all similar materials and would typically be considered where the depth of the insulation is not an issue.

In order to calculate the cost to insulate at ceiling level to the current Building Regulations (Part L) standard, which specifies a maximum allowed U-value of 0.16 W/m$^2$K, a ceiling area of 95 m$^2$ was assumed. The thermal conductivity of each material determines the required thickness of the material to achieve this U-value.

**Table 4.2: Comparison of Attic Insulation Materials**

| Insulation Material | Thermal Conductivity (W/mK) | Required Thickness (mm) | Cost (€)[12] |
|---|---|---|---|
| Cellulose | 0.040 | 250 | 453[13] |
| Fibreglass | 0.040 | 250 | 419 |
| Mineral wool | 0.044 | 275 | 1199 |
| Thermafleece | 0.039 | 244 | 2,565 |
| Sheep's wool | 0.042 | 265 | 3,696[14] |
| Eco-wool | 0.0425 | 270 | 2,459 |
| Hemp | 0.038 | 238 | 4,285 |

The above values are guideline values used to show the cost differential across the range of comparable materials.

### 4.2.2 Wall Insulation

Again, dry, loose-fill cellulose insulation is compared with the full suite of wool insulation materials as well as the rigid foam insulation materials, i.e. expanded polystyrene, polyisocyanurate and phenolic. All of these materials are considered for insulation of walls but the type used is dependent on whether or not the homeowner wishes to insulate above and beyond what is required by the Building Regulations.

[11] Rafter insulation could also be considered where counter-battens are present in a roof
[12] This figure is based on an assumed area of 95m$^2$ insulated to the thickness required to meet Building Regulations standards, material supply only and including VAT. Prices as of June 2012
[13] Actually calculated on 300mm thickness
[14] Based on Comfort roll

In order to calculate the cost to insulate walls to the current Building Regulations (Part L) standard, which specifies a maximum allowed U-value of 0.21 W/m$^2$K, an area of 85 m$^2$ was assumed. The thermal conductivity of each material determines the required thickness of the material to achieve this U-value.

**Table 4.3: Comparison of Wall Insulation Materials**

| Insulation Material | Thermal Conductivity (W/mK) | Required Thickness (mm) | Cost (€)[15] |
|---|---|---|---|
| Cellulose | 0.035 | 170 | 541[16] |
| Fibreglass | 0.040 | 190 | 270 |
| Mineral wool | 0.044 | 210 | 903 |
| Thermafleece | 0.039 | 186 | 1,650 |
| Sheep's wool | 0.042 | 200 | 2,288 |
| Eco-wool | 0.0425 | 202 | 3,444 |
| Hemp | 0.038 | 181 | 3,021 |
| Polystyrene | 0.037 | 176 | 1,543 |
| Polyisocyanurate | 0.023 | 110 | 1,712 |
| Phenolic | 0.021 | 100 | 2,998 |

Like many of the natural insulation products cellulose insulation has the added benefit of excellent soundproofing qualities. The dense, loose nature of cellulose slows down the speed that sound can travel and therefore the resultant sound levels. The application method of cellulose ensures that all cavities and spaces are completely filled leaving few air pockets for sound to travel. Cellulose also has the ability to trap air which again results in a reduced medium for sound to travel. In terms of comparison to other insulating materials cellulose is approximately 2-3 times denser than fibreglass. Sound also travels faster in more rigid materials, therefore rigid insulating material may be less effective in terms of sound insulation. Cellulose insulation can help deaden the sound through walls, between floor levels and outside noise.

It is critical that insulation is installed correctly to ensure that it meets its required U-value and building standards. Some materials such as fibreglass and/or mineral wool are often self-installed. It is important that insulation slabs and/or rolls are installed with no gaps between adjoining slabs and/or rolls, or between slabs and/or rolls and other parts of the building that form part of the overall insulation area, such as rafters or joists etc. Any gaps left over will enable the passage of air and result in a reduction in performance. It also important to ensure that insulation is installed to prevent thermal bridging and that no compression occurs which can reduce the insulation value. Cellulose insulation can be self installed or installed by a professional, as can fibreglass, or mineral wool. In the form of loose fibres that are blown into place, it is more usual for a professional to carry out these works. Foam and rigid insulations will also tend to be installed by professionals. The cost of installation will depend

[15] This figure is based on an assumed area of 85m$^2$ insulated to the thickness required to meet Building Regulations standards
[16] Actually calculated on 200mm thickness

on the type of insulation, equipment required, duration of job and the competitiveness of the contractor.

With regard to health and safety during installation it is recommended for materials such as fibreglass, mineral wool and phenolic or other foam sprays that personnel protective equipment (PPE) such as gloves, eyewear, overalls and dust masks or breathing apparatus are used. Materials such as cellulose, polyester and wool/polyester mix would require a dust mask. Other insulating materials such as rigid plastics like polystyrene and polyisocyanurate; and sheep's wool can technically be installed using no PPE.

Cellulose Insulation is a hygroscopic material which means that it can absorb and release moisture. This property allows distribution of moisture through a space, preventing build up of moisture in one area and enabling moisture to dry more quickly. This feature of cellulose means that insulating performance is reasonably constant with changing humidity levels. It also gives breathability to a building and allows for a more comfortable and healthy living environment. Natural fibres, such as cellulose, sheep's wool and hemp, absorb and desorb moisture hygroscopically, unlike synthetic fibres. Provision of adequate loft ventilation is key in allowing the removal of moisture when it is released from hygroscopic materials.

# 5 DRIVERS AND BARRIERS TO CELLULOSE INSULATION MARKET DEVELOPMENT

There are many drivers of and barriers to the development of a market for cellulose insulation products and these are examined in this section.

## 5.1 DRIVERS

The main driver behind the demand for insulation products in Europe is energy savings. There are three main reasons to promote energy savings: security of supply, environmental and limited influence on supply. It was identified by the EU that buildings are the largest user of energy, approximately 40%[17] of the total energy used. Therefore they have been highlighted as an area of significant energy savings by the EU, and are a key element of the Europe 2020 20% energy efficiency targets to be achieved by 2020.[18]

From the individual or business perspective insulation brings about both energy and cost savings. The SEAI[19] has indicated that the potential heat loss through a roof can be between 30-35%, when properly insulated this can reduce heating bills by 20%. Heat loss through walls is generally between 25-30% and in some cases can be as much as 50%, when insulated to building regulations specifications this can result in 15-25% savings in heating costs.

**Table 5.1: Indicative Heat Loss and Cost Savings by Insulation Installation**

| Area of the Building | Heat Loss | Cost Savings through Insulating |
|---|---|---|
| Roof | 30-35% | 20% |
| Walls | 25-30% | 15-25% |

The drivers of cellulose insulation use in Ireland are across the following broad categories: environmental, economic and energy.

### 5.1.1 The Kyoto Protocol Regulations on Gas Emissions – Impact on Thermal Insulation

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change (UNFCCC) adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16 February 2005. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialised countries and the European community for reducing greenhouse gas (GHG) emissions. This amounts to an average of five per cent against 1990 levels over the five-year period 2008-2012.

Recognising that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity,

[17] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010L0031:EN:NOT
[18] http://ec.europa.eu/europe2020/targets/eu-targets/index_en.htm
[19] http://www.seai.ie/uploadedfiles/InfoCentre/Insulatingyourhome.pdf

the Protocol places a heavier burden on developed nations under the principle of "common but differentiated responsibilities".[20]

The EU committed itself in the Kyoto Protocol to reduce its GHG emissions by 8% from its 1990 levels by 2008-2012. Irelands target is to limit the increase in GHG's to 13% above 1990 levels. This increase was permitted in order to allow Ireland to develop economically. The EPA has indicated that Ireland is on track to meet its Kyoto commitment.[21]

The Protocol states that countries must implement or further policies and measures in accordance with their national circumstances in order to meet their targets. One such measure in the Protocol is the enhancement of energy efficiency in relevant sectors of the economy. This clearly has an impact on the increased use of insulation in new and existing building applications in order to derive greater heat use efficiency, energy savings and reduce carbon dioxide emissions.[22]

For 2020, the EU has committed to cutting its emissions to 20% below 1990 levels.[23]

### 5.1.2 Building Regulations

The Building Regulations are a set of legal requirements which serve to provide for the health, safety and welfare of people in and around buildings, S.I. No. 497 of 1997 Building Regulations 1997 as amended.[24] In general, regulations apply to the construction of new buildings and to extensions and material alterations to existing buildings; and to certain changes of use of existing buildings. The regulations apply to all types of construction.[25]

The regulations set out the basic requirements to be observed in the design and construction of buildings. The requirements of the regulations are set out as general functional requirements, or general statements of intent of the relevant regulation. Technical Guidance Documents A to M provide guidance on how to comply with the requirements of the Regulations.

Certain parts of the regulations (listed Parts A to M) apply to material change of use of a building. The second schedule lists the various parts (Parts A to M) and the regulations within each part. The third schedule lists the types of buildings that are exempted from the Building Regulations.

Part L of the Building Regulations is concerned with the conservation of fuel and energy. It specifies that a building must be designed and constructed so as to ensure the energy performance of the building limits the amount of energy required for its operation and the amount of $CO_2$ emissions associated with that energy use as far as is reasonably practicable.

There have been a number of amendments to Part L of the Building Regulations. The more recent amendments are S.I. No. 259 of 2008 Building Regulations (Part L Amendment)

[20] http://unfccc.int/kyoto_protocol/items/2830.php
[21] http://www.epa.ie/news/pr/2012/name,32668,en.html
[22] Kyoto Protocol to the United Nations Framework Convention on Climate Change. United Nations, 1998
[23] http://ec.europa.eu/clima/policies/brief/eu/index_en.htm
[24] http://www.environ.ie/en/Legislation/DevelopmentandHousing/BuildingStandards/FileDownLoad,1636,en.pdf
[25] http://www.environ.ie/en/DevelopmentHousing/BuildingStandards/

Regulations 2008[26] and S.I. No. 259 of 2011 Building Regulations (Part L Amendment) Regulations 2011.[27] Further detail on these and other Building Regulations is available from the DECLG.[28]

In existing buildings the above terms must be achieved through a number of measures. The measures that relate to insulation are: limiting heat loss and, where appropriate, maximising heat gain through the fabric of the building; limiting the heat loss from pipes, ducts and vessels used for the transport or storage of heated water or air.

New dwellings must be designed and constructed providing that the energy performance is such as to limit the calculated primary energy consumption and related $CO_2$ emissions insofar as is reasonably practicable, when both energy consumption and $CO_2$ emissions are calculated using the Dwelling Energy Assessment Procedure (DEAP) published by the SEAI. The main measure that relates to insulation is limiting heat loss and, where appropriate, maximising heat gain through the fabric of the building.[29] In line with the more stringent 2011 regulations the aim is to put in place a Nearly Zero Energy Building (NZEB) Framework for Dwellings in 2015 to ensure all new buildings are NZEB by 2020.

For buildings other than dwellings providing that the energy performance of the new building is such as to limit the calculated primary energy consumption and related $CO_2$ emissions insofar as is reasonably practicable, when both energy consumption and $CO_2$ emissions are calculated using the Non-domestic Energy Assessment Procedure (NEAP) published by the SEAI. Insulation can be used to achieve these requirements as it will serve to: limit the heat loss and, where appropriate, maximise the heat gains through the fabric of the building; limit the heat loss from pipes, ducts and vessels used for the transport or storage of heated water or air.[30]

Part D of the Building Regulations deals with “Materials and Workmanship”. In relation to products/materials, it sets the requirement for products/materials to be “proper materials”, fit for the intended use and the conditions of use. Technical Guidance Document D provides guidance on methods for showing compliance with material and workmanship requirements and the certification that may be required for construction products.

Part B of the Building Regulations “Fire” is relevant to insulation materials providing the relevant classifications and uses for various materials.

### 5.1.3 S.I. No. 243 of 2012 European Union (Energy Performance of Buildings) Regulations 2012 of Directive 2010/31/EU of the European Parliament and of the Council[31]

The Energy Performance of Buildings Directive (20/91/EC of 16 December 2002) has been recast and is superseded by the new directive Energy Performance of Buildings Directive (EPBD) (2010/31/EC of 19 May 2010).[32] The Recast EPBD was transposed into Irish Legislation by S.I. No. 243 of 2012. The recast aims to strengthen the energy performance requirements and to clarify and simplify some of the items in the original directive. A draft

[26] http://www.environ.ie/en/Legislation/DevelopmentandHousing/BuildingStandards/FileDownLoad,17840,en.pdf
[27] http://www.environ.ie/en/Legislation/DevelopmentandHousing/BuildingStandards/FileDownLoad,27314,en.pdf
[28] http://www.environ.ie/en/DevelopmentHousing/BuildingStandards/
[29] http://www.environ.ie/en/Publications/DevelopmentandHousing/BuildingStandards/FileDownLoad,27316,en.pdf
[30] http://www.environ.ie/en/Publications/DevelopmentandHousing/BuildingStandards/FileDownLoad,20322,en.pdf
[31] http://www.environ.ie/en/DevelopmentHousing/BuildingStandards/RHLegislation/FileDownLoad,31049,en.pdf
[32] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010L0031:EN:NOT

action plan for the implementation of the recast was published in September 2012 by the EPBD Implementation Group, which went to public consultation in 2012.[33]

The recast requires EU Member States to ensure that all new buildings will be nearly zero-energy by 31 December 2020 (or by 31 December 2018 in the case of new buildings owned and occupied by public authorities).

These Regulations provide for the transposition and implementation of Articles 1, 2, 3, 4(2), 6, 7, 11, 12, 13, 14(4), 15(4), 17, 18, 27, 28 and 29 of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings (recast). The Regulations requires a person who commissions the construction of a new building to examine the technical, environmental and economic feasibility of installing high efficiency alternative energy systems at design stage. This requirement will apply to new buildings for which planning permission is applied for on or after 9 January 2013.

The Regulations also require the Building Energy Rating (BER) of buildings as follows:

- A new building offered for sale or for let on or after 9 January 2013;
- An existing building offered for sale or for let on or after 9 January 2013.

Where a new building is offered for sale or for let from plans, the Regulations provide that a provisional BER certificate be secured which will be replaced by a final BER certificate on completion of construction. This Part also requires that a building's energy performance indicator be stated in advertisements relating to the sale or letting of the building.

A limited number of building categories are exempt from the Regulations, as envisaged in the relevant EU Directive e.g. protected structures, places of worship etc.

### 5.1.4 National Energy Rating System BER Certification System

A Building Energy Rating Certificate (BER) indicates the energy performance, $CO_2$ emission and indicative running cost of a building. The rating system is similar to the energy labelling found on electrical goods such as fridges, dishwashers and cookers etc. The rating is based on a performance scale ranging from A to G, where A is the most energy efficient and G is the least energy efficient. The rating is based on a number of factors such as space heating, water heating, ventilation and lighting and is calculated on the basis of standard occupancy. It is expressed as primary energy use per unit floor area per year (kWh/m$^2$/year).

The BER scheme was introduced in Ireland in a phased approach on the 1$^{st}$ January 2007 dealing with new dwellings; new non-domestic buildings came under the regulations on the 1$^{st}$ July 2008. Since 1 January 2009, a BER is now required when any building is being offered for sale or rent, certain exemptions apply for buildings such as national monuments and protected structures (further details are listed in the Regulations). Additionally all buildings over 500m$^2$ frequently accessed by the public must display either a BER certificate or a DEC (Display Energy Certificate) from 9$^{th}$ Jan 2013. On and from 9 July 2015, this requirement is extended to all buildings in excess of 250 m$^2$ which are frequently visited by the public when occupied by public bodies. The DEC is calculated differently to the BER rating and also requires a specialised DEC assessor.

[33] http://www.environ.ie/en/Publications/DevelopmentandHousing/BuildingStandards/FileDownLoad,31057,en.pdf

The BER certificate provides consumers with information regarding the energy performance of a building and enables them to take this into consideration in any decision on property transactions. See Figure 5.1 for a sample BER certificate.

The insulation market has grown significantly since the introduction of the BER scheme and is one of the main drivers for the development of sustainable insulation products.

The SEAI is the sole authority designated under the Regulations for the management of the BER scheme: responsibilities include; the registration of BER and DEC Assessors, the issue of BER certificates, quality assurance, the maintenance of records, databases and documents, fees and levies, the development of codes of practice for assessors and assessor training providers.

The energy and carbon performance of buildings calculated using the Dwelling Energy Assessment Procedure for new dwellings will also determine compliance to Part L of the Building Regulations.

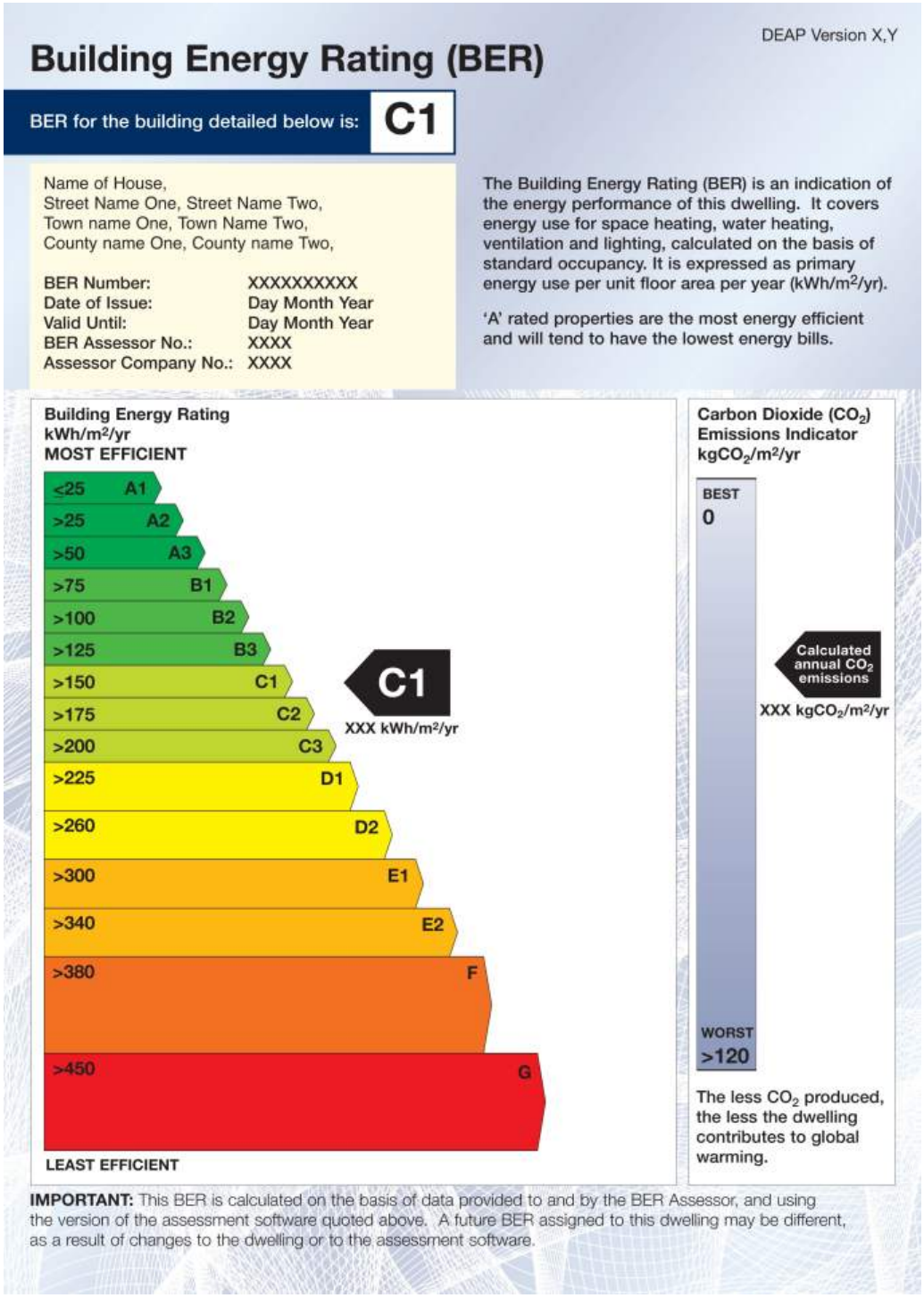


**Figure 5.1: Example of a Building Energy Rating Certificate for Dwellings**

### 5.1.5 Better Energy: The National Upgrade Programme

The National Insulation Programme for Economic Recovery was launched in 2009. The insulation programme addressed three key areas in order to: cut heating bills for householders, reduce energy use and carbon emissions and create thousands of jobs both directly and indirectly. The aim of the programme was to redirect the economy and refocus state and private investment onto a more sustainable path during challenging economic times.

The programme consisted of a number of grant schemes: The Home Energy Saving Scheme applicable to private middle income homes and the Warmer Homes Scheme and Local Authority housing for low income private homes and rented local authority homes.

The Home Energy Saving Scheme has been relaunched as part of the Better Energy Homes Grant Scheme under Better Energy: the National Upgrade Programme which was launched in May 2011. The scheme is open to all owners of existing houses built before 2006. The SEAI administers the scheme. The grants currently cover wall insulation, roof insulation, heating system upgrades and BER assessment. The statistics to 20/06/2012 indicate that over €138 million has been paid in grant support, out of the total over €105 million has been spent on insulation upgrade measures in Irish homes. Through the scheme 94,700 roofs and 100,500 walls have been insulated. Roof insulation has the highest uptake at 28%, followed by cavity wall at 24%, and drylining and external insulation at 3% each.

By 20/06/2012 197,936 applications were approved the highest number of applications came from Dublin, Cork, Galway, Limerick, Kerry and Clare.

Ultimately, the scheme has given impetus to the general public to upgrade their insulation which has improved market conditions for the insulation industry.

The Better Energy programme is designed to support the energy efficiency upgrades of one million homes, businesses and public buildings. Within this programme, financial support is available through the Better Energy Workplaces Scheme for implementing a wide range of qualifying sustainable energy upgrading projects in the public, commercial, industrial and community sectors.

### 5.1.6 Pay As You Save Scheme

In September 2010, the then Minister for Communications, Energy and Natural Resources said that the Government was developing plans that would see the retrofitting of energy efficiency upgrades in one million homes by 2020 through a ‘Pay As You Save’ scheme. The new coalition government has, in their programme for Government, committed to continuing to facilitate the retrofitting of energy efficiency measures to homes through a continuation of the current schemes; and a ‘Pay As You Save’ scheme after 2013.

The ‘Pay As You Save’ scheme is due to be introduced by 2014. The scheme is a financial model where consumers finance energy efficiency upgrades over a period of time where repayments are made as part of their energy bill, and based on savings made through improved energy efficiency.

The governmental commitment to facilitate the improvement in energy efficiency of the existing housing stock and future new-builds creates security for thermal insulation as it means that there is a larger potential market than there would be without such schemes.

### 5.1.7 Energy Efficiency Directive 2012/27/EU

There has recently been agreement of a new EU Directive[34] designed to boost energy efficiency throughout Europe. The directive will lead to greater investment by both public and private sectors to make both homes and public buildings warmer and more efficient.

Some of the obligations include:

- Setting indicative national energy efficiency targets for 2020
- An annual 3% renovation rate of buildings owned and occupied by central government, such as schools, hospitals etc [35]

Ireland has already committed to reaching energy efficiency savings of 20% by 2020 under the National Energy Efficiency Action Plan. It is considered that energy suppliers will play a key role in meeting this goal.

The commitment to building renovation will also provide for the continued need for insulation in public buildings currently not adequately insulated.

### 5.1.8 Large Potential Market

The current private housing stock is over 1.9 million units however there are a number of vacant houses. The number of occupied houses in the state is in the region of 1.7 million.

The census data of 1991[36] indicates that there were 1.2 million private households in Ireland. This time was before the first set of Building Regulations came into effect and therefore prior to the current high standard insulation specifications. There is no data with regard to house demolitions which may have occurred from 1991 to 2011 but it is considered that there are in the region of one million private households in the country with sub-standard levels of insulation.

There are in the region of 150,000 existing local authority and voluntary social houses in Ireland[37] and a proportion of this housing stock will need to be retrofit with insulation to bring them in line with building standards.

There are also new builds to consider. The construction industry has slowed considerably in the past number of years. In 2007 at the height of the recent building boom there were over 62,000 planning permissions granted, where almost 23,000 were for dwellings and the remainder were for other constructions, extensions, alterations, conversions etc. This has been in steady decline since this time and in 2011 nearly 16,000 planning permissions were

[34] http://eur-lex.europa.eu/JOHtml.do?uri=OJ:L:2012:315:SOM:EN:HTML
[35] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52011PC0370:EN:NOT
[36] http://www.cso.ie/census/Census_1991_Results.htm
[37] http://www.environ.ie/en/Publications/DevelopmentandHousing/Housing/FileDownLoad,21123,en.pdf , http://www.environ.ie/en/LocalGovernment/LocalGovernmentAuditService/PublicationsDocuments/FileDownLoad,27141,en.pdf and http://www.environ.ie/en/Publications/StatisticsandRegularPublications/HousingStatistics/FileDownLoad,15291,en.xls

granted, where almost 5,000 were for dwellings and the remainder were for other constructions, extensions, alterations, conversions etc.[38]

In 2011 the Housing Agency produced a report on behalf of the DECLG which reveals that there are over 98,000 social housing units required in order to meet the current demand.[39]

There are also existing commercial buildings and public and Government buildings that may require greater levels of insulation. In the National Energy Efficiency Action Plan the government committed to an even higher energy efficiency saving target of 33% for the public sector by 2020.[40]

The data shows that the potential market available for insulation is high given the existing building stock requiring upgrading and the continuation of new builds that must meet building regulations. There is significant scope for the insulation products given the potential market.

### 5.1.9 Green Public Procurement

The European Commission adopted its Communication on public procurement for a better environment on 16 July 2008. The Commission proposed a political target of 50% Green Public Procurement (GPP) to be reached by the Member States by the year 2010. The target is linked to a process for setting common, voluntary, green public procurement criteria, recommended for inclusion in tender documents for a series of priority product and service groups.

To date the Commission has developed 19 common GPP criteria for product and service groups, in consultation with stakeholders and Member State representatives. These criteria are available on the Europa GPP website under the **"Training Toolkit for Green Public Procurement"**.[41] Thermal insulation is one of the product groups that have been developed. Further criteria are under development by the Commission.

The Green Public Procurement National Action Plan for Ireland called **"Green Tenders – An Action Plan on Green Public Procurement"** was published on 18th January 2012 by DECLG and the Department of Public Expenditure and Reform.[42]

The overall objective of the plan is to assist public authorities to successfully plan and implement green public procurement (GPP) by highlighting existing best practice and outlining further actions to boost green public procurement. The annual public sector procurement budget accounts for 10% to 12% of Ireland's GDP, which equated to about €14 billion in 2011. This places Ireland's public sector in a strong position to stimulate the marketplace in favour of the provision of more resource-efficient, less polluting goods, services and works.

38 http://www.cso.ie/quicktables/GetQuickTables.aspx?FileName=BHA03.asp&TableName=Planning+Permissions+Granted&StatisticalProduct=DB_BH

39 http://www.environ.ie/en/Publications/StatisticsandRegularPublications/HousingStatistics/FileDownLoad,27864,en.pdf

40 http://www.dcenr.gov.ie/NR/rdonlyres/FC3D76AF-7FF1-483F-81CD-52DCB0C73097/0/NEEAP_full_launch_report.pdf

41 http://ec.europa.eu/environment/gpp/toolkit_en.htm

42 http://www.environ.ie/en/PublicationsDocuments/FileDownLoad,29208,en.pdf

The EU's renewed **Sustainable Development Strategy**[43] commits EU governments to *"aiming to achieve by 2010 an EU average level of green public procurement equal to that currently achieved by the best-performing Member States"*. This target was made more specific in the **Commission's Communication on Public Procurement for a Better Environment**[44] in which the Commission proposes a 50% target for each Member State to be reached from 2010. In September 2008, the European Council welcomed this political indicative target of 50% GPP tendering per Member State leaving the Member State the flexibility *"to define its own targets in every sector to contribute to the overall 50% target"* and *"to apply more ambitious GPP modalities".*[45]

Green Tenders adopts the indicative EU political target of 50% of GPP, where GPP means incorporating green criteria into the procurement contract. This target will apply in respect of both the number and the value of public procurement contracts concluded. The focus initially will be on the number, ensuring that as soon as possible, at least half of such contracts will include core GPP criteria – i.e., criteria that are suitable for use by any contracting authority, and address the key environmental impacts. Simultaneously, monitoring of these contracts will also take account of their monetary value, aspiring to meet and exceed 50% of expenditure on public procurement. In the first instance, targets will apply to eight priority product groups.

Green Tenders nominates eight product/service groups as priority groups for GPP. These are:

1. Construction
2. Energy
3. Transport
4. Food and catering services
5. Cleaning products and services
6. Paper
7. Uniforms and other textiles
8. ICT

These groups have been selected on the basis of the following criteria: amount of public expenditure; scope for environmental improvement; potential impact on suppliers; potential for setting an example to private or corporate consumers; political sensitivity; existence of relevant and easy-to-use criteria; market availability and economic efficiency.

A guidance document for Green Public Procurement in the Construction Sector is being prepared by the OPW Architectural Services. The framework provided in this document for buildings is for Public Buildings other than Dwellings. Guidance on the sustainable procurement of dwellings is provided by the Housing/Architectural Section of the Department of Environment, Community and Local Government in the following documents: Parts A to M of the Building Regulations – Dwellings, Quality Housing for Sustainable Communities, Social Housing Retrofit Programme and the National Retrofit Code of Practice (draft version published for public consultation).

All materials used in construction should be assessed for environmental impacts over the appropriate appraisal period for the project. Pending further research, including at EU level, and stakeholder engagement on methodologies for doing so, public procurers should

[43] http://register.consilium.europa.eu/pdf/en/06/st10/st10917.en06.pdf
[44] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0400:FIN:EN:PDF
[45] http://register.consilium.europa.eu/pdf/en/08/st13/st13067.en08.pdf

consider the manufacture, construction, maintenance and disposal impacts of the most commonly used materials, but should be satisfied that appropriate methodologies are used. These include embodied energy (and associated $CO_2$ and other pollutants), resource use, responsible sourcing, construction wastage, durability, recyclability and disposal. Public procurers should ensure that the environmental advantages claimed by material suppliers can be verified.

The GPP criteria for thermal insulation provides that additional points be awarded to wood based materials which include cellulose insulation; thereby placing cellulose insulation in a good position when it comes to public purchasing decisions.[46]

A recent EU study monitoring the effect of GPP has shown that 26% of the last contracts signed by public authorities in the EU27 for the ten product groups included all EU core GPP criteria. In addition, 55% of the last contracts signed included at least one EU core GPP criterion. Also the value of contracts including GPP is significant with 38% of the total value procured included GPP criteria, be they EU, national, regional, local or other ones.[47] This is positive encouragement for organisations producing green products in Ireland where GPP is in its early stages of implementation.

### 5.1.10 Rising Energy Costs and Energy Security

The world energy demand is increasing and the EU's dependency on imported fossil fuels is also increasing. Ireland like many other EU member states is highly reliant on imports of oil, gas and coal. The global demand for energy will continue to grow in line with current demands and to meet the growing global population which is predicted to be in the region of 9 billion by 2050, over 30% higher than today's population of 7 billion. This places demand on availability and cost of energy supply. As Irish energy prices are reasonably high in an EU context this provides a good incentive for building owners to insulate their buildings and save on potential space heating losses, which can be as much as 33% for the residential sector.[48] There is also a drive to produce energy from renewable sources where Ireland has a renewable energy target of 16% by 2020, and is currently producing 6.5% from renewable sources.[49] This coupled with incentives such as grants to encourage insulation and thereby energy savings will assist Ireland to achieve the 2020 targets, provide greater indigenous energy security and avoid $CO_2$ emissions thus assist meeting the Kyoto commitment.

### 5.1.11 Embodied Energy and Embodied Carbon

The dictionary of energy defines embodied energy as "the sum of the energy requirements associated, directly or indirectly, with the delivery of a good or service".[50] In terms of insulation products cellulose insulation has the lowest embodied energy however in order to establish the full embodied energy of an insulation material it must be calculated in relation to the thickness required in order to meet building regulations in comparison to other potential insulating materials. The EU GPP Thermal Insulation Technical Background Report details the embodied energy for a selection of insulation materials.[51]

[46] http://ec.europa.eu/environment/gpp/pdf/thermal_insulation_GPP_product_sheet.pdf
[47] http://ec.europa.eu/environment/gpp/pdf/CEPS-CoE-GPP%20MAIN%20REPORT.pdf
[48] http://www.trainenergy-iee.eu/cms/upload/Download-Docs/english/tradesman/Module%201%20-%20Energy%20Stats%20and%20Legislation%20-%20Ireland.pdf
[49] http://www.seai.ie/Publications/Statistics_Publications/Renewable_Energy_in_Ireland_2011.pdf
[50] www.ice.org.uk/.../Energy-Reports---Embodied-Energy-and-Carbon.aspx
[51] http://ec.europa.eu/environment/gpp/pdf/thermal_insulation_GPP_%20background_report.pdf

Embodied carbon can be defined as the amount of carbon released from material extraction, transport, manufacturing, and related activities. This may be calculated from cradle to (factory) gate, cradle to (installation) site, or (ideally) from cradle to grave.[52] The significantly lower levels of energy required to produce cellulose insulation release a small fraction of carbon dioxide in the process compared to producing other insulation products. Thereby using cellulose insulation, which has the lowest embodied carbon of insulation products, can act as a carbon sink in your building.

The energy requirements to produce cellulose insulation, made in electrically-driven mills, are comparatively small as they consume relatively little energy when operating, and no energy when shut down after use. Many other insulation material types have high energy production requirements as they are made in furnaces which are in constant operation or may have high energy manufacture processes such as plastic foams.[53]

The green credentials of cellulose insulation make it an ideal material for use in passivhaus and in timber frame houses which are increasing in their share of the building market. The near zero energy buildings policy and Kyoto commitment also add to the importance of carbon considerations when selecting a thermal insulation material.

### 5.1.12 Ecolabels

The EU Ecolabel is a voluntary certification scheme which was introduced in 1992. The label is awarded to products or services that are proven to be kinder to the environment. In order to attain the Ecolabel a range of strict criteria set at European level must be met. The environmental and performance criteria must be verified by independent assessors prior to the award of the label. The European Eco-labelling Board (EUEB) is the designated award body. The full life cycle of a product is considered under the Ecolabel scheme. The label is recognised across the EU and the EEA countries (Norway, Iceland and Liechtenstein) and conveys a message of high standards and environmental friendliness to consumers. It is also deemed to afford a competitive advantage to producers and service providers particularly with the recent growth in green procurement. The eco-label is represented by the flower logo, as per Figure 5.2.

[52] http://www.sustain.co.uk/embodied-carbon.aspx
[53] http://www.tasconindustries.com/Insulation%20Comparison.html


**Figure 5.2: EU Ecolabel**

There is currently no EU Eco-label that applies to insulation. However it is listed as a priority product for development in the future. Building components including insulation have been ranked 3rd in environmental priority order in the EU Ecolabel Work Plan 2011-2015. [54] A draft final European Ecolabel Criteria for Office Buildings is under development which includes thermal insulation as a criterion.[55]

There are a range of other European and International Ecolabels that deal with thermal insulation, such as the New Zealand, Canada and Australia Environmental Choice Labels, the Korean Ecolabel, the Taiwan GreenMark, the UK Energy Saving Recommended Logo, the US Energy Star, the Czech Ecolabel, the Ukraine Ecolabel and the Thailand Ecolabel.[56] The German Blue Angel whilst not having criteria specifically for thermal insulation, does have criteria for building materials made of waste glass and for building materials made of waste paper which could be potentially used for thermal insulation.[57]

The EU Ecolabel and national Ecolabel co-exist happily. The Ecolabel Regulation requests Member States and the European Commission to ensure coordination between the EU Ecolabel and other national schemes, particularly in the selection of product groups and the development and revision of the criteria. The EU Ecolabel and these labels are developing a policy of co-operation and co-ordination.[58] The revised Ecolabel Regulation, Regulation (EC) 66/2010 of the European Parliament and of the Council of 25 November 2009 on the EU Ecolabel was published in 2010.[59]

The EU Ecolabel is part of a broader action plan on Sustainable Consumption and Production and Sustainable Industrial Policy adopted by the Commission on 16 July 2008.

[54] http://ec.europa.eu/environment/ecolabel/about_ecolabel/pdf/work_plan.pdf
[55] http://susproc.jrc.ec.europa.eu/buildings/docs/WP-3draft%20OFFICE%20BUILDING.pdf
[56] http://www.globalecolabelling.net/categories_7_criteria/list_by_program/1501.htm
[57] http://ec.europa.eu/environment/gpp/pdf/thermal_insulation_GPP_%20background_report.pdf
[58] http://ec.europa.eu/environment/ecolabel/useful_links/other_ecolabels_en.htm
[59] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:027:0001:0019:EN:PDF

## 5.2 BARRIERS

### 5.2.1 Cost

The experiences of the homeowners that participated in the Home Energy Savings scheme, as detailed in *Bringing Energy Home*[60], illustrated that people do not make decisions on insulation solely on the cost involved in upgrading their insulation. Increased comfort is also a major motivation for people to carry out insulation upgrades. Where cost is the major influencing factor is when comparing one product versus another, especially where they are both considered to be comparable in terms of performance. If one product is appreciably more expensive than another, the less expensive option will, in all probability, be chosen and the homeowner will not feel as though they have chosen a less effective option. Therefore it is important to price an insulation product competitively when comparing with competing materials on the market.

The supply cost of cellulose insulation is similar in price to the cheapest insulating products on the market. Cellulose can be self installed in an attic by renting the appropriate installation equipment or it can be installed by a professional installer. Other products can also be self installed with or without the need for specialised equipment or can be installed by a professional. The full cost of the supply and installation plus any preparatory work to be carried out to ensure the optimal benefit from the insulation product must be considered before selecting a product in order to compare products equally.

Of course in the current challenging economic times it can be difficult for individuals and businesses to provide upfront payment for thermal insulation works even with consideration of the long term cost savings.

### 5.2.2 Certification

Works to which the Building Regulations apply, will be subject to the requirements of Part D Materials and Workmanship. As such any product, material or system incorporated into the construction works, should be fit for the use for which they are intended and for the conditions in which they are to be used.

Currently, certification of cellulose insulation products demonstrates performance of the product and may establish fitness for purpose of the systems thus facilitating its use in the Irish construction industry. Certification may include a European Technical Approval/Assessment, Agrément Certification or equivalent from a suitable 3rd party. It is essential that the performance of the product is fit for the purpose for which it is intended, the conditions in which it is to be used and meets the requirements of the Irish Building Regulations.

Works are subject to Building Regulations and are subject to the requirements of Part D Materials and Workmanship.

Certification of cellulose insulation products will demonstrate fitness for purpose of the systems and facilitate use of the material in the Irish construction industry. Certification of an innovative product may include a European Technical Approval and Agrément Certificate or

[60] http://www.seai.ie/News_Events/Press_Releases/Bringing_Energy_Home_Report.pdf

equivalent from a suitable 3rd party and which would demonstrate that the product is fit for the purpose for which it is intended, the conditions in which it is to be used and meets the requirements of the Irish Building Regulations.

The standard for construction of timberframe systems is I.S. 440:2009 Timberframe Dwellings. Timberframe systems for use in Ireland should be designed and constructed to this standard.

The development of a harmonised European standard for cellulose insulation products prEN 15101-1 is underway which will allow the product to be placed on the market when it conforms to this standard, see Section 7.

Whilst an EN installation standard prEN15101-2 is also being developed, the product when installed will in addition be required to comply with relevant national standards such as I.S. 440 and as referred to by the Building Regulations.

When incorporating a product, material or system into construction works that conforms to a harmonised European standard (hEN), it is essential that the declared performances are fit for the use in which the product, material or system is intended and for the conditions in which it is to be used. The NSAI has produced additional national guidance for some hENs and ENs in the form of National Annexes or Standard Recommendations (SRs) which provide guidance on the appropriate minimum performance levels for specific intended uses of the products, materials and systems in Ireland. Where a construction product is covered by such guidance, compliance with the National Annex/Standard Recommendation in so far as it relates to the product, material or system may be used to demonstrate that when incorporated into construction works the product material or system is fit for the use for which it is intended.

In terms of SEAI insulation schemes, ceiling-level insulation materials must be manufactured and installed to the relevant Irish, British or European Standard. Otherwise materials should demonstrate fitness for use through e.g. European Technical Approvals/Assessments, Irish Agrément Certificate or equivalent.

Certification of products is necessary to ensure quality assurance of products, consumer protection and compliance with Building Regulations. The cost of certification can be prohibitive, being of the order of €25,000 to have an insulation material certified. For small companies looking to enter into business in an insulation market where CIPs currently have a small share of the market, this is an significant cost since there is no guarantee that certification will increase revenue sufficiently to recoup the cost in a reasonable timeframe. However certification provides consumer product reassurance and if used to market a product effectively can significantly increase sales of a product.

### 5.2.3 Relative Newness to Market

Historically in Ireland fibreglass insulation was predominantly used in particular for ceiling insulation. The range of insulating products on the market has since increased and a greater variety of insulation products are now used in ceilings, walls and floors.

New products to the Irish market can often undergo a period of apparent buyer reluctance and it can take time to build confidence and the reputation of a product. Consumers will often avoid using new or novel building products with the ”tried and tested” products favoured

instead. Competition from existing suppliers of alternative types of thermal insulation has an impact on the uptake of a new product such as cellulose insulation.

Cellulose insulation is reasonably new on the Irish market and anecdotal industry information has shown that the fear of a ”new” product has resulted in initial slow uptake and growth. However it is gaining popularity due to its green properties and with the increase of timber housing and the passive house building model.

A method of increasing consumer confidence and creating product awareness is through demonstration projects using cellulose insulation to showcase the benefits of a product. This demonstration can be made into a written or video case study which could go on a website for easy public access. An addendum to the case studies can be made over time to demonstrate further real benefits to consumers such as their long term cost savings by space heating savings from using cellulose insulation.

Certification of innovative products demonstrating fitness for use also provides confidence to specifiers, designers and public sector bodies and promotes the use of innovative products.

### 5.2.4 Motivation for Insulating

Insulation of buildings can often require a large capital commitment with a long payback period. However with the Europe 2020 commitment to energy efficiency and national insulation grant aid programmes this has assisted the building owner to overcome this barrier. The main consumer motivation is improved comfort with lower utility bill costs. The environmental motivation is to save energy and reduce carbon emissions. A further reason to insulate is to increase the value of the building made visible through the Building Energy Rating should a building be rented or be put up for sale.

### 5.2.5 Supply of Feedstock Materials

Security of supply and the lack of a central control of waste material can be an issue for end users of recycled materials in Ireland. Long term contracts at index linked market pricing for recycled newsprint can be beneficial both to the supplier and end user of the waste paper. A long term contract will guarantee a supply of paper to the end user and the supplier will have the security of an end market for the recovered paper which can not always be guaranteed by short term export market contracts, especially in times of market and economic uncertainty.

Engagement with local community, business groups or schools etc as suppliers of recycled newsprint is another way to source feedstock. Incentives could be put in place in order to maintain the supply relationship. This also has the benefit of local waste materials feeding back into local products which is good for the wider community and also brings additional energy and carbon saving credentials to the cellulose insulation product.

### 5.2.6 Specifications

It is critically important that insulation requirements are specified in the correct way in order to allow the proper assessment of an insulating material. It can happen that insulation is specified by thickness required but insulation should be specified by U-value in order to meet building regulation requirements which are specified by U-value.

# 6 MARKETS IN IRELAND

## 6.1 GENERAL THERMAL INSULATION MARKET

The thermal insulation market in Ireland is estimated to be between €120-130 million[61] per annum. This includes thermal insulation used in new build and retrofit applications. The market is divided in to a number of distinct segments which are seen in Table 6.1.

**Table 6.1: Estimated Market Share by Insulation Type[62]**

| Thermal Insulation Type | Estimated Market Share |
|---|---|
| EPS / XPS | 25-30% |
| Phenolic | 5% |
| PIR | 25-30% |
| Mineral wool / Glass Fibre | 25-30% |
| Naturals | <10% |

The naturals segment is made of up materials such as hemp, sheep's wool, cork, cotton, cellulose insulation etc. It is estimated that cellulose insulation holds less than 1% of the total market.

## 6.2 MANUFACTURERS OF CELLULOSE INSULATION PRODUCTS IN IRELAND

There is currently one manufacturer of cellulose insulation made from recycled paper in Ireland. The company is called Ecocel and is based in Co. Cork. Ecocel produces the cellulose insulation from waste newspapers sourced in Ireland.

There is also a company called Cygnum Timber Frame Ltd. in Co. Cork that produces pre-insulated timber frame products for use in construction. Cellulose insulation is used as the insulating material in these frames. Cygnum produces its own cellulose insulation on site from locally sourced materials. The cellulose insulation is for their own production needs and is not sold as a separate product. Cygnum developed this pre-insulated timber frame product through funding received through an EU LIFE project. http://www.insulatfh.eu/

## 6.3 OUTLETS FOR CELLULOSE INSULATION PRODUCTS

The main end users of cellulose insulation in Ireland are:

- Retrofit
- Timber Frame Construction
- DIY

[61] Derived from data sourced from the CSO, DECLG, SEAI and market pricing
[62] Based on data derived from Competition Authority Reports, UK Market reports and Insulation Companies public reports

Attics and ceilings are the main target applications of the retrofit market as the majority of the poorly insulated pre-2006 houses are concrete / brick builds and are not suitable for cellulose wall insulation.

Timber frame construction has large possibilities for the use of cellulose insulation. It is possible to use it in the walls, floors, ceilings and roofs.

The DIY market is also a potential market in Ireland. However to date there has only been a small amount of activity in this area. DIY is not suitable for wall insulation as this is a highly skilled procedure and should be carried out by a professional in order to ensure the insulation is installed correctly.

## 6.4 CELLULOSE INSULATION PRODUCTS IN IRELAND

There are a range of different cellulose insulation products made from recycled newsprint on the Irish market. Table 6.2 shows information on the main products available.

**Table 6.2: Cellulose Insulation Products Available in Ireland**

| Products[63] | Range of Applications | Installation Method | Manufactured |
|---|---|---|---|
| Product 1 | • Roof, wall and ceiling | Blown-in, machine spray and manual options | Germany |
| Product 2 | • Attic and loft<br>  ○ New build<br>  ○ Retrofit<br>• Timber frame walls, roof and floor | Blown-in | Ireland |
| Product 3 | • Ceiling<br>• Roof<br>  ○ New build<br>  ○ Retrofit<br>• Timber frame walls<br>• Half timber frame walls | Blown-in | Austria, Belgium & France |
| Product 4 | • Attic<br>• Timber frame external walls | Blown-in | Finland |
| Product 5 | • Lofts<br>  ○ DIY<br>  ○ New build<br>  ○ Retrofit<br>• Timber frame walls, roof and floor | Loose<br>Blown-in | Wales |

The stated U-values in the technical documents that can be achieved by these cellulose insulation products will depend on a number of factors such as the thickness and density of

[63] Certification of cellulose insulation products may demonstrate fitness for purpose of the systems and facilitate use of the material. It is recommended that the user or specifier checks if a product has the appropriate certification for a particular application.

the material and the quality of installation. It is important to assess each product on that basis.

## 6.5 PREDICTED SIZE OF MARKET FOR CELLULOSE INSULATION PRODUCTS IN IRELAND

The main market opportunities for cellulose insulation are in the retrofit of attics in concrete build houses and in the attics, walls and floors of timber frame builds.

At the peak of the building boom timber frame builds were estimated to represent between 25-30% of the building market. It is considered that the timber frame market share is still similar to its boom time share. The Irish Timber Frame Manufacturers Association (ITFMA) estimates that the market share will grow to 50% over the next 10 years.[64] Countries such as the USA, Australia, Canada and Scandinavia have timber frame build rates of over 90% of the total market share.[65]

Based on timber frame owning a 30% market share of the new builds this would account for 1,500 houses in 2011. If house builds grow by 10% over the next 10 years in conjunction with a growth of 50% market share for timber frame houses this would account for 2,750 houses per annum.

The main insulating materials used in timber frame houses are:

- Mineral wools
- Cellulose fibres
- Synthetics i.e. PIR, EPS
- Naturals i.e. sheep's wool, hemp

The dominant materials currently used in timber frame builds in Ireland are mineral wool products and cellulose insulation products. With the increase in interest in green materials it is likely that mineral wool (with recycled content), cellulose insulation and naturals will be the more widely used insulating materials in timber frame construction. It is considered that cellulose insulation would hold between 30-40% of this timber frame market. There is of course the option for the client to specify the type of insulation product they would be most interested in using providing it meets the building requirements.

Assuming a conservative average of 2,000 kgs (2 tonnes) of cellulose insulation per house this would equate to 1,650,000-2,200,000 kgs (1,650-2,200 tonnes) of cellulose insulation product. The estimated value of this market is €875,000-1.16 million.

There are also non-household timber frame builds which are increasing in popularity for many reasons including decreased build time, versatility and engineered panels produced off site in controlled factory conditions leading to greater accuracy. In 2011 non-residential builds represented 3,000 of the planning permissions granted in Ireland. The proportion of timber builds in this sector is less than in the domestic sector but it is a growth area. Based

[64] http://www.itfma.ie
[65] http://www.sustainablehomes.co.uk/Portals/63188/docs/Timber%20Frame%20Housing.pdf

on 5-10% share of timber frame and of that a 30-40% share of cellulose insulation a conservative market value estimate is €70,000-190,000.

The retrofit market in Ireland has been stimulated by the introduction of government supports since 2009. As the building industry in Ireland slowed the retrofit market was able to provide a market for insulation products in Ireland. Projections based on the current rates of uptake of the insulation grants for ceiling/attic insulation indicate a market value estimate of €85,000 -170,000.

The overall estimated value of the cellulose insulation market over the next 10 years in Ireland could be in the region of €1-1.5 million.

The existing market for cellulose insulation is in the region of €300,000-400,000.[66] This indicates a significant increase in the market. This increase is highly dependent on the continued grant/support schemes for thermal insulation retrofits and the continued trend of timber frame builds.

This would equate to an additional 1,400 to 2,000 tonnes of cellulose insulation in order to meet this potential demand.

It is considered that this additional demand would be met through increasing the production capacity of existing indigenous producers and increased supply through existing producers as per Table 6.2.

## 6.6 AVAILABILITY OF WASTE PAPER IN IRELAND

The recovery of waste paper in Ireland is driven by a number of different factors. The Irish Packaging Regulations have been an integral piece of legislation which has progressed paper recycling. The target for 2011 has been set at 60% overall packaging recovery and a minimum of 60% of paper & board (by weight) must be recycled. The 60% target still applies in 2013. The National Strategy on Biodegradable Waste, which demonstrates how Ireland shall achieve the Landfill Directive targets, specifies the proportion of paper waste diverted from landfill to be over 67% of the quantity generated by 2016. The landfill levies imposed in Ireland have been key to directing materials to the recycling route.

According to the 2011 EPA National Waste Report 542,282 tonnes of waste paper were collected for recovery. The majority of this paper was exported for recycling, 540,085 tonnes which was 99.6% of the total recycled. In contrast 2,197 tonnes (0.4% of the total) was recycled in Ireland. Paper and Cardboard represented 45% of the recovered Municipal Waste Stream in 2011.

National Newspapers of Ireland (NNI) introduced a voluntary Producer Responsibility Initiative in 2007 which changed the system where unsold newspapers were disposed of locally by the retailer to a whole copy return system. This bulking up of newsprint has resulted in the availability of greater quantities of source segregated newsprint which may previously have been added to other paper materials to produce a mixed paper grade. This pre-consumer recycled newsprint is a perfect medium for use in the production of cellulose insulation. Used or post-consumer newsprint can also be used in the manufacture of

[66] Based on industry market intelligence

cellulose insulation. According to the NNI more than 95% of unsold newspapers are recycled.[67]

In 2010 rx3 commissioned a study into the recovered paper market in Ireland.[68] The study was carried out by Pöyry Management Consulting (London) Ltd. and the data in the report is based on the 2009 period. The study revealed that paper consumption in Ireland was 720,000 tonnes and collection of paper for recovery was 495,000 tonnes, this equates to a recovery rate of 69% which is just above the European average of 67%.

A breakdown of the paper collected for recovery by paper grade is in Figure 6.1 and Table 6.3.

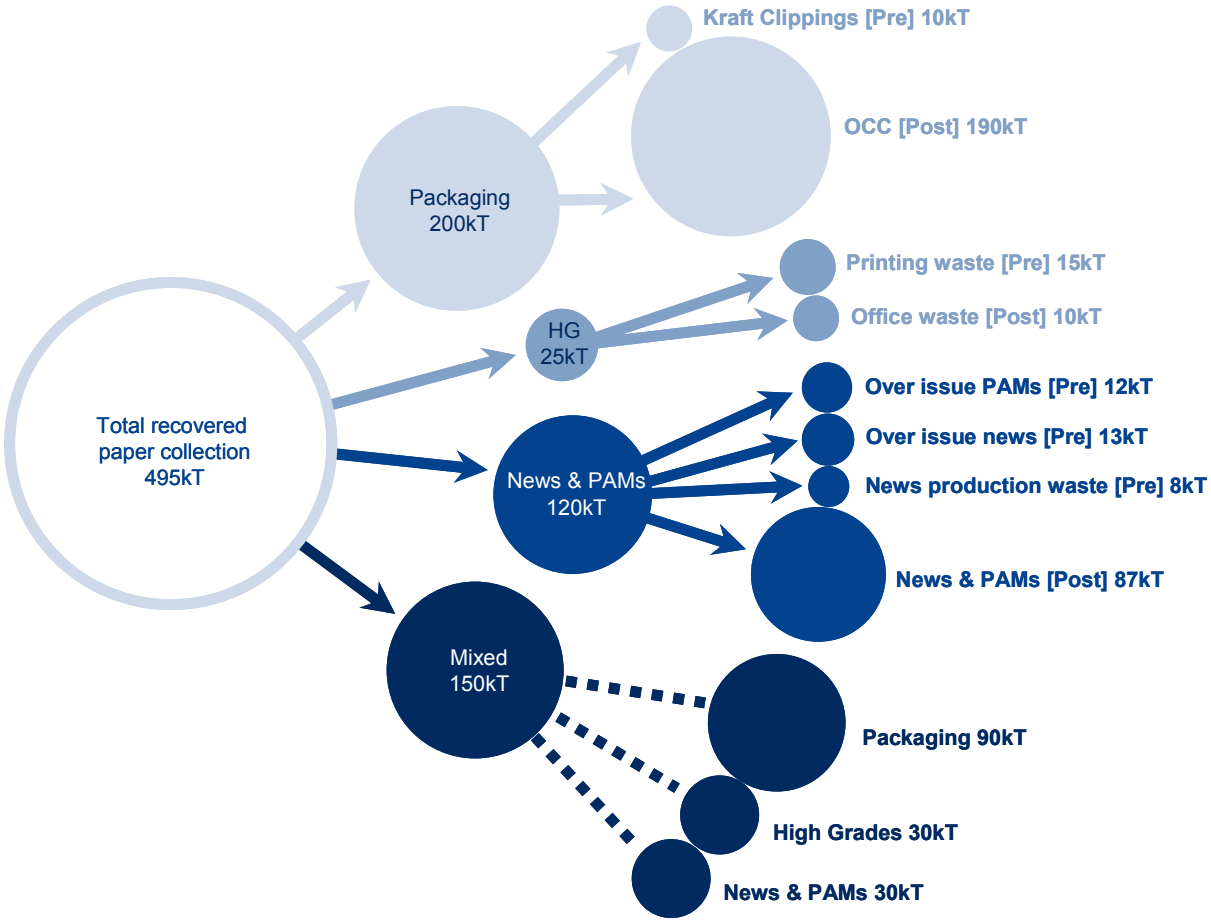


**Figure 6.1: Paper Collected for Recovery by Grade in Ireland in 2009**

[67] http://www.nni.ie/v2/broad/portal.php?content=../_includes/environment.php

[68] http://www.rx3.ie/MDGUploadedFiles/file/rx3%20Publications/An%20Assessment%20of%20the%20Recovered%20Paper%20Supply%20Chain%20in%20Ireland.pdf

**Table 6.3: Paper Collected for Recovery by Grade in Ireland in 2009**

| OCC (kT) | | High Grades (kT) | | News & PAMs (kT) | | Mixed Paper (kT) | |
|---|---|---|---|---|---|---|---|
| Kraft clippings | 10 | Printing waste | 15 | Over issue PAMs | 12 | **Packaging* | *90* |
| OCC | 190 | Office waste | 10 | Over issue news | 13 | **High grades* | *30* |
| | | | | News production waste | 8 | **News & PAMs* | *30* |
| | | | | News & PAMs | 87 | | |
| **Total: 200** | | **Total: 25** | | **Total: 120** | | **Total: 150** | |

** Note that the breakdown for mixed shows composition, not output segmentation*

The figures indicate that 120,000 tonnes of news and pams were collected and processed for the purposes of recovery. Of this 33,000 tonnes was pre-consumer in origin and 87,000 tonnes was post-consumer in origin. It was estimated that an additional 30,000 tonnes of newsprint was collected and processed as part of the mixed paper grades. This indicates that a total of 150,000 tonnes were collected for the purposes of recovery but presented as different grades.

The NNI has reported that approximately of 80% of all newspapers are recycled. This would indicate that in 2009 in the region of 30,000 tonnes of newsprint was disposed of to landfill.

These figures would indicate that there is sufficient good quality paper supply in Ireland to sustain a cellulose insulation business. The ideal sources of newsprint would originate from source separated collections such as the whole copy return system, civic amenity/recycling centres or other single stream collections. These types of systems reduce the potential for contamination of the newsprint and tend to produce a high quality product. The price that will be paid for the newsprint will be determined by its quality. Figures 6.2 and 6.3 are examples of the quality of newsprint that would be desirable for use in the production of cellulose insulation.


**Figure 6.2: High Quality Post-Consumer Newsprint**

**Figure 6.3: High Quality Pre-Consumer Over Issue Newsprint**

# 7 RESEARCH INTO THE NEED FOR STANDARDS FOR CELLULOSE INSULATION PRODUCTS IN IRELAND

## 7.1 STANDARDS IN PLACE IN THE UK, EUROPE, USA AND AUSTRALIA

The Construction Products Regulation (305/2011/EU - CPR) which replaces the Construction Products Directive (89/106/EEC - CPD) is laying down harmonised conditions for the marketing of construction products.[69]

The Construction Products Directive was introduced by the EU in order to create a single market in Europe by removing technical barriers to trade between member states through the use of harmonised standards and approvals.

The directive applied to construction products that were produced for, or incorporated within, building and civil engineering construction works. It harmonised assessment methods for construction products subject to regulatory controls for CE marking purposes. A CE marked product can be sold anywhere in the European Economic Area. The CE mark does not denote quality but rather demonstrates conformity to the testing and reporting regime of the standard.

As part of the Better Regulation initiative, the CPR provides more clarification of the concepts and the use of CE marking; introduces simplified procedures, which will reduce the costs incurred by enterprises, in particular small and medium enterprises (SMEs).

By imposing new and stricter designation criteria to bodies involved in the assessment and the verification of construction products, the CPR is also increasing the credibility and reliability of the whole system.

The free movement of designers, civil engineers and construction services is now facilitated after the publication and EU-wide implementation of common European technical standards for structural design: the Eurocodes.

Supporting activities in the field of improving the competitiveness of the sector, specific policies, background research and technical assessment methods are increasing the level playing field for manufacturers, civil engineers and contractors.

Once developed the harmonised standard replaces any existing national standards which may be in existence in order to establish the level playing field for product trade across Europe. Where no harmonised product standards exist a **E**uropean **T**echnical **A**pproval (ETA) for a construction product is a favourable technical assessment of its fitness for an intended use, based on the contribution made by this product to the fulfilment of the six Essential Requirements, as stated in the CPR for the construction works in which the product is installed.

In conjunction with a Conformity procedure (which is intended to ensure that the product specification set out in an ETA is maintained by the manufacturer), ETAs allow manufacturers to place CE marking on their products.[70]

[69] http://ec.europa.eu/enterprise/sectors/construction/index_en.htm

When incorporating a product, material or system into construction works, it is essential however, that the declared performances are fit for the use in which the product, material or system is intended and for the conditions in which it is to be used.

There are a number of EU Standards that have been developed for thermal insulation but there are currently no EU standards in place for Cellulose Insulation Products. However two standards are being developed under the technical committee CEN / TC 88.

- Thermal insulation products for buildings - In-situ formed loose fill cellulose (LFCI) products - Part 1: Specification for the products before installation (Project Reference prEN 15101-1). Part 1 describes the product characteristics and includes procedures for testing, marking and labelling and the rules for evaluation of conformity.

- Thermal insulation products for buildings - In-situ formed loose fill cellulose (LFCI) products - Part 2: Specification for the installed products (Project Reference prEN 15101-2). Part 2 also specifies the checks and tests to be used for the declarations made by the installer of the product.

On consultation with CEN and NSAI, it is known that prEN 15101-1 and prEN 15101-2 are currently in preparation and their foreseen date of availability is January 2014. The earlier draft versions of these standards can be purchased and the NSAI / SAI Global website contains details on how to procure these documents. However the final versions when publically available must be used as they may be significantly different to draft versions.

Thermal conductivity of cellulose insulation must be measured in accordance with IS EN 12667:2000 Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Products of high and medium thermal resistance.

Upon completion of cellulose insulation installation any exposed pipework above the installed insulation must be insulated in accordance with BS 5422:2009 Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range of –40°C to +700°C. This updated standard supersedes BS 5422:2001 which has been withdrawn.

There are a number of British Standards that relate to cellulose insulation:

- BS5803-3:1985 Thermal insulation for use in pitched roof spaces in dwellings – Specification for cellulose fibre thermal insulation for application by blowing which is used to determine product characteristics, corrosivity, vibration, settlement and humidity etc.

- BS5803-4:1985 Thermal insulation for use in pitched roof spaces in dwellings – Methods for determining flammability and resistance to smouldering.

[70] http://www.eota.be/en-GB/content/what-is-an-eta/4/

- BS5803-5:1985 Thermal insulation for use in pitched roof spaces in dwellings – Specification for the installation of man-made mineral fibre and cellulose fibre thermal insulation which is used to assess condensation.

ASTM International, formerly known as the American Society for Testing and Materials has many standards relating to cellulose insulation.[71]

- ASTM C739 - 11 Standard Specification for Cellulosic Fiber Loose-Fill Thermal Insulation – This specification covers the composition and physical requirements of chemically treated, recycled cellulosic fiber loose-fill type thermal insulation for installation in attics or enclosed spaces in housing and other buildings by pneumatic or pouring method. It covers testing for r-value, odour, moisture, vapour sorption, fungi, resistance, critical radiant flux, smouldering combustion, corrosiveness settled density and thermal resistance etc.

- ASTM C1497 - 04 Standard Specification for Cellulosic Fiber Stabilized Thermal Insulation. This specification covers the composition and physical properties of spray-applied cellulosic fiber stabilized thermal insulation applied to open or closed ceiling spaces, regardless of slope. Test methods to determine the following properties include: thermal insulation: density, corrosiveness, critical radiant flux, fungi resistance, water vapor sorption, odour emission, smoldering combustion, thermal resistance, flame resistance permanency, shrinkage, and settling.

- ASTM C1015 - 06(2011)e1 Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation. This practice covers procedures for the installation of cellulosic and mineral fiber loose-fill insulation in ceilings, attics, and floor and wall cavities of new or existing housing and other framed buildings.

The Australian standard AS 2462-1981 for Cellulosic fibre thermal insulation specifies the composition and physical requirements of cellulosic fibre thermal insulation available as loose fill and derived from wood based paper amended in 1985 and 1986. The material is intended to be used in temperatures ranging from -20°C to 80°C as loose fill thermal insulation in buildings, applied by pneumatic or hand spreading techniques, primarily for above ceiling situations.[72] These earlier standards however have been superseded by the standard AS / NZ 4859.1 2002 which was amended in 2006. This standard is concerned with "Materials for the thermal insulation of buildings - General criteria and technical provisions".[73]

There are additional standards that relate to cellulose insulation. However the main standards are cited above.

## 7.2 CURRENT STANDARDS ADHERED TO IN IRELAND AND CERTIFICATION

With no national standards for Cellulose Insulation Products currently in place in Ireland, NSAI Agrément certification has been used to demonstrate fitness for purpose of these building products.[74] NSAI Agrément is the organisation appointed by Government to issue European Technical Approvals. NSAI Agrément is responsible for Agrément assessment and

[71] http://www.astm.org/search/site-search.html?query=cellulose+insulation
[72] http://www.saiglobal.com/shop/Script/Details.asp?DocN=stds000003549
[73] www.saiglobal.com/shop/Script/Details.asp?DocN=AS0733779441AT
[74] http://www.nsai.ie/About-NSAI/Departments/Agrement.aspx

certification and operates as part of the NSAI (National Standards Authority of Ireland) and is a full member of EOTA, the European Organisation of Technical Approvals.

NSAI Agrément issue technical certification for new and innovative products and processes in building and materials technology. The process of Agrément certification applies to those products and processes that are not already regulated by existing building standards, either because they are innovative or because they deviate from established norms. The certification confirms that new building products, materials, techniques and equipment are both safe and fit for purpose. The purpose of Agrément certification is to raise standards in the building industry with respect to these innovative products and processes.

Agrément certification is a code of proof that a product is a proper material suitable for its' intended use in Irish site conditions, that it meets requirements of the Irish building regulations and the rules of the European Union of Agrément Institutes for Construction (UEAtc).

Agrément certification involves the following steps:

- Process of application
- Development of a Technical Assessment Specification (TAS), which sets out the technical criteria for assessment and testing
- Product assessment to ensure that it conforms to the TAS. This might include laboratory testing, on-site evaluation and inspection of the production process
- Subject to the results of the assessment, NSAI Agrément Certificate drafted
- Certificate published on the NSAI website

The criteria upon which Agrément certification is based vary from product to product, taking into account construction standards across a range of measures such as:

- Safety
- Habitability
- Durability
- Maintenance
- Practicability

In order for a cellulose insulation product to achieve Agrément certification it must tested against a number of standards such as BS5803-3, BS5803-4,& BS5803-5, IS EN 12667:2000 and BS 5422:2001. It must comply with all of the relevant building regulation requirements and the ECTI publication EF 207:2003 Guide to the National rules for electrical installation as applicable to domestic installations.

Where cellulose insulation is used as a part of a system it should also comply with standards relevant to that system. In particular where cellulose insulation is used in timber frame construction it should comply with I.S. 440:2009 Timberframe Dwellings.


**Figure 7.1: NSAI Agrément Logo**

## 7.3 REQUIREMENTS FOR IRISH STANDARDS

As mentioned in Section 7.1 Cellulose Insulation is a building product and comes under the jurisdiction of the Construction Products Regulation. As harmonised European standards are being developed for use in all member states it will not be a requirement to develop a separate National Standard.

# 8 RECOMMENDATIONS AND CONCLUSIONS

There are a wide range of insulation products on the market in Ireland each with their own particular properties and characteristics. It is important to select a product that is suited to the building type and that meets the needs of the occupier.

Cellulose Insulation is competitively priced in relation to other insulating materials which makes it an attractive option for installation. The cost of installation of the cellulose insulation may vary as there is the potential to self install (attics only) or to engage a professional installer. It is essential that the material is installed correctly in order to ensure that the required U-value is achieved.

There are instances where insulating materials are specified by depth of material. It is critical that thermal insulation is always specified by U-value rather than thickness in order to gain the maximum benefit from the insulating material.

The green credentials of cellulose insulation are also a benefit to consider when deciding on an insulating material to use. Cellulose insulation made from waste newsprint has a low embodied energy, is also considered to be less of an irritant during the installation process and it maintains a long term healthy environment within a building. The increasing trend towards green eco-conscious purchasing decisions puts cellulose insulation in a good position. Cellulose insulation products are also manufactured in Ireland which provide further environmental and community benefits through locally sourced newsprint and reduced transport impacts.

The study demonstrated that there is sufficient high quality waste newsprint generated in Ireland which could be made available for use in cellulose insulation production. The National Newspapers of Ireland (NNI) and local community may be good sources of high quality pre and post-consumer newsprint feedstock for indigenous manufacturers.

Certification of a cellulose insulation product is important to gain access to markets. European standards are currently being developed for cellulose insulation products and are due to be published in 2014. Draft versions of these standards are available however these can change prior to the publication of the final versions. It would be advantageous for cellulose insulation manufacturers to access the draft standard in order to prepare for the full standard which will supersede any existing national certification systems.

It is a recommendation that cellulose insulation products obtain appropriate third party certification until the harmonised standard prEN 15101-1 for in-situ formed loose fill cellulose insulation products is published. This certification will enable access to the market for the product, and it will ensure ease of transition to the new harmonised standard when it is produced.

The main applications for cellulose insulation at the current time in Ireland are in the roof, attic and walls of timber frame builds. It is also used in floor applications but less so than in roofs, attics and walls. It is also used in the attics of non-timber frame buildings. However it is predominantly used in the timber frame building market. The requirements of I.S. 440:2009 Timberframe Dwellings should be complied with in timber frame construction.

In Ireland cellulose insulation is installed using the dry blown method. The wet spray wall market is not developed in Ireland and it is considered by industry that this an area which is

unlikely to develop as it is a challenging and more time consuming process than dry cellulose insulation installation.

In timber frame builds it is typical that the insulation is installed after the building has been erected. However timber frame walls pre-insulated with cellulose insulation, which are manufactured in Ireland, can be purchased for building construction.

It is known that over 1 million private houses in the current housing stock were built with low levels of thermal insulation prior to the introduction of the building regulations. SEAI data indicates that in the region of 100,000 private houses have upgraded their insulation through the current insulation grant programme. Private households also install thermal insulation outside of the government grant programme; however there is no clear data on the number of households or the degree and type of insulation measures installed. Based on the available data on private households it shows that there are still a significant number of households requiring insulation in order to bring them up to current building standards.

The local authority and voluntary social housing stock which is estimated at 150,000 units is also undergoing retrofit activity. Consideration of cellulose insulation as a retrofit insulating product in line with green procurement objectives would be dependent on products obtaining the appropriate certification.

Additionally there are public and commercial buildings pre-dating 2006 that require thermal insulation to current building standards. With the continued government commitment to drive energy efficiencies to meet EU and national 2020 energy targets of reducing energy consumption by 20% through continued energy efficiency schemes; there is potential for cellulose insulation to take a share of the retrofit of these houses and public and commercial buildings.

The retrofit ceiling insulation market is dominated by the fibreglass market and pre-dating the retrofit grant scheme the ceiling insulation most commonly used was again fibreglass. Due to this fibreglass dominance the cellulose insulation share is very small however this can be increased as consumers become more open to a “new” material such as cellulose insulation and understand the additional benefits such as soundproofing, environmental and health and safety.

The current SEAI insulation grant system is based on policy which encourages deep retrofit of buildings and it is not possible to receive grant aid for attic insulation alone. When the grant system comes to an end and the “Pay as you Save” scheme commences policy will continue to encourage multiple insulation measures, however it is likely that attic insulation will be a key part of retrofit activity.

A properly insulated roof can bring energy savings of 30-35% and financial savings of 20%, this is a significant benefit to homeowners and will help achieve national and EU energy targets. It has been reported by suppliers and installers of insulation that many homeowners request attic insulation only. It is recommended that any “Pay as you Save” scheme introduced would be a flexible system that would allow for single insulation measures in order to bring some energy efficiencies where attic only insulation is required and increase the levels of insulation in Irish homes.

There is also continuing new build taking place, less than 16,000 planning permissions were granted in 2011, these builds must conform to building regulations and will require insulation

thereby providing market opportunities for cellulose insulation. The opportunities are in particular, where the new builds are timber frame constructions.

The market for cellulose insulation peaked in Ireland in line with the building boom. The market for cellulose insulation has dropped since this time as it was closely aligned to timber frame new builds. This has left existing manufacturers of cellulose insulation with capacity to produce sufficient quantities for future demands on cellulose insulation. It is for this reason that it is recommended that the future supply of cellulose insulation be delivered through existing manufacturers where infrastructure is in place to process waste newspaper into cellulose insulation.

With the continued interest in green products and public environmental consciousness, combined with the increased uptake of timber frame builds and schemes in place for retrofit insulation it is considered that the market for cellulose insulation will increase. However as a “new” product and with the strong historical dominant market position of other insulating products, it will be a gradual increase with a relatively low overall market share.


regulations
environmental
BER
newsprint
standards
recycled
timber
Ireland
mineral
market
roof
building
wall
thermal
energy
savings
installation
paper
GPP
efficiency
retrofit
green
insulation
certification
U-value
loose-fill
materials
NSAI
material
Ecolabel
heat
wool
carbon
supply
performance
products
ceiling
houses
construction
cellulose