

Written evidence submitted by

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**Joe Duirwyn** is the founding director of Hartwyn, a construction company focusing on natural materials use and training. Founder member of SBUK. Associate of the Quality of Life Foundation.

*We are individual members of the independent and voluntary Architects Climate Action Network (ACAN), a mission driven unincorporated organisation established by a group of practising architects in 2019 to rapidly accelerate industry efforts to respond to the climate and ecological emergencies. We have three overarching aims; 1) Rapid decarbonisation of the built environment; 2) Embedding ecological and regenerative principles and 3) Cultural transformation of the design professions to achieve this.*

*We are part of the Natural Materials working group focusing primarily on the first and second aims, Rapid Decarbonisation and Ecological Regeneration. Our group within the ACAN network launched in early 2021, with the aim to help enable natural materials to be used in mainstream construction. We have brought together professionals working in the nature-based materials industry, including architects, designers, specifiers, consultants, builders & contractors, producers, manufacturers, suppliers, and a combination of the above. Our response reflects the insights and intelligence of this diverse group, and our submission will focus on why and how we think natural construction materials should be supported.*

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**“How can materials be employed to reduce the carbon impact of new buildings, including efficient heating and cooling, and which materials are most effective at reducing embodied carbon?”**

**What role can nature-based materials play in achieving the government's net-zero ambition?**

**What role can the planning system, permitted development and building regulations play in delivering a sustainable built environment? How can these policies incentivise developers to use low carbon materials and sustainable design?”**

1.0 Introduction

1.1 Our current material use as an industry is unsustainable. We must radically and urgently change our approach towards the substance of our built environment in order to reduce carbon and significantly alter our current projection towards an uninhabitable planet. When used holistically, natural materials have long been established as a low carbon solution with many widely ranging positive impacts. We define ‘natural materials’ as minimally processed materials of organic origin that are abundant / renewable, climate positive and non-toxic.

2.0 Reject ‘Business as usual’

2.1 In order to achieve a ‘net-zero-carbon’ future, we need to reduce our energy use in every way possible. If we continue to consume materials at our current rate, we will not achieve carbon targets for the built environment, nor the UK. Therefore the transition to an alternative model is vital. We cannot continue with business as usual.

3.0 Embodied Carbon/Energy

3.1 The construction industry has been working effectively on reducing the operational energy of our built environment for many years, leading to an understanding of an overall carbon budget for designing and specifying our buildings. Reducing the baseline carbon of our materials choices is the quickest route to successful zero carbon or net zero carbon targets.<sup>1</sup> Natural materials have extremely low embodied carbon throughout the product life-cycle:

- Sourced from low intensity crops <sup>2</sup>
- Unprocessed, or requiring minimal processing
- Locally abundant, reducing transport miles <sup>3</sup>
- Can be sourced from waste streams <sup>4</sup>
- Can be carbon negative in use (cradle to gate analysis), or are significantly lower carbon than conventional alternatives

3.2 Utilising natural materials not only immediately lowers the embodied carbon of our buildings but also combines many distinct characteristics that result in healthy, high-performance structures, with minimal technological intervention.

4.0 Sequestered Carbon

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<sup>1</sup>Woodknowledge Wales. 2021. *Embodied Carbon Guidance for Welsh Social Housing Developers, their design teams, contractors and suppliers - Woodknowledge Wales*. [online] Available at: <<https://woodknowledge.wales/wkw-resource/hgh-ec-guidance>> [Accessed 15 May 2021].

<sup>2</sup> Climate CoLab. 2021. *Growing Hemp - Materials Matter 2016 - Climate CoLab*. [online] Available at: <<https://www.climatecolab.org/contests/2016/materials-matter/c/proposal/1330112>> [Accessed 15 May 2021].

<sup>3</sup> Bre.co.uk. 2021. [online] Available at: <[https://www.bre.co.uk/filelibrary/pdf/projects/low\\_impact\\_materials/IP15\\_11.pdf](https://www.bre.co.uk/filelibrary/pdf/projects/low_impact_materials/IP15_11.pdf)> [Accessed 15 May 2021].

<sup>4</sup> 2021. [online] Available at: <<https://www.greenspec.co.uk/building-design/woodfibre-manufact-process/>> [Accessed 15 May 2021].

4.1 Natural materials have the potential to not only radically reduce both operational and embodied carbon, but also for us to transition towards a model whereby we treat the built environment as a carbon sink - sequestering carbon both through resource management (i.e. the growth of forests), and locking it within the building fabric.

4.2 Plant-based materials have the added benefit of having absorbed CO<sub>2</sub> whilst growing, which is stored (or 'sequestered') within the material for the duration of its life, until it decomposes or burns. Therefore, using plant-based materials in long-life buildings means that carbon is locked away in the building for as long as it lasts. This carbon capture and storage could play a vital role in an urgent response to the climate emergency. If we can both regenerate the land and increase the number of buildings (including retrofit of existing) that are carbon stores, then we can immediately prevent significant amounts of carbon from entering the atmosphere.

#### 5.0 Performance: Energy efficiency

5.1 Natural materials can be used to improve the thermal performance of existing buildings and new buildings, amongst other benefits. Many historic buildings in the UK are in need of significant thermal upgrade in order to reduce energy loss, and natural materials are crucial in ensuring that the building fabric is not negatively affected by maintaining breathability.

5.2 While most natural insulation products are slightly thicker than man-made alternatives, the overall building fabric need not change significantly in thickness if detailed correctly. For example, timber frame construction with natural insulation can achieve Passivhaus standards of thermal performance while totalling a wall thickness of approximately 350mm, whilst conventional brick and block wall construction is typically between 300-340mm thick including only just enough insulation to pass Building Regulations. It's vital that the minimum thermal performance of new buildings and new thermal elements in buildings is significantly upgraded from current building regulations if the UK is to meet energy targets. Therefore, switching conventional construction methods to timber frames, for example, will save on space while enabling improved performance.

#### 6.0 Health impacts + financial cost

6.1 Natural materials are considered 'old fashioned' and humble, yet there is hugely complex science involved, which means that apart from having the lowest embodied carbon and also facilitating the sequestration of carbon, they can work to control relative humidity, reduce airborne toxins and formaldehydes, and some are naturally fireproof.

6.2 One of the key benefits of most natural building materials is their vapour-open characteristic. This is sometimes called 'breathability', but it refers to vapour and humidity rather than air movement. A vapour-open building allows humidity to self-regulate through the building fabric, without causing moisture build up. Vapour-closed buildings (which are typical in conventional construction) try to shut moisture in and out, but over time this can lead to damp and mould growth inside the room, as well as rot within the building fabric. Living in such vapour-sealed buildings requires reliance on high levels of constant ventilation, which inevitably causes heat loss and reduced energy efficiency. Ventilation is always important in any building, particularly well insulated and draught-proof buildings, but humidity control can be self-regulated by vapour-open building materials, which reduces the energy demand and significantly improves air quality.

6.3 There is now overwhelming scientific evidence that maintaining indoor air humidity between 40-60%, has significant benefits for human health. It is the optimal level for our respiratory immune system. Drier air provides a clear pathway for airborne viruses, such as COVID-19. Scientists around the world are calling on the World Health Organisation to recognise this humidity range as a critical factor for health. The International WELL Being Institute recognises indoor humidity control as a key factor for Covid-19 Recovery across the world. Respiratory illnesses like asthma alone cost the NHS £4.9<sup>5</sup> billion a year, which are conditions largely attributed to air pollution and poor housing conditions<sup>6</sup>.

6.4 Natural internal finishes like clay plasters, wood, hemp-lime and cork have hygroscopic properties, meaning that they go one step further than vapour-open by actively drawing and storing humidity within the material, helping regulate the internal air humidity. Natural earthen plasters (unfired clay) are one of the best materials available when it comes to moisture buffering. Clay has a hygroscopic capacity that is 10 times better than gypsum, with wood better still.

6.5 While unfired earth plasters have been used for millennia in buildings as the world urbanised, they have been replaced with high carbon, toxic finishing materials.

6.6 The Living Building Challenge<sup>7</sup> (LBC), the world's most rigorous sustainability building standard, advocates for regenerative buildings that are in harmony with nature through nature-based solutions and materials. Certification to the LBC standard is achieved only following the demonstration of design intent e.g. on carbon, energy, water, air quality, over a 12-month continuous period. This fosters greater use of natural materials, localised supply chains and local community benefit, and a real collaboration across the project team, i.e. material supply, design, construction and operation. It also goes a long way to removing the performance gap between design and building in use.

6.7 Core to the LBC Material imperative is the Red List of prohibited use of chemicals, materials or products of concern within buildings. Red List compliance is monitored and verified through rigorous transparency and the Declare label. (Declare labels, likened to food ingredient labelling, provide transparency information on material sourcing, in use and reuse/disposal)

6.8 Toxicology is another important consideration for specification. EPS (Expanded PolyStyrene) insulation is recognised by the EPA (United States Environmental Protection Agency) as a health threat <sup>8</sup>(US EPA, Styrene, 2020) and is considered a human carcinogen. Natural materials are often VOC free and non-toxic, and in some cases actually help to filter toxins from the air<sup>9</sup>.

## 7.0 Waste + Circularity

7.1 It's important to consider the full life cycle of 'nature-based' / natural materials, from their sourcing to their disposal, as each part of the process has an impact. Whole Life Carbon considers as much of a material or fabric's lifetime carbon impact as possible, from the initial resource extraction and processing

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<sup>5</sup> England, N., 2021. *NHS England » Respiratory disease*. [online] England.nhs.uk. Available at: <<https://www.england.nhs.uk/ourwork/clinical-policy/respiratory-disease/>> [Accessed 15 May 2021].

<sup>6</sup> RCPCH. 2021. *The inside story: Health effects of indoor air quality on children and young people*. [online] Available at: <<https://www.rcpch.ac.uk/resources/inside-story-health-effects-indoor-air-quality-children-young-people>> [Accessed 15 May 2021].

<sup>7</sup> Passivhaustrust.org.uk. 2021. *Project Gallery*. [online] Available at: <<https://www.passivhaustrust.org.uk/projects/detail/?cld=88>> [Accessed 15 May 2021].

<sup>8</sup>US EPA. 2020. *Styrene*. [online] Available at: <[https://www.epa.gov/sites/production/files/2020-05/documents/styrene\\_update\\_2a.pdf](https://www.epa.gov/sites/production/files/2020-05/documents/styrene_update_2a.pdf)>

<sup>9</sup> Epa.gov. 2021. [online] Available at: <[https://www.epa.gov/sites/production/files/2020-05/documents/styrene\\_update\\_2a.pdf](https://www.epa.gov/sites/production/files/2020-05/documents/styrene_update_2a.pdf)> [Accessed 15 May 2021].

through delivery, installation, and operation. We also must consider the end-of-life implications for our materials. One consideration is designing for the circular economy by using our buildings as materials banks, allowing for disassembly and reuse before ultimate disposal. Natural materials lend themselves particularly well to this. Lime mortar, along with its high-performance characteristics is easily removed from brick or block, allowing non-destructive disassembly of buildings. Most timber elements can be reused or recycled effectively. Ultimately, plant-based materials like timber, straw, hemp, or wool are safely compostable, returning nutrients to the ground and sinking carbon into the soil. Clay and sand can also safely return to the earth to be extracted and used again in the future, providing they have not had their molecular structure altered through processing, such as with firing or the addition of cement. Lime, on the other hand, will eventually naturally return to limestone through its curing process, making it a cyclical material.

## 8.0 The Role of Planning Policy in Material Production

8.1 The responsible production and sourcing of natural construction materials is strongly linked to UK land use and planning policy, where there is potential for regenerative land management practices.

8.2 Plant-based construction materials in particular, such as timber, straw and hemp, can be sourced from diverse regenerative land management practices, which can have the added benefits of providing food, increasing biodiversity, reducing flood risk, restoring soils, increasing carbon storage, and improving mental and physical health, to name a few. There is a significant unmet demand in the UK for access to affordable land with attached low-cost housing that enables people to work in agroecology and agroforestry. When asked in a small survey in June 2020, approx. 750 people said they would ecologically manage land under 10 acres in the UK if there was an opportunity to build their own zero-carbon home on the site. Policies that support people entering these lifestyles of small-scale sustainable land management could have a very positive effect on regenerating our land and providing a sustainable and diverse resource of natural construction materials, as well as improving local resilience.

8.3 The UK is facing its biggest mental health crisis in history, yet working in nature, such as planting and nurturing forestry stock, agroecology practices, and working with earth, are all known to contribute towards improved mental health.

8.4 Some existing supportive initiatives include the Ecological Land Cooperative and Community Supported Agriculture, among others. However, planning policy and affordability play a significant role to the access of land throughout the UK, and the current policies are preventative rather than supportive. Wales' One Planet Development scheme<sup>10</sup> allows self builders to build zero carbon homes on agricultural land, but only under very strict criteria, making it extremely difficult to achieve. Proper research is needed into the links between potential rural planning policies and regenerative resource management contributing to industries reliant on low-carbon materials and food.

## 9.0 The Role of Planning Policy on Housing Development

9.1 In Austria approximately 70% of development is self-build (or custom-build), which typically uses higher levels of sustainable products and materials than developer-led housing. In the UK, only 10% of development is self/custom-build, with most new housing built by developers. Breaking this development

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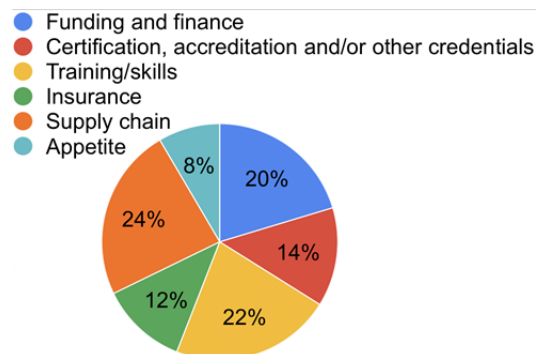
<sup>10</sup> One Planet Centre. 2021. *What is One Planet Development in Wales?*. [online] Available at: <<https://theoneplanetlife.com/what-is-one-planet-development-in-wales/>> [Accessed 15 May 2021].

model through more self-build supportive planning policies would encourage higher-quality house building with more sustainable materials.

## 10.0 Businesses in the Natural Material Industry

10.1 This next part of our response seeks to complement the evidence for why natural materials have a significant role to play in achieving net zero. To support the preparation of a response, we carried out a brief survey of businesses working in the nature-based materials industry, to gather first-hand information and evidence of the challenges facing the industry. A link to the survey results can be found [here](#). This survey is intended as an initial 'litmus test', suggesting a direction of travel for further research.

10.2 The survey identifies a number of challenges that businesses starting out in the nature-based materials industry face specifically. These offer a clear direction for positive intervention in terms of policy, to reduce the barriers facing the growth of the industry.



- The supply chain is identified by ¼ of respondents as the most significant challenge faced. The topic of supply chain will be explored in more detail in the next section.
- A lack of training and skills is the second most common challenge, experienced as a barrier both in terms of workforce and in the wider industry of architects, designers and specifiers. There is the opportunity to support educational programmes, both within and outside of existing courses and schools, to disseminate the necessary knowledge and skills to support a growth in use of nature-based materials. Specific to architects, the proposed amendments to the Architects Act 1997 including the requirements for additional training in response to sustainability offer an opportunity for this to be delivered industry-wide within a quick time scale, contrasted with educating through existing universities which will take decades to fully impact on practice;
- Funding and finance follows as the third.

10.3 A specific issue highlighted by the above is the barrier that certification, accreditation and other credentials pose to the industry. This is closely related to the issue of funding and finance, with testing and data gathering coming at a very high cost which is particularly challenging for an industry which appears to be dominated by micro businesses (just under 80% of respondents). With the growth of BIM, BREAAAM and other data-led systems, this burden is going to increase. From the shared perspective of the group membership targeted, support for nature-based and other low carbon materials could have a substantial positive impact upon the growth of the industry.

10.4 As an example of how government support through policy can have a significant impact on the natural material industry, France's natural fibre insulation industry grew by 90% in 2020 directly due to

proactive policy. Pro-timber / natural material policies would also create meaningful jobs and career opportunities.

## 11.0 Material Supply

11.1 The survey also gathered insights on the importance of the supply of natural materials in the growth of their business:

- The survey identifies over ⅓ of the respondents foreseeing an increase in demand as one of the most significant impacts that the climate crisis will have on their business;
- Just under ⅕ of respondents to the same question expressed that reliability of material sourcing was a core concern;
- 47% of respondents sourced some or all of their materials from the UK, with the majority sourcing from a combination of both the UK and EU;
- Material shortages have been experienced in recent years, currently including steel, timber (which has increased in price by as high as 90%), wood fibre, gypsum and straw.

11.2 This demonstrates the challenge currently facing the UK in terms of meeting the scale of additional demand upon the industry, placing even more urgency upon necessary measures to support businesses working and operating in the industry, with a particular focus on producers and suppliers.

11.3 The supply chain challenge presents a need to diversify materials to reduce reliance on any single material stream, thereby dependency on specific land typologies, production systems and sources. Of the survey respondents, 80% are already engaged with multiple nature-based materials, including timber, straw, hemp, flax, earth & cob, lime and clay. In terms of industry growth and presence, however, this fragmentation could be perceived as a challenge in the face of well-organised, long-established lobbying bodies for higher carbon materials.

11.4 The UK currently imports the majority of timber for construction, but also has significant areas of woodland that are undermanaged. There are opportunities to better use the timber we currently have in the UK, but also huge potential to increase our tree cover by supporting forestry.<sup>11 12</sup> Much of the low grade timber and woodland thinnings currently grown in the UK could be utilised for upscaling the wood fibre insulation industry.<sup>13 14</sup> Research shows that there is currently enough waste straw available in the UK to build approximately 53,000 three-bed houses per year.<sup>15</sup> Hemp for construction can also be a bi-product as the hemp plant is grown for a wide range of uses. Hemp is incredibly beneficial to the soil and so can play a strong role in regenerative land management.<sup>16</sup> Clay plasters and other products are

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<sup>11</sup> Woodknowledge Wales. 2021. *Home-Grown Homes Project—A study for improving the Timber Construction Supply Industry in Wales - Woodknowledge Wales*. [online] Available at: <<https://woodknowledge.wales/wkw-resource/home-grown-homes-report>> [Accessed 15 May 2021].

<sup>12</sup> Woodknowledge.wales. 2021. [online] Available at: <<https://woodknowledge.wales/wp-content/uploads/2020/10/Serious-about-Green-WKW-FERL-report-Oct-2020-vB-002.pdf>> [Accessed 15 May 2021].

<sup>13</sup> Woodknowledge.wales. 2021. [online] Available at: <[https://woodknowledge.wales/wp-content/uploads/2020/10/PFT-NFIN-Study-201404117\\_RevE-2.pdf](https://woodknowledge.wales/wp-content/uploads/2020/10/PFT-NFIN-Study-201404117_RevE-2.pdf)> [Accessed 15 May 2021].

<sup>14</sup> Napier. 2021. *phase i innovation and commercialisation of homegrown wood fibre insulation*. [online] Available at: <<https://www.napier.ac.uk/research-and-innovation/research-search/projects/phase-i-innovation-and-commercialisation-of-homegrown-wood-fibre-insulation>> [Accessed 15 May 2021].

<sup>15</sup> John Butler - Sustainable Building Consultancy. 2021. *Is there enough straw to build with? Sustainable Materials series — John Butler - Sustainable Building Consultancy*. [online] Available at: <<https://www.sustainablebuildconsultancy.com/blog/isthereenoughstraw>> [Accessed 15 May 2021].

<sup>16</sup> Growyorkshire.co.uk. 2021. [online] Available at: <<https://www.growyorkshire.co.uk/wp-content/uploads/2021/03/Yorkshire->

already manufactured in the UK and with the raw materials readily available within the country it is an industry that can be scaled up quickly, providing jobs throughout the supply chain.

## 12.0 Conclusion: How can the government help?

- Regulate embodied carbon within building regulations
- Set traffic-light system for declaring embodied carbon on products for consumer clarity
- Encourage sequestered carbon within buildings through incentives
- Support regenerative land management with forward-thinking planning policies
- Boost the green economy with grants and business support for natural material manufacturers/suppliers
- Make transparency on material ingredients/components mandatory - eg through Declare and other transparency labels
- Mandate the teaching of climate literacy and low-carbon construction methods within industry education at all levels
- Regulate vapour-open construction for new and historic buildings within building regulations
- Regulate use of single-use products/materials

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