Built Environment — Smarter Transformation

Fabric First – Sustainable Insulation in Scottish Construction

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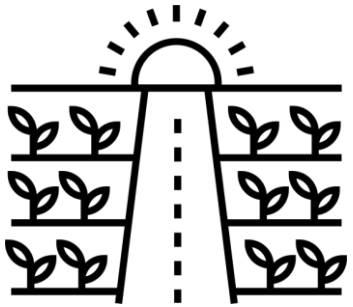
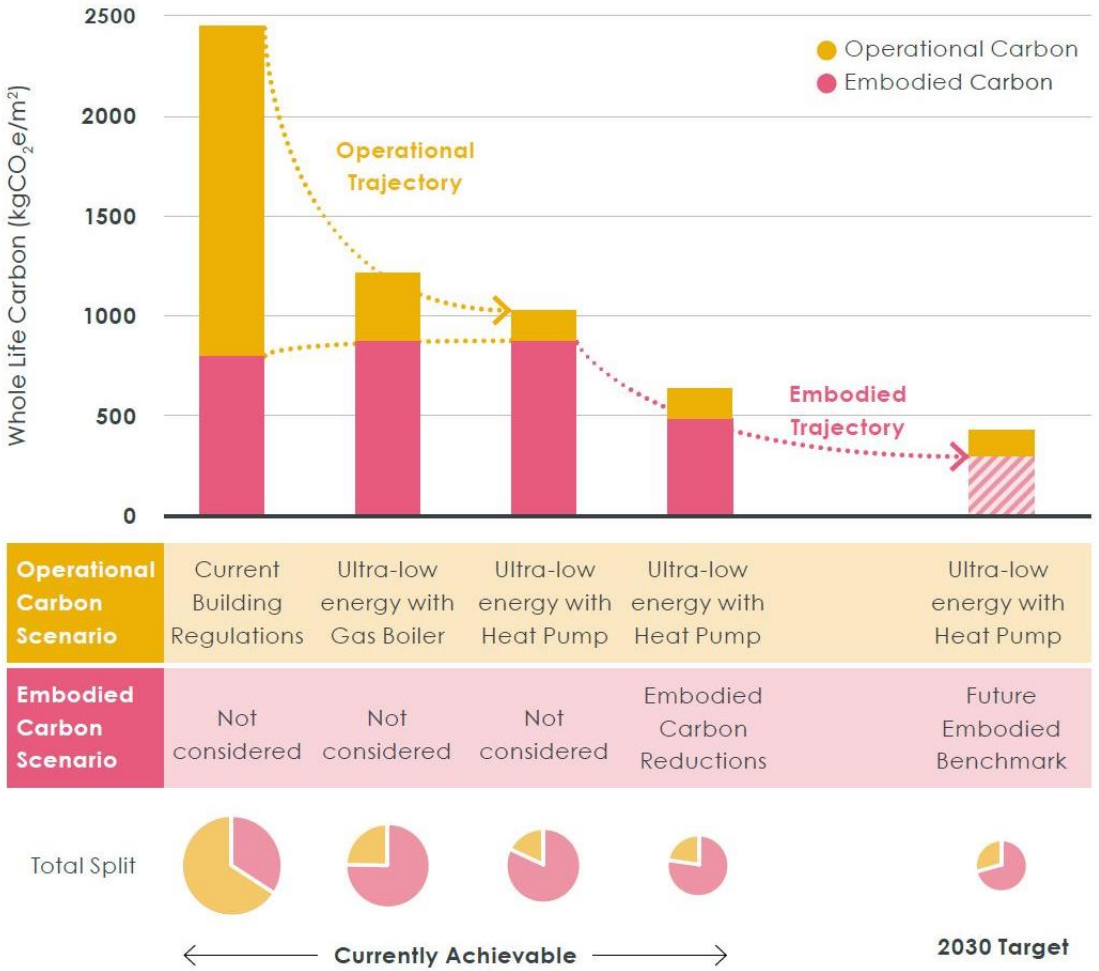
Lowering Embodied Carbon and Operational Carbon with Natural Fiber + Recycled Insulation

- Fabric First Principles
- Research - Sustainable Insulation products in the Scottish construction industry Report and its findings.
- Facilities – The BE-ST Innovation Factory and Insulation Hub.
- Local Materials – Sisal Tech and IndiNature



Embodied Vs Operational Carbon



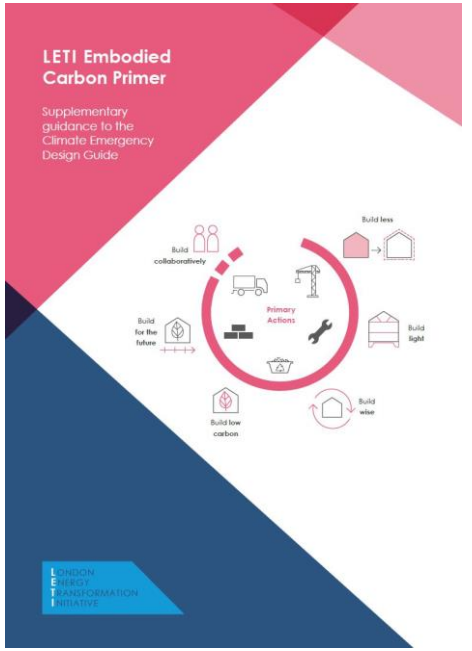


Figure 5.1 - Diagram showing operational and embodied carbon and trajectories

Fabric First

- **Insulate to reduce demand** – Improve u-values of building fabric to prevent heat loss.
- **Improve Airtighness** – Determine if a Mechanical Ventilation Heat Recovery system is viable to achieve 0.6 active air changes per hour or look to local regulations for passive air change guidance.
- **Design for passive solar gain** – How can orientation, thermal mass and glazing ratios be balanced to manage passive gains and losses.
- **Optomise Natural Ventilation** – Where over heating occurs seek passive solutions and night purging in larger buildings.
- **Specify systems to fit reduced need** – What are you needs and challenges?

Questions of current insulation products

- **Extraction of raw materials** – The majority of inorganic and fossil fuel derived materials are based on an extraction model utilising methods that impact negatively on biodiversity.
- **Carbon intensive manufacturing** – A1 Non-Combustible products are usually defined by the need for extreme manufacturing temperatures to increase the products ignition point.
- **Health Considerations** – Installers require PPE to prevent skin, eye and lung irritation. Once installed some products off-gas and can contribute to poor Indoor Air Quality.
- **Circularity** – Lightweight and volumetric materials are disposed of to landfill and can take 100’s of years to decompose. Even those that can be recycled are often soiled as they are skipped preventing recovery.
- **Moisture Movement** – Vapour closed materials prevent vapor transfer and need to be carefully detailed, especially important in Retrofit projects.

Where are we now?

- **Knowledge** – Specifiers default to what they know, emerging products are competing with very well established products
- **£££ vs Carbon** – At what cost? Whole life carbon assessments are changing the way choices are made but how do we fund the shift to Fabric First principles and incentivise clients to invest now to save later.
- **Thermal Performance** – Synthetic products can achieve 0.03 W/mK compared to 0.04 W/mK for Natural fibres, this equates to an extra 70-80mm of materials.
- **Carbon Performance** – Synthetic materials range between 20 – 45 MJ/kg, recycled products range between 4-20 MJ/kg and most natural fibres around 4 MJ/kg of embodied energy.
- **More than just U-Values** – There are benefits to material choices that have a higher heat capacity and higher density as they can help improve temperature regulation during extreme highs and lows.

Key stakeholders:
University of Edinburgh
Zero Waste Scotland
Scottish Construction Leadership Forum – Supply Chain Sub Group

Material Categories

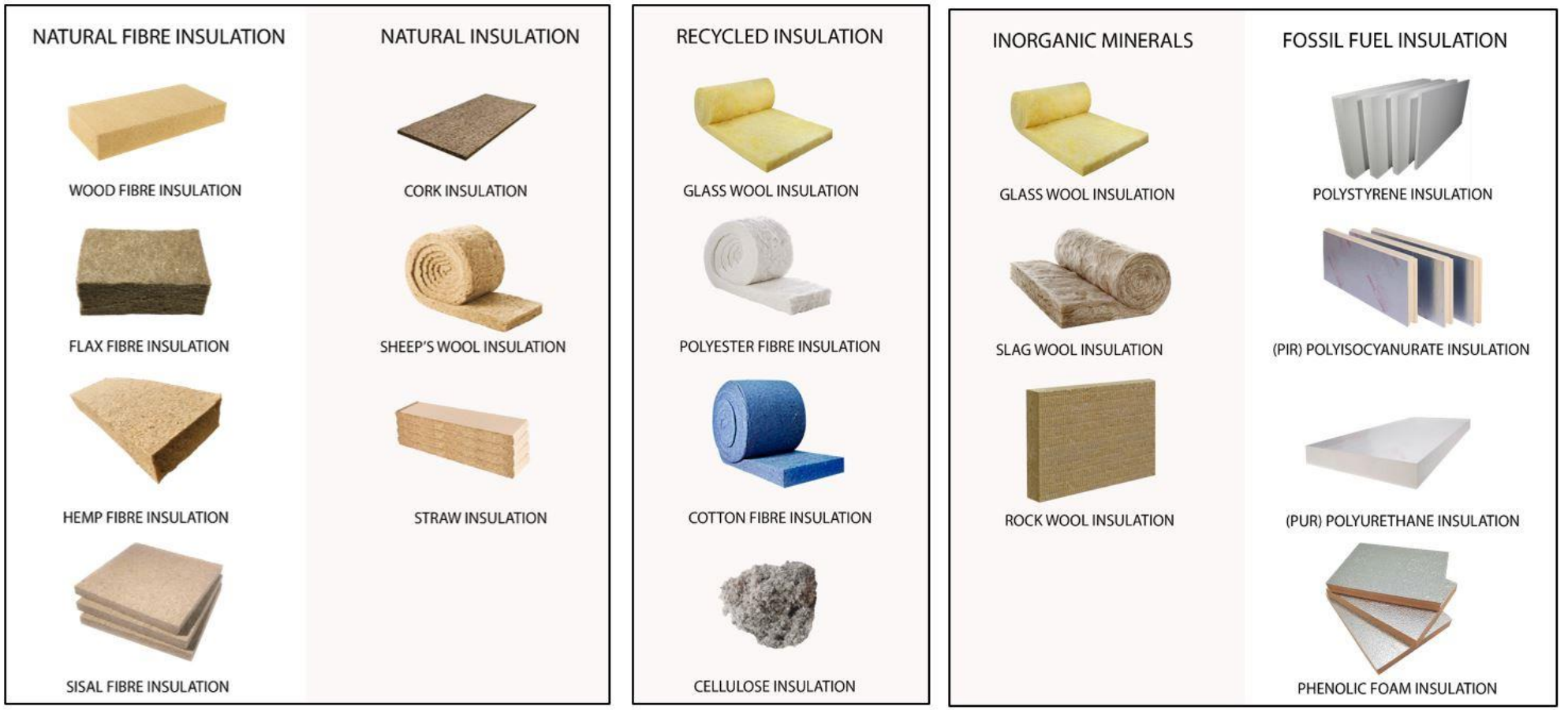


Figure 5: Building insulation example materials

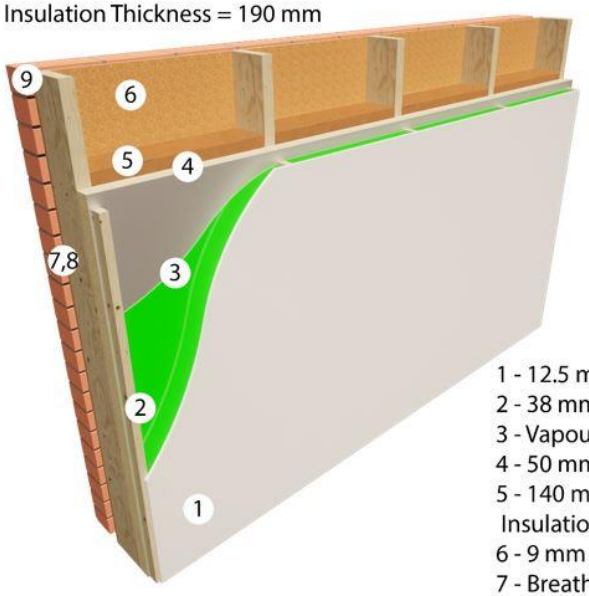
So why Natural and Circular Products?

- **Sequestered Carbon** – By choosing natural materials you can lock away harvested carbon and by supporting circular practices we can enable higher value reuse, prolonging the usable life before .
- **Manufacturing Process** – Natural materials tend to be fibre based and are bonded together with polyester, bio-polyester where possible, at 110°C. Check the Environmental Product Declaration for full product details as they can vary.
- **Health Considerations** – We already utilise a number of the natural fibres used for insulation in our own clothing. Fire retardants and other treatments are added to improve performance.
- **Circularity** – Natural materials are often biodegradable when exposed to moisture or where circular manufacturing processes are available, spent materials have a route to re-enter the market.
- **Moisture Movement** – Products like sheeps wool insulation can absorb and release moisture vapour, allow walls to breathe avoiding condensation that can lead to mould growth.

Global Warming Potential

Synthetic Vs Natural

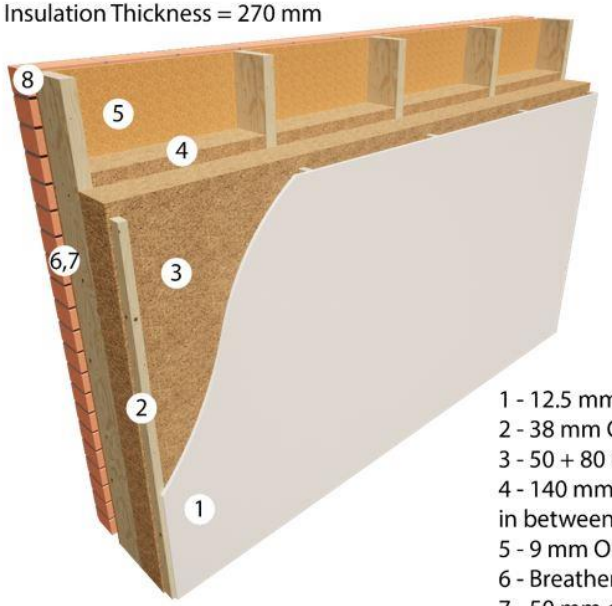
U - Value = 0.15 W/m K
Wall Thickness = 405 mm
Insulation Thickness = 190 mm



1 - 12.5 mm Plasterboard
2 - 38 mm Cavity void
3 - Vapour Control Layer
4 - 50 mm PIR Insulation
5 - 140 mm Mineral Wool
Insulation in between the studs
6 - 9 mm OSB
7 - Breather Paper
8 - 50 mm cavity
9 - 102.5 mm Brickwork

Figure 8: Mineral wool & PIR baseline wall

U - Value = 0.14 W/m K
Wall Thickness = 485 mm
Insulation Thickness = 270 mm



1 - 12.5 mm Plasterboard
2 - 38 mm Cavity void
3 - 50 + 80 mm Hemp Insulation
4 - 140 mm Hemp Insulation
in between the studs
5 - 9 mm OSB
6 - Breather Paper
7 - 50 mm cavity
8 - 102.5 mm Brickwork

Figure 9: Hemp insulation wall example

BE-ST Insulation Hub

Our Pilot Insulation Line is a prototype scale equipment for producing thermally bonded insulation batts

Sisalwool 100 – by Sisal Tech

Hygroscopic sisal fibre and pre-consumer waste wool blend being pioneered in Scotland.

www.sisaltech.com

IndiTherm® – by IndiNature

Flexible natural fibre thermal insulation batts made from hemp being made in Jedburgh.

www.indinature.co

In Summary

Access the Sustainable Insulation report

- **Don’t forget about the building fabric** – It should go hand in hand with new system installs.
- **All insulation is good insulation** – Natural and Circular materials are just looking to be part of the bigger picture and make the most of the resources that we have while reducing impact.
- **Joined up policy** – We are on a trajectory to look/monitor/track/report whole life carbon but we need to do this collaboratively in a sharable format.
- **Skills and training** – There are new products coming to market all the time, existing products are also improving so keeping up with change will require more CPD and staff development.
- **Pay attention to the details** – Check your Environmental Product Declarations and understand the products you are specifying and ensure a good fit with your project.
- **Access the report –** At www.be-st.build/accelerate-to-zero/sustainability/embodied-carbon/sustainable-insulation Or with the QR Code.