






Comparison between conventional insulations


Insulation type	Aerogel	
 <p data-bbox="256 629 488 663">Photo credit: Lawrence Berkeley Natl. Laboratory</p>	<p data-bbox="504 320 1543 790">Aerogel is made by extracting water from a silica gel and replacing it with gas such as carbon dioxide in a process called supercritical drying. The result is a substance that is capable of insulating against extreme temperatures and of absorbing pollutants such as crude oil. It was invented in 1931, but it wasn't until 1990s that NASA started taking an interest in the substance. In 2002 NASA produced a stronger and more flexible version of the gel, which is now being used to develop an insulated lining in space suits for the first manned mission to Mars. Although aerogel is classed as a solid, 99% of the substance is made up of gas. Its nano-sized pores act as air pockets, and can draw pollutants from surroundings. It has very high compressive strength. It is available bonded to plasterboard, or sandwiched within lightweight PVC panels in varying thicknesses.</p> <p data-bbox="504 831 1543 981">A type of glass Airglass has been developed, it looks like a normal windowpane, and however it has very good insulating properties, and is much lighter. Airglass is very brittle, but development of improved elasticity is in progress.</p>	
Pros	Cons	
<p data-bbox="240 1046 979 1559"> Made from natural materials, however highly processed. Reclaimable High strength-to-weight ratio, and high insulating value for relatively little thickness. Very good thermal, electrical and sound insulator Stable and rigid, durable and rot-proof, Impermeable to water-vapour Non-combustible free from HCFC Can be applied directly to the existing external wall surface. No protective equipment required to install. Does not produce any airborne fibres </p> <p data-bbox="240 1599 979 1704"> Space Therm K value: 0.013 W/mk Cost: only available as bespoke, about £80 m2 </p> <p data-bbox="240 1744 979 1852"> Airglass k value: 0.021 W/mk Cost: bespoke </p>	<p data-bbox="979 1046 1543 1335"> Non renewable High embodied energy Non bio-degradable New product, little known of possible problems Protective equipment required to install (mask). Ammonia used in production </p>	

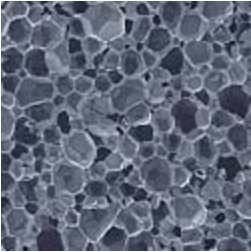
Insulation type	Cellular Glass Board	
	Manufactured from pure glass, up to 60% recycled post consumer waste.	
Pros	Cons	
<p>Low embodied energy Reclaimable Biologically neutral and inert Non-toxic Good sound insulation. Stable and rigid, durable and rot-proof, Impermeable to water-vapour Non-combustible Free from HCFC Can be applied directly to the existing external wall surface. No protective equipment required to install. Does not produce any airborne fibres</p> <p>k value: 0.042 W/mk Cost: £9.50 per m2</p>	<p>Non renewable Non bio-degradable High embodied energy Not suitable for general recycling. Protective equipment required to install.</p>	



Insulation type	Eco wool/ Non-itch	
	Made from 85% UK recycled plastic. It comes in rolls and is suitable for loft and stud wall insulation. It comes in slabs or rolls of varying thicknesses and is easy to install as a DIY job in stud walls or lofts.	
Pros	Cons	
<p>Made from 85% recycled UK plastic Reclaimable/recyclable Stable durable and rot-proof. Non-toxic, non -irritant Good sound insulation. Stable and rigid, durable and rot-proof, Impermeable to water-vapour No protective equipment required to install. Does not produce any airborne fibres</p> <p>k value : 0.039 - 0.042 W/mk Cost : roughly £3 m2</p>	<p>High embodied energy, Non bio-degradable</p>	

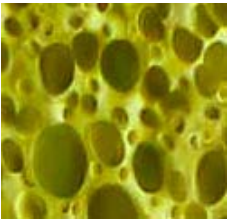
Insulation type	Fibreglass Batts and Rolls	
	<p>Made from molten glass, usually with 20% to 30% recycled industrial waste and post-consumer content. Fibreglass is the most common residential insulating material, and is usually applied as batts of insulation, pressed between studs. Some fibreglass is unfaced, some is paper-faced with a thin layer of asphalt, and some is foil-faced. Paper-faced batts are vapour retarders, foil-faced batts are vapour barriers the vapour barrier must face the proper direction.</p> <p>Also available as Fibreglass Board.</p>	
<p>Pros</p> <p>Some brands made in part from recycled material Reclaimable not recyclable Durable and rot-proof Non-flammable, except for the facing. Some brands contain less formaldehyde</p> <p>k value : 0.032-0.040 W/mk Cost : £2 - £2.80 per m2</p>	<p>Cons</p> <p>Non-renewable Non-biodegradable High embodied energy, fibreglass is energy intensive in manufacture and fibers are wrapped in oil-based resins. Health and safety issues include: Potential cancer risk from exposure to glass fibers Formaldehyde off-gassing from the backing/resin Use of petrochemicals in the resin Resins, dyes and oils used in manufacturing are a health risk to workers and create toxic waste Asphalt treated papers may emit odours. Protective clothing must be worn as installation may cause irritation to skin, nose, and eyes.</p>	


Insulation type	Latex foam	
	<p>Dense latex foam with a fibreglass face is available for internal DIY wall insulation (e.g. Sempatap 10mm foam). It is can be bought in rolls and glued to the wall rather like wallpaper, before being painted over.</p>	
<p>Pros</p> <p>Natural or recycled material Stable durable and rot-proof. Biologically neutral and inert Non-toxic Good sound insulation. Stable and rigid, durable and rot-proof, Impermeable to water-vapour Can be applied directly to the existing internal wall surface. No protective equipment required to install. Does not produce any airborne fibres</p> <p>k value: 1.5 W/mk Cost: £145 a roll</p>	<p>Cons</p> <p>Non renewable High embodied energy, Non bio-degradable</p>	

Insulation type	Mineral Wool	
	<p>Available in Batts and Rolls, two types of mineral wool are widely used: Slag wool uses the waste produced by iron ore blast furnaces - over 75% waste mixed with 25% basalt. 80% of global mineral wool is slag wool.</p> <p>Rock wool uses natural rocks. Rocks & limestone are heated in a 1500C furnace and the liquid stone is spun into fibres and blown with gas to make them finer.</p> <p>In the UK, most energy supplier subsidised loft and cavity wall insulation is mineral wool. Cavity wall insulation involves mineral wool fibre blown into the cavity through a hose.</p>	
Pros		Cons
<p>Natural or recycled material Reclaimable/recyclable Well suited to a breathable construction. Stable durable and rot-proof. Rock wool is the only insulation that will stop fire completely.</p> <p>k value: 0.035 W/mk Cost: £2 - 3 per m2</p>		<p>Non renewable High embodied energy, highly reliant on fossil fuels. Non bio-degradable Protective equipment required to install (mask).</p>

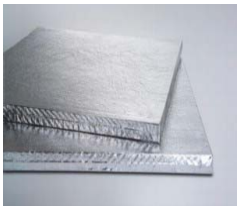
Insulation type	Phenolic Foam Board	
	<p>Closed cell phenolic foam is used in roofing, cavity board, external wall board, plaster board dry linings systems, floor insulation and as sarking board.</p> <p>Flexible-faced phenolic foam boards used in the building industry are typically manufactured in the continuous lamination process. This involves spraying a mixture of phenolic resin, catalyst and blowing agent onto a moving facing. A top facing is then introduced and the product then goes through a heated conveyor press and heated ovens and is then cut to the required size.</p>	
Pros		Cons
<p>High strength-to-weight ratio, and high insulating value for relatively little thickness. Moisture resistance No airborne fibres</p> <p>k value: 0.018 - 0.025 W/mk Cost: £5 per m2</p>		<p>Non renewable Non bio-degradable Very high embodied energy Petrochemical derived Recyclable at source only. Will create toxic fumes when burned</p>

Insulation type	Polystyrene	
<p>Expanded Polystyrene</p> 	<p>Polystyrene is a thermoplastic substance usually a solid and melting if heated (for moulding or extrusion). Most commonly used is expanded polystyrene (EPS), which is produced from a mixture of about 90-95% polystyrene and 5-10% gas most commonly pentane or carbon dioxide. The solid plastic is expanded into foam using heat (usually steam), the trapped gases provide good thermal insulation.</p>	
<p>Extruded Polystyrene</p> 	<p>Polystyrene Beads Same material as EPS, used primarily in masonry cavities , can be recovered for re-use.</p> <p>Extruded polystyrene (EXP) foam is solid polystyrene crystals along with special additives and a blowing agent, fed into an extruder. The mixture melted at high temperatures and pressure, into fluid which expands to a foam and is shaped. This process results in a uniform closed-cell structure and smooth continuous skin.</p>	
Pros	Cons	
<p>EPS: Rigid, lightweight, resistance to rot and mould, deters pests and is and fire retardant. Good sound and thermal insulating properties. Can be used in structural insulated panel building systems (SIPs). Polystyrene beads are suitable for cavity walls. Not made with CFCs (chlorofluorocarbons) or HCFCs (hydrochloro-fluorocarbons) If the building is dismantled carefully EPS blocks can be removed and reused</p> <p>k value: 0.38 W/mk Cost: £5 per m2</p> <p>Polystyrene beads k value 0.040 W/m°C</p> <p>EXP: As above plus... Can use recycled polystyrene in production. Can be recycled by the manufacturer. Resistance to water vapour diffusion, water absorption and fire retardant. Uniform density distribution. Very high compressive strength.</p> <p>K K value: 0.032 W/mk Cost: £3 per m2</p>	<p>EPS: Not easily recyclable and takes a very long time to decompose in the environment and has been documented to cause major environmental impacts such as starvation in birds and other marine wildlife. Non-breathable, not recommended for older breathable constructions. Petrochemical derived. PVC plastics used to cover wiring can be degraded by long time contact with polystyrene. Protective gear is essential when working with polystyrene products. Creates toxic fumes when burned and deteriorates releasing gases under UV light (sunlight). Expanded using pentane which produces smog. EXP is not suitable to use near high temperatures, such as chimneys, steam pipes, electrical heaters or other such surfaces.</p>	

Insulation type	Polyurethane/Polyisocyanurate Board	
	<p>PIR can come in the shape of foam or rigid board; its low-density rigid foam exhibits high thermal performance. PIR insulation products have excellent thermal conductivity.</p> <p>Sprayfoam is applied at high temperatures; within seconds of being sprayed it will cure to form Rigid Foam. Once sprayed it expands by over thirty times giving a seamless covering. Any thickness can be achieved; it is lightweight and high in compressive strength.</p>	
Pros	Cons	
<p>Board is reclaimable Recyclable, though in practice most goes to landfill Resistant to moisture Resists compression, good under floors HCFC's not used in production in the UK Stable durable and rot-proof. Plugs gaps or leaks Vermin proof No airborne fibres</p> <p>k value: 0.033 W/mk Cost: £10 per m2 (100mm) £5 per m2 (50mm)</p>	<p>Non renewable Non bio-degradable Very high embodied energy Petrochemical derived Non-biodegradable Will create toxic fumes when burned Fluorocarbons, highly toxic chemicals are still used in some countries.</p>	

Insulation type	Structural Insulated Panel (SIP's) Polystyrene	
	<p>SIP's are a building method using pre cut polystyrene to quickly erect a structure.</p> <ul style="list-style-type: none"> •Pre-fabricated panels are shipped to job sites where the shell of the building can be erected quickly, saving labour time and money. •A typical construction consists of 4 to 8inch thick foam board insulation sandwiched between two oriented strand boards (OSB) or other structural facing materials. •The thermal resistance or R-value of polystyrene foam board depends on its density. They typically range from R-3.8 to R-5.0 per inch. 	
Pros	Cons	
<p>SIPs can provide a more airtight dwelling, saving on energy losses through drafts and thermal bridging. High strength-to-weight ratio, and high insulating value for relatively little thickness. Materials can be customised within reason to customer requirements. A vacuum can be used to bond the sheathing and core together, vacuums create high thermal</p>	<p>Quality of installation is vital to the performance of the building; an inexperienced builder may not be able to guarantee thermal and structural performances. A well-designed and installed ventilation system is necessary due to the air tightness of the building.</p> <p>Fire safety is a common concern about using SIPs, though they have passed all regulatory tests.</p> <p>Any foam insulation product can provide a good</p>	

<p>resistance.</p> <p>Borax treated panels are available.</p> <p>k value: variable roughly 0.040 W/mk</p> <p>Cost: variable</p>	<p>environment for these pests to dwell. A few cases have been noted where insects and rodents have tunnelled throughout the SIPs, some installers suggest insecticide application to the structure and ground surrounding it. This can have a huge detrimental effect on wildlife and biodiversity</p>
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Insulation type	VIP	
	<p>Passive House Solutions supply the highest performance insulation system available. The thermal conductivity in vacuum insulation panels (VIPs) is about ten times smaller than in conventional, non-evacuated insulation materials such as mineral or glass fibres or polystyrene or polyurethane foams. VIPs with the same insulation thickness as conventional insulation materials therefore insulate about ten times better.</p>	
Pros	Cons	
<p>Very high strength-to-weight ratio, and high insulating value for relatively little thickness.</p> <p>Reclaimable</p> <p>Biologically neutral and inert</p> <p>Vermin, and rot-proof.</p> <p>Stable and rigid, durable and rot-proof, free from HCFC</p> <p>Can be applied directly to the existing external wall surface.</p> <p>No protective equipment required to install.</p> <p>Does not produce any airborne fibres</p> <p>k value: 0.004W/mk, (decreases in value over time)</p> <p>Cost: bespoke</p>	<p>Non renewable</p> <p>High embodied energy,</p> <p>Reliant on fossil fuels.</p> <p>Non bio-degradable</p> <p>Expensive</p> <p>Vacuum will fail overtime, reducing insulating capacity slowly over time.</p> <p>If vacuum seal is broken, panel is useless, not suitable for applications where DIY and renovations may be carried out in the future.</p>	