HUNTSMAN

Enriching lives through innovation

Polyurethanes

Insulation solutions

Insulation

The simplest, most cost-effective way to maximize energy efficiency

Europe's climate change challenge

The urgent need to effectively combat climate change has been widely recognized. By 2020 in Europe, for example, Heads of State have committed to reduce greenhouse gas emissions by at least 20% compared to 1990 levels by cutting fossil fuel consumption.

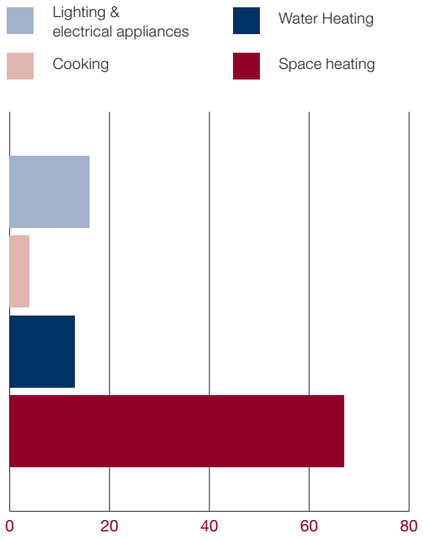
These political commitments now need to be met. A study undertaken by the Centre for European Policy Studies (CEPS)* has demonstrated that energy efficiency in buildings can deliver a major contribution to reduce overall energy demand and help to combat climate change. Moreover, the study concluded that energy efficiency in buildings is the only measure that is both cost-effective and based on existing and proven technologies that do not require a trade-off against other risks.

*CEPS Study: *Revisiting EU Policy Options for Tackling Climate Change: A Social Cost-Benefit Analysis of GHG Emissions Reduction Strategies*

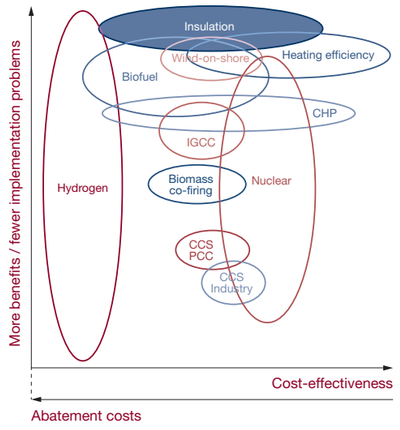
The largest proportion of energy consumption in buildings is maintaining temperature control via heating and cooling. Proper insulation and thermal design of the building envelope is the most cost-effective way to dramatically reduce heat loss, cut energy use and help combat global warming.

Governments are implementing more rigorous energy consumption regulations for new buildings. And many architects, contractors and homeowners realize the need to go further for the sake of both the environment and our wallets, for example, by working towards zero-energy buildings. However, existing buildings account for around 40% of the energy consumed in the European Union (EU) and consequently for high levels of greenhouse gas emissions. The main challenge, therefore, is to accelerate the rate of deep renovation required to transform existing buildings into energy-neutral, comfortable, healthy dwellings and work environments. Insulating buildings and improving airtightness of roofs, walls or cellars can reduce energy consumption by up to 30%.

Share in total building energy consumption



Climate solutions – a cost-effective analysis



Making nearly zero-energy houses a reality

The European Energy Performance of Buildings Directive of 2010 (EPBD) requires that: "Member States shall ensure that by 31 December 2020 all new buildings are nearly zero-energy buildings; and after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings."

Member States shall furthermore: "Draw up national plans for increasing the number of nearly zero-energy buildings and, following the leading example of the public sector, develop policies and take measures such as the setting of targets in order to stimulate the transformation of buildings that are refurbished into nearly zero-energy buildings."

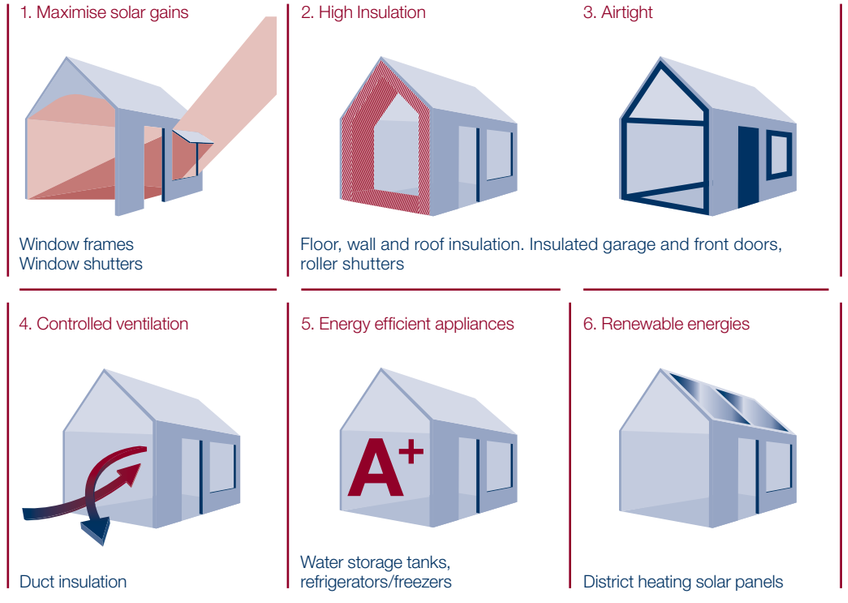
A nearly zero-energy building is defined in the EPBD recast as: "A building that has a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby."

A passive house is a construction concept that can meet the ambitious targets of a nearly zero-energy house. It is designed to provide a comfortable indoor climate throughout winter and summer. By installing extensive insulation, energy-efficient windows, low levels of air infiltration and heat recovery ventilation, a passive house eliminates the need for traditional heating and air conditioning systems. Depending on the climate zone, the energy requirement for heating and cooling can be lower than 10 to 20 kWh/m^2 per year.

Huntsman has worked closely with ISOPA (the European Diisocyanate and Polyol Producers Association) to bring to life a demonstration polyurethane passive house in Brussels, Belgium. Using traditional construction techniques, the house incorporates a wide range of polyurethane product solutions that are ideally suited to the design of nearly zero-energy buildings. Features include walls, roof and floors insulated with U-values down to 0.1 W/m^2.K at reasonable thicknesses; high airtightness achieved using polyurethane one component foam (OCF) and sealants; insulated garage doors; and highly energy-efficient appliances. For more information see: www.polyurethanes.org/passivehouse

The versatile application of polyurethanes in the 6 steps towards a nearly zero energy house:

*Recreated with permission of Passief Huis Platform



New construction

Polyurethane insulation satisfies the two vital factors for designing effective insulation solutions:
- low thermal conductivity
- durable performance.

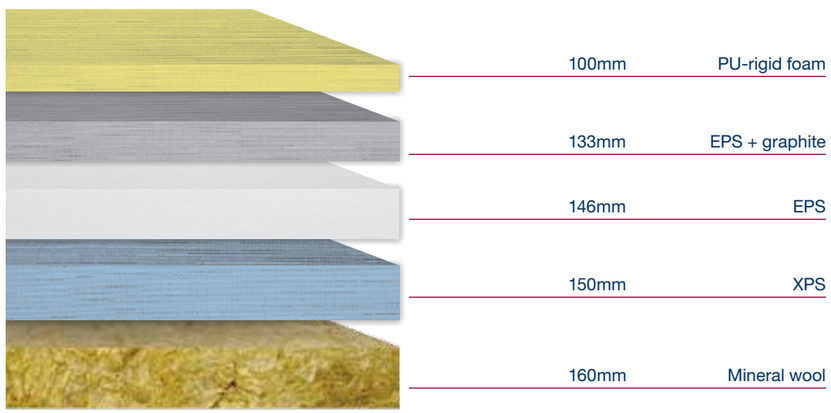
Polyurethane insulation is commonly applied in both residential and non-residential applications, to insulate floors, walls and roofs.

In all of these scenarios, the most critical factor overall when designing insulation systems is to achieve very low U-values that minimize energy use and related CO_2 emissions. Working towards future targets for nearly zero-energy houses, the use of conventional insulation materials will be constrained by their thickness. Among the most commonly used insulation materials, polyurethane insulation is characterized by the lowest thermal conductivity, making it the most cost-effective way to retain heat inside a building in winter or keep it cool when it's hot outside. Within a few years, floor, roof and wall insulation systems can deliver a full return on investment.

After the design for low U-values, the most important issue is the longevity of the insulating performance. This is the ability of a product to maintain the level of performance required over a given or long period of time while under the influence of foreseeable circumstances. Tests in practice have confirmed that polyurethane insulation delivers excellent durability and consistent performance during a building's lifetime*.

Durability of polyurethane insulation products. PU Europe factsheet no 16, November 2011.

Material Thickness at equal thermal insulation value



Retrofitting and renovation

Many existing buildings have no or minimal insulation. Polyurethane is the insulant of choice for retrofitting a building due to its excellent thermal conductivity and many other benefits.

Limit loss of space

A common renovation challenge is the restricted amount of space available to fit the insulation. The excellent thermal conductivity of rigid polyurethane makes it one of the thinnest, least bulky solutions. Polyurethane insulation therefore minimizes the loss of living and working space, which is especially important in cases where internal insulation is the only option. If the external building perimeter is limited, for example, due to neighboring buildings, roof overhang or regulatory restraints, thin polyurethane insulation solutions are an excellent choice to optimize space.

Improve airtightness and eliminating cold bridges

Many older buildings have areas where insulation is reduced (thermal bridging), for example, at joints and around windows, doors and gaps in the building envelope. These can all lead to air leakage. Cold bridges and air leakages can cause condensation. This is easily overcome by filling these gaps with one component foam (OCF), which adheres extremely well to almost all building materials. Furthermore, a continuous layer of insulating foam can be sprayed onto floors, walls and roofs or injected into the cavity wall, making the whole building envelope seamlessly airtight.

Increase living comfort

Consistent temperature control and air tightness increases living comfort considerably. Rigid polyurethane is one of the most effective insulants to achieve this: warm in winter and cool in summer, without adding to heating or cooling costs. In addition, insulation makes walls and floors warmer to the touch. Use of OCF eliminates draughts and the formation of condensation, which could lead to mold growth and the deterioration of building fabrics.

Provide solutions for hard-to-reach places

Insulating an existing building sometimes means retrofitting awkward places that are difficult to access. Spray polyurethane foam (SPF) provides a versatile solution combining good thermal insulation properties, strong bonding to any surface and rapid cure. Cavity walls that are empty or insufficiently insulated are another area where polyurethane injection foam can bring clear benefits in terms of energy saving, airtightness and structural properties.

Increase storm and wind resistance

The excellent adhesive properties of SPF and its ability to form a continuous even layer without any gaps, makes it highly suitable for harsher climates. It provides reliable weatherization and structural stability in one. Also, the ventilated facade building principle provides excellent weather protection against wind loading and rain.

Achieve a better energy label

Some EU countries have introduced energy labels that rate buildings according to their level of insulation and energy consumption. This is a very important factor for buyers or tenants: the better the label, the more energy efficient the house and the lower the energy bill. Furthermore, a dwelling with a good energy label might have a higher market value when sold. Not only is rigid polyurethane insulation one of the most effective insulants, it is also strong, chemically resistant and has long-life performance.

Contribution to sustainable construction

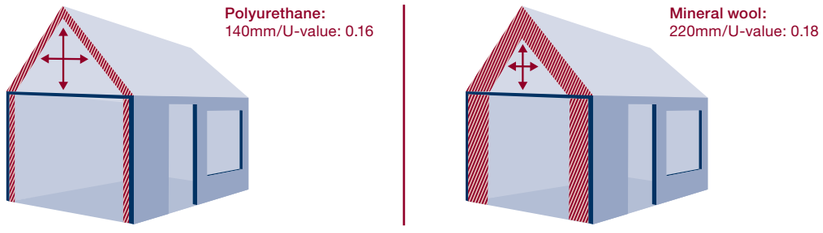
Humanity is facing its greatest challenges – to support continued population growth, improve life expectancy and meet the growing need for food, energy and shelter with diminishing natural resources and rising levels of pollution. Sustainable development is the driving force for acting in a more responsible way and introducing solutions that balance the need to secure economic growth and social development with reducing our environmental footprint.

Applying this principle to the building sector, sustainable construction could be described as the process of reducing the environmental impacts of a building over its entire lifetime, while optimizing its economic viability and the comfort and safety of its occupants.

Key economic benefits

- Lower lifecycle costs in many new build and refurbishment applications.
- Lower maintenance with reduced running costs for building owners.
- Higher return on investment rates than most common financial products.
- Cost savings and increased disposable income because improved energy efficiency in buildings leads to immediate savings for the consumer.
- Increased income from rent and sales because less bulky insulation means more living space.
- Creation of jobs and economic growth as the requirement for insulation in the new build sector increases and the refurbishment market develops.

Optimising living space and rental value (thermal insulation effect / U-value [W/(m^2.K)])



Key benefits to society

- Help to combat the effects of global warming and related impacts.
- Increase energy security through reduced reliance on imported fossil fuels.
- Support employment by creating new local jobs across the supply chain.
- Reduce fuel poverty with lower energy bills.
- Ensure that buildings are healthier and more comfortable.

Adapting to climate change

The last decade has seen a record number of floods, droughts and storms throughout the world. In response to these events, building regulators have been compelled to enforce specific requirements to improve public safety and minimize the cost of rehabilitation. With its closed-cell structure and hydrophobic nature, polyurethane insulation foam shows very little propensity to absorb water. This makes it an ideal material to use in areas that are susceptible to flooding and where walls need to be protected from heavy wind and rain. In addition, the excellent adhesive properties of SPF ensure that it is the material of choice for roof insulation in hurricane zones.

Lifecycle assessment

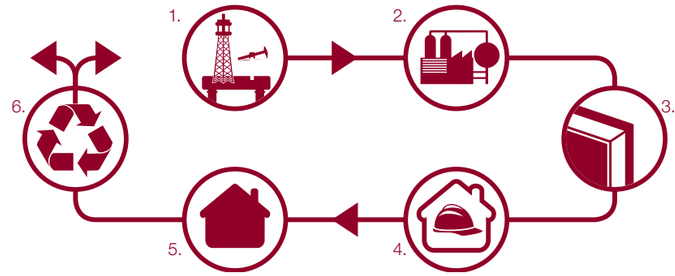
Using lifecycle assessment methodologies, third-party research* has compared polyurethane insulation to other traditional insulants and (thanks to higher energy savings or, in the case of equivalent R-values, reduced material use and knock-on effects) demonstrated that it can bring:

- lower lifecycle costs
- similar to improved lifecycle environmental performance.

**Lifecycle Environmental and Economic Analysis of Polyurethane Insulation in Low Energy Buildings.* PU Europe factsheet 15, 2010

High performance over complete life cycle of building:

1. Extraction of crude oil resources
2. Transformation
3. Manufacturing of foam insulation panel
4. Use of panels in construction
5. Lifetime within building use
6. Recovery of panel at end of life



Key environmental benefits

- Reduce energy demand and related pollution by achieving improved thermal efficiency.
- Save natural resources and energy by securing long-term performance.
- Reduce the knock-on effects on the overall structure, for example, the depth of studs, size of fixings, structural load etc.
- Minimize the building footprint and land use by optimizing insulation thickness.
- Low environmental impact at the building level because polyurethane insulation saves more than 100 times more energy than is used in its manufacture.
- Cut transport costs through lighter, thinner insulation systems that require fewer deliveries.
- Secure energy savings over the lifetime of a building through high long-term performance.

Deconstructing the myths

To dispel any misconceptions about polyurethane insulation we have clarified some common myths.

"Polyurethane insulation is not sustainable because it is based on fossil fuel resources"

- Making polyurethane insulation uses less than 0.1% of the total amount of fossil fuels consumed per annum and saves easily 100 times more.
- Polyurethane maintains high performance over time, ensuring long-term energy and CO_2 savings.

"Polyurethane is chemically-based and therefore dangerous"

- Polyurethane is safe and chemically inert. Polyurethane insulation products have extremely low indoor air emission levels and easily achieve best-in-class classification in countries that practice such testing.
- The low breathability of polyurethane prevents interstitial condensation. It is not affected by mold growth or dust mites and helps to prevent related health problems.

"Sustainable construction materials are those with low embodied energy"

- There are no sustainable materials, only materials that contribute to more sustainable building designs.
- Insulation materials are 'energy negative' – insulation material embodied energy is not a recognized selection criteria.
- Embodied energy should be considered only once the material contribution is calculated at the building level in the end-use application.

Features and benefits of polyurethane foam insulation

Rigid polyurethane foam offers specifiers a versatile material with a compelling combination of physical strengths and mechanical properties.

Low Thermal Conductivity
Rigid polyurethane foam is widely known for its excellent thermal conductivity rating, which is among the lowest of any insulating material. This ensures efficient heat retention or alternatively, consistent temperature control of refrigerated or frozen environments.

Strength
High levels of both shear and compression strength are achieved with rigid polyurethane. These values can be further enhanced by bonding to facing materials such as metal or plasterboard.

Processability
Rigid polyurethane foam is the only insulant that can be processed under continuous block or batch factory production or by on-site mixing for spray and injection application.

Chemical resistance
Rigid polyurethane foam provides excellent resistance to many common chemicals, solvents and oils.

Behaviour in fire
Like all organic building materials (wood, paper, plastics, paints, etc), rigid polyurethane foam is combustible, although its ignitability and burn rate can be modified to suit a variety of building applications. PU insulation is usually protected by a non combustible or protective covering material and the overall fire performance of a composite panel can be enhanced significantly by using a facing material such as steel. Polyisocyanurate (PIR) foam is developed to meet higher fire requirements than polyurethane. Rigid polyurethane and PIR foams are usually used at lower thicknesses than other insulants, so their calorific value is low compared to other insulating materials.

Compatibility
The majority of popular building facings – including paper, glass fiber, aluminum, plywood, plasterboard, bitumen and foil – are compatible with rigid polyurethane foam. The many combinations available add to the inherent strength of the foam, allowing its use in semi-structural panels and cladding. Cosmetic finishes such as paint and plaster can also be applied, equipping the product to operate effectively as a moisture barrier in high humidity environments.

Adhesion
During the curing stage, rigid polyurethane foam is highly adhesive, allowing it to bond with many building-facing materials. Bond strength is often higher than the tensile or shear strength of the foam.

Durability
PU insulation is not affected by water vapor or air infiltration, it cannot sag or slump, and is very difficult to squash, all of which gives a better guarantee of high performance over the life of the building. Products can be tailored to tolerate extreme temperature ranges of –200°C to +160°C can be tolerated by rigid polyurethane foam products.

Water vapor transmission
Rigid polyurethane foam has low permeability to water vapor. Polyurethane foam products with a aluminum foil or polyethylene film facing will have the water vapor permeability of those materials.

Lightness
At typical densities of say 30kg/m^3, rigid polyurethane foam is made up of 97% gas trapped in cells and just 3% polyurethane polymer. The lightness of the material is a bonus that lowers transport costs and ensures easier on-site handling and installation.

Polyurethane foam-based insulation in practice

Popular applications for polyurethane foam-based insulation

Composite panels
These are factory-engineered exterior panels manufactured with metal skins that contain polyurethane (PUR) or PIR foam insulant and are typically used for roofing and wall cladding.

Insulation board
This is a high-performance PUR or Polyisocyanurate (PIR) foam laminated between two facing materials such as aluminum, multi-laminate foil, paper, bituminous glass fleece, cork and gypsum board. Products can be used to insulate all areas of the building envelope in both residential and commercial construction.

Structural insulated panels (SIPs)
A modern method of construction in which polyurethane foam is sandwiched between two rigid faces, typically oriented strand board (OSB), to form a structural composite construction panel. The panels are factory cut using computer aided design (CAD) software to the exact building design. They are then transported to the construction site and quickly, cleanly and efficiently erected to form the building structure.

Spray polyurethane foam (SPF)
SPF is spray-applied in situ at a building site, where it is typically used for floors and roofs. Sprayed polyurethane adheres well to the area it is applied to, where it acts as an insulant and air barrier.

One component foam (OCF)
OCF is a self-expanding, self-adhesive moisture-curing gap filler. Key advantages include its portability and ease of application. OCF is supplied to the building and DIY industries in pressurized cans.

Technical insulation
This is the term used by Huntsman to categorize a wide range of insulation applications, including discontinuous panels (used in e.g. cold rooms), water heaters, boilers and refrigeration systems.

Pipe insulation
Polyurethane foam is used in numerous industrial and domestic pipe solutions wherever heat or cold fluids need to be moved around, for example, to insulate and protect district heating and cooling pipes and for oil and gas pipelines.

About half the energy used in the life of a building is for heating and cooling, so effective insulation is a major priority.

If all buildings were effectively insulated, global energy consumption could be cut by 20%.

Composite panels

Composite panels are factory-engineered exterior panels used for a wide range of non-residential and residential buildings. Applications include cladding, partitioning, load-bearing walls and roofing elements. Panels are factory produced on a continuous lamination basis with metal facings – usually steel or aluminum – encapsulating a foamed PUR or PIR core. The thickness of the polyurethane foam can range from 30mm to 240mm, depending upon application and required insulation characteristics. These versatile products are also known as sandwich panels due to the physical interaction of two materials. This composition offers a high degree of stability, rigidity and excellent load-bearing capacity. Since 2010, CE (European conformity) marking in line with product standard EN14509 has been compulsory for all sandwich panels sold in the EU, ensuring high quality.

Working with composite panels

The growth in composite panel usage has been driven by the construction industry's need for a lightweight panel with good thermal insulation qualities and simple on-site installation. This requirement has been assisted by the technical development of rigid polyurethane foams offering very high insulation values, especially compared to traditional building style. The ease of mounting composite panels to the building sub-structure is another major factor in their popularity.

Building times are significantly reduced compared to traditional methods, with spin-off savings in labor costs. Composite panels offer architects and specifiers an exciting dimension when planning, costing and designing new and refurbished buildings. A wide and attractive choice of surface finishes is available, both in terms of color and metallic coatings. Hidden joints, combination options with other materials and foamed moldings for roofs and walls enable the creation of buildings of striking architectural value and appearance.

The INSPIRE® range

INSPIRE® foam is Huntsman's PIR solution designed to meet the most stringent fire requirements. The INSPIRE® range delivers excellent results in well-established fire tests such as the single burning item (SBI) test. It is an ideal choice for new panel applications where superior resistance to fire (REI) is a key requirement, particularly compared to alternative insulants.

Other fire classifications involving

large-scale tests for Factory mutual (FM) approval are sometimes required. INSPIRE® foam is an excellent candidate to obtain FM approval with the corresponding sandwich panel. FM-approved panels produced using INSPIRE® PIR grades find use across the building sector.

Versatile applications

Composite panels are extremely versatile, making them increasingly popular across a diverse range of construction and renovation projects. Popular applications include specifications for wall partitioning and as load-bearing roof panels in:

- Administration centers
- Airports
- Climate-controlled rooms
- Cold stores
- Deep-freeze stores
- Exhibition centers
- Hospitals
- Hotels
- Logistics centers
- Power plants
- Recycling facilities
- Residential care homes
- Retail stores
- Schools
- Sports centers
- Telecom shelters
- Warehouses
- Waste incineration plants
- Workshops

Features and benefits of composite panels

Feature	Construction benefit
Single manufactured unit	• Fast on-site erection to enable labor cost savings • Enable fast project completion • Minimize on-site impact on product quality
High insulation value at low panel thickness	• Reduced energy costs for life of building • Make dimensional space savings • Increase saleable/leaseable building area
Structural value and combined air/water barrier	• Long span, high load construction performance • Realise material cost savings • Ease of construction
Removable panels	• Design and refurbishment flexibility
Low maintenance	• Low whole-life costs for building owners/tenants
Surface treatments: texture and profiling	• Increases flexibility for design and appearance
Good fire performance (INSPIRE® range)	• Superior reaction and resistance to fire requirements • Proven to pass large-scale tests such as FM approval

Insulation board

Huntsman is a leading producer of PUR and PIR systems that are used to manufacture rigid foam insulation board for residential and commercial construction. As insulating products, boards are laminated on both surfaces with a variety of facing materials.

Board is a highly versatile insulant that is suitable for many construction tasks, including flat and pitched roofs, cavity walls, floors, internal linings and external wall insulation systems. More than 600,000 tonnes of polyurethane board and block is used by the construction industry each year – a figure that is forecast to grow steadily due to new legislation governing energy consumption and greater awareness of the valuable role played by effective insulation.

Working with insulation board and block

Insulation board is the most widely used rigid polyurethane foam product in the construction sector. Its popularity reflects a range of properties that make it a simple and highly effective product to work with.

The prime attribute of rigid polyurethane foam is its outstanding insulation qualities, however, this is supported by many other practical benefits.

- Board is extremely versatile, providing insulation for an infinite number and variety of building applications.
- It fits neatly and unobtrusively into wall and roof cavities.
- It can be used in conjunction with many facing materials to add specific properties and finishes.
- Rigid polyurethane foam is light and simple to transport to and around building sites.
- It is a clean, non-hazardous material that requires no special handling, storage or specialist trade skills to work with.
- Equally, it is not temperature or moisture sensitive, and can be fitted under most weather and climatic conditions.

Versatile applications

The versatility of insulation board makes it the first choice for many roofing, flooring and external wall applications.

Flat roofs

It is standard industry practice to use insulation board beneath partially bonded built-up bituminous flat roof and multi-layer component flat roofing systems.

Pitched roofs

Board provides class-leading levels of roof insulation in pitched roofs, for use between and under rafters, and as sarking board insulation above them. It is also used to create ‘warm roof’ designs.

Flooring insulation

It is an excellent insulant to guard against heat loss from a ground floor, whether constructed from solid concrete or suspended timber.

Cavity walls

Board is the preferred insulation for partial fill cavity walls, providing maximum performance with the minimum thickness.

Internal dry lining of external walls

Using an insulation board and gypsum board laminate to dry line internal walls can improve insulation levels and create a suitable surface for internal decoration.

External wall insulation

Insulation board is increasingly used in both renovation and new build designs to create external thermally insulating cladding systems (ETICs) or external wall insulating systems (EWIs). Together with excellent PIR insulation, ventilated facades are an easy-to-install, dry method to reduce energy consumption and create long-lasting weathering protection. The external facade can consist of almost any type of decorative element from natural stone to plastics and zinc panels, giving architects greater aesthetic freedom.

Features and benefits of insulation board and block

Feature	Construction benefit
Low thermal conductivity	• Excellent insulant for domestic and commercial buildings
Versatility	• Suitable for use in many varied applications and with different facing materials
Good fire performance	• Proven by large scale testing, particularly compared to alternative insulants
Ease of use/Installation	• Light, clean, simple to install as board or cut into block applications
Longevity	• Majority of installations will retain thermal qualities for at least 50 years

Structured insulated panels (SIPs)

Introduced more than 50 years ago, building with SIPs is now established as the fastest growing modern construction method. The increasing popularity of SIPs are driven by the ever increasing legislative demand for energy reduction in the built environment. As a panelised, factory produced construction system, buildings can be constructed with reduced waste, improved airtightness and higher quality. The external finish to the SIP construction can ensure that the building is aesthetically the same as buildings built using more traditional techniques.

SIPs are formed when polyurethane foam is sandwiched between two rigid faces, typically OSB or cement particleboard (CPB), producing a composite construction panel. The auto-adhesive nature of polyurethane foam during the manufacturing process results in panels that are tough, load bearing and relatively lightweight compared to traditional building materials. The use of polyurethane foam also ensures that maximum levels of thermal insulation can be achieved in this type of construction.

Building with SIPs

- Factory-produced panels are pre-cut to the building design using CAD software for use in walls, floors and roofing.
- SIPs can enable new design possibilities that would not be possible with conventional building materials and techniques.
- They are assembled onsite with reduced labor requirements, improved quality and minimal on-site waste.
- By ensuring maximum airtightness and minimal thermal bridging, SIPs provide excellent levels of thermal insulation.
- Structural loads are distributed throughout the panel, so eliminating point load pressure.
- SIP construction techniques eliminate the use of roof trusses and so greater space can be achieved with ‘warm roof’ designs, allowing more rooms to occupy a similar build footprint.
- Any external finish can be chosen for a SIP construction as required or to suit the local built environment.

Key features and benefits of structural insulated panels

Feature	Construction benefit
Factory-manufactured panels	• Fast on site erection • Improve build quality • Reduce onsite labor • Reduce site waste
Low thermal conductivity	• Increase energy efficiency of the construction • Reduce wall thickness, leading to reduction in building footprint
Improved construction quality	• Improve airtightness to reduce energy consumption • Reduce thermal bridges
Structural advantages	• Spread building loads throughout the structure for greater design flexibility • Eliminate roof trusses to enable ‘warm roof’ design and optimize use of internal space • Increase number of rooms for a similar building footprint
Reduced weight	• Enable use of comparatively lighter foundations

Versatile applications

SIPs are suitable for a wide variety of constructions and building types, including houses, extensions, apartments, schools and offices. They can also be used in conjunction with other building methods to form hybrid structures for both external walls and roofing elements. As energy legislation continues to change, the use of SIPs in modern construction methods is expected to keep growing and the range of available products will also continue to develop.

Spray polyurethane foam (SPF)

SPF is a versatile insulant used in a wide array of applications from floors and roofs to walls and ceilings. The nature of this specific application technique makes it especially good for retrofitting. When applied to interior or exterior walls and non-ventilated roofs, SPF saves on energy costs by providing excellent thermal insulation as well as sealing gaps and spaces in the existing construction. Acting as an air and vapor barrier, SPF blocks moisture infiltration and condensation inside wall cavities and prevents thermal bridging between the outside environment and inside air. Application involves two liquid components that are mixed under pressure and sprayed on site with professional spray equipment by qualified and certified installers.

Floor insulation

When used to insulate floors, SPF completely fills the cavities and can adhere to irregular shapes, slopes, and penetrations such as pipes, windows, doors and sheathing fasteners. This makes it particularly suitable in locations with a lot of utility pipes in the flooring zone.

Roof insulation

Using SPF is also an ideal way to retrofit a previously insulated flat roof. A seamless layer of closed cell foam sprayed over a traditional dark-colored roof will minimize energy lost from air infiltration, improve energy performance and eliminate thermal bridging across fasteners. Sprayed polyurethane roofs provide a seamless moisture barrier reducing the potential for moisture-induced structural damage.

Injection foam

Cavity filling

In buildings with an empty or insufficiently insulated traditional cavity wall, thermal performance can easily be improved by filling the cavity with PUR injection foam. Cavity-injected PUR foam provides excellent thermal insulation and also bonds the two walls together, stabilizing the building and sealing all gaps – all without any loss of inner or outer space. The European Environment Agency also recommends PUR cavity injection as a measure to reduce flood damage, due to its resistance to moisture ingress*.

PUR foam is injected into the cavity as a liquid mixture through regularly spaced holes in the outer wall. The foam expands, bonds both walls and consequently does not sag in the cavity. Cavity injection is a fast retrofitting insulation method applied by qualified professionals. The chemicals are mixed as liquids on site, which makes transport faster for the applicator and saves storage space.

Applications for polyurethane insulation: Today's solution for tomorrow's needs. PU Europe, 2011

Feature and benefits of spray and injection insulation

Feature	Construction benefit
Low thermal conductivity	• Excellent insulant • Cost savings on heating and cooling • Limit loss of internal space
Excellent adhesion	• Bond to most surface types • Increase wind and storm resistance (roof tiles) • Provide wall stability – useful for failing wall ties
No sagging or settling	• Eliminate cold bridges and draughts through seamless, airtight continuous layer and gap filling
Moisture and vapor barrier	• Prevent condensation and formation of mould • Reduce flood damage
Versatility	• Retrofit suitability for hard-to-reach and awkward spaces
Fast cure external injection (cavity)	• No relocation necessary for retrofitting

One component foam (OCF)

OCF is a self-expanding, self-adhesive, moisture-curing gap and crack-filler. Its main advantages include portability, ease of application and low cost. OCF is supplied to the building and do-it-yourself (DIY) sectors in pressurized cans fitted with dispensing nozzles.

When dispensed, the mixture from the can expands to form a sticky froth, which will adhere to most building surfaces without pre-treatment. The froth reacts with atmospheric moisture and within two hours expands to form a semi-rigid polyurethane foam with good flexibility. This expansion process ensures that as the foam cures, it tightly fits the joint or gap being filled. When completely cured the foam can be cut, plastered and painted. Adhesion to damp surfaces, as well as to most building materials, is excellent.

OCF is widely used for filling joints on-site, for example, around windows and door frames, filling cavities and sealing around HVAC units. It is also used to prevent air leaks and vapor diffusion, for example, sealing openings in roof constructions and insulation materials, sealing edges in cold storage units and as a sealant for pipes through walls or other barriers. In addition, OCF can act as a foamable adhesive to replace nails and screws, for example, to bond insulation boards, wall panels and roof tiles, therefore preventing thermal bridges.

OCF is ideal for weatherization (the process of modifying a building to reduce energy consumption) because it delivers two benefits in one product: air sealing and insulation. It can reduce air leakages in buildings by up to 40%. For example, a study* carried out by the European OCF producers demonstrated how the product could deliver over 80 million tons of CO_2 emissions annually in Europe.

*LCA Study from Produkte durch Recycling (PDR) *Environmental profile of 1K Polyurethane foam packed in pressurised cans.* 18 December 2002

Features and benefits of OCF

Feature	Construction benefit
Seal air leaks and improve airtightness	• Energy savings, especially during summer and winter • Reduce CO_2 emissions • Ensure draught proofing for improved comfort of occupants • Reduce degradation of the building fabric • Reduce risk of condensation • Improve insulation
Excellent adhesion	• Form reliable, strong bonds on most substrates (except teflon, PE and PP)
Very good filling capacities	• Increase energy savings
Versatility	• Ideally suited to gap filling, mounting, sealing and bonding
Ease of use / ready-to-use	• OCF is light, fast and simple to apply, helping to enable labor cost savings

Technical insulation

Technical insulation is a term used at Huntsman to define a diverse range of rigid polyurethane foam applications covering many low-volume, discontinuous products. Although fragmented, it is a major market for polyurethane foam.

Typical applications for technical insulation products include discontinuous panels, water heaters, cool boxes, reefers, refrigerated transport, commercial display units, pipe insulation, OCF and mining.

Energy performance is the critical factor for specifiers and is usually measured on the final product by energy usage or heat leakage analysis. These targets can be attained through the use of different blowing agent technologies, which produce specific performance characteristics in rigid polyurethane foam.

Huntsman is a significant supplier to this market, both in terms of direct supply and through its close association with nominated systems houses. Combining its in-depth expertise and experience in polyurethanes with a focused view of the technical insulation market, Huntsman is perfectly placed to offer state-of-the-art, leading-edge solutions to its customers.

Hot insulation

One of the most important insulation tasks is in the production and storage of hot water, which requires less energy when stored in appropriately insulated boilers. This can be achieved by injecting rigid foam into the double metal mantle or spraying directly onto the exterior of the boiler. Hot water used for municipal heating systems or industrial use can also be protected against energy loss by using polyurethane foam pipe insulation.

Cold insulation

Insulation to assist chilling and refrigeration of foodstuffs throughout the supply chain is a primary function of rigid polyurethane foam in the technical insulation sector. In food transport containers and delivery vehicles, discontinuous panels ensure that the correct temperature controlled environment is achieved.

Similar products, but on a larger scale, are used in the construction of cold store factories, processing plants and warehouses. In the retail sector, polyurethane foam can be found in the point-of-sale chilled and refrigerated display units that are present in virtually every food store in the developed world.

Appliances

Polyurethane is the only insulating material used in the production of domestic refrigerators. Employed to improve overall energy performance, it satisfies the needs of manufacturers creating appliances for environmentally conscious consumers who want to reduce their carbon footprint and keep utility costs under control. Polyurethane insulation also provides extra advantages. Injected into the empty cavity between a refrigerator's inner liner and outer metal skin, it holds the two substrates firmly in place, increasing the strength and rigidity of an appliance's physical structure.

Features and benefits of technical insulation

Feature	Construction benefit
Low thermal conductivity	• Excellent insulant for domestic and commercial buildings
Versatility	• Suitable for use in many varied applications and with different facing materials
Good fire performance	• Proven by large scale testing, particularly compared to alternative insulants
Ease of use/installation	• Light, clean, simple to install as board or cut in block applications
Longevity	• Majority of installations will retain thermal qualities for at least 50 years

Pipe insulation

Increased global energy demand calls for substantial investment in cost-efficient, environmentally sustainable supply infrastructure. Rigid polyurethane foam has been successfully used to insulate and protect pipes for more than 30 years. It is now used more widely than ever and is increasingly replacing alternative materials. One of the most popular applications is for district heating and cooling systems, where it is the preferred choice of insulation for many specifiers. It is also commonly used for on and offshore oil pipelines, heating and plumbing services for power stations, chemical plants and refineries, and in dairy industry applications.

District heating and cooling

District heating and cooling systems have to be extremely efficient in order to distribute warm or cold water to residential, commercial and industrial users from centralised sources. Thanks to optimally scaled plants, primary energies are used to pump heat in the desired direction. Warm or chilled water is the standard medium used in these networks and polyurethane insulation is the key to delivering the energy where it is needed as efficiently as possible.

Oil and gas

On every continent, many thousands of kilometers of pipeline are used to serve the oil and gas industries. An intricate network of onshore and offshore transmission pipelines, platforms and tanks forms the foundation of the modern energy supply industry. Polyurethane insulation helps engineers to optimize the efficient performance of the network, making it easier for them to maintain the desired temperature efficiency through the chain.

Industrial pipelines

Pipelines play an essential role within chemical parks and plants where they are used extensively to move fluids efficiently. Insulating these pipelines reduces energy dissipation and saves pumping costs. Petrochemical, pharmaceutical, food, beverage and mining industries are commonly equipped with lines insulated with polyurethanes.

Versatile applications

Huntsman offers a versatile range of solutions for the pipeline industry, equipping pipelines with superior thermal conductivity and high temperature resistance properties. Our polyurethane insulation solutions comply with the EU district heating standard EN253. A broad system portfolio covers all specific production techniques – including discontinuous, continuous and spray – required for the manufacture of rigid and flexible pipes. Over the last ten years Huntsman has supplied insulation for more than 40,000km of pipelines.

Features and benefits of Polyurethane pipe insulation

Feature	Construction benefit
Low thermal conductivity	• Prevent heat loss and heat exchange with a minimal layer of insulation
Suitable for a wide range of temperatures	• Suited to operate in a wide range of temperatures from -162°C to +164°C
Excellent mechanical and product properties even with low densities	• Product reliability and longevity • Low maintenance • Low cost of ownership
Factory produced or foamed in situ	• Production versatility to suit specific applications
Flexible pipes	• Improve handling and installation • Reduce pipe laying costs

Commitment to the polyurethane insulation industry

Huntsman has been a long-established supplier and trusted partner to the international polyurethane insulation industry for more than 45 years. Our research experts and foam technologists work constantly to develop and refine foam insulation systems that meet the ever evolving needs of specifiers and engineers who use polyurethane-based products across a broad range of sectors.

Innovation and technical support

Reflecting this commitment to the market, Huntsman operates three dedicated centers of excellence for foam technology research and development. A technical center in Ternate, near Milan serves customers in Europe, Africa, the Middle East and Indian sub-continent. The Woodlands in the USA supports the Americas, while Shanghai covers the needs of customers in Asia Pacific.

Working together towards shared goals

In addition to these regional technical hubs, our international network of technical service centers offers a extensive support package to customers. Technical service teams are available to help with the selection of the most appropriate processes, chemical systems, and product performance problem solving. Centers can also provide demonstrations and testing resources.

This structure of regional and technical centers provides customers in the construction industry and other sectors direct access to the extensive resources and worldwide service support that the Huntsman group of companies can deliver. This encourages the establishment of close, long-term collaborative relationships, working together towards the shared goals of continuous product development and innovation.

Market extension and industry participation

With deep knowledge and expertise in areas such as sustainable construction, lifecycle analysis and building fire safety, Huntsman is a recognized leader with a strong commitment to driving progress in the polyurethane insulation market. The company also takes an active role in polyurethane-related industry groups, further reflecting our dedication to the sector.

Product stewardship

Huntsman is committed to responsible product stewardship and achieving environment, health and safety (EHS) excellence in every aspect of our business.

Product stewardship demonstrates our commitment to Responsible Care® through the active assessment of our products at every stage in their lifecycle, from sourcing raw materials, through manufacture and use, to eventual disposal. This involves working closely with our customers, suppliers and supply chain partners to ensure that they understand the EHS issues relating to our chemicals and best practice for use in their own polyurethanes products.

The full provision of detailed product information is a vital component of an effective stewardship program.

We produce and circulate a wide range of materials to advise and guide customers on the safe handling and management of our products. We also provide awareness training via the industry's Walk the Talk initiative to ensure that our customers' employees know how to use Huntsman products with the utmost safety.

Huntsman strives to operate as a highly professional chemical company whose successful product stewardship performance is clear for all to see. Our product stewardship standard covers a wide range of EHS activities focused on risk management of our products through their lifecycle: product design and development, supply of raw materials, manufacture, storage, packaging and distribution, use of chemicals, use of final products, recycling, reuse and disposal. With this approach, we can ensure that our products are promoted, distributed and utilized in a sustainable and socially acceptable manner with respect for the environment, health and safety.

In summary, we are totally committed to managing an active product stewardship process that helps us work with our partners and customers to create safer, more environmentally sustainable products. Ultimately, this is what makes a difference to our quality of life.

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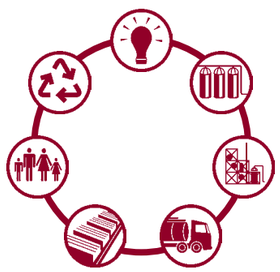
Discover Walk the Talk

walk the talk safety in action



HUNTSMAN

Enriching lives through innovation

European headquarters
Huntsman
Everslaan 45
B-3078 Everberg
Belgium
Telephone +32 2 758 92 68
Fax +32 2 758 72 68

American headquarters
Huntsman
10003 Woodloch Forest Drive
The Woodlands
Texas 77380
USA
Telephone +1 281 719 6000
Fax +1 281 719 6054

Asian headquarters
Huntsman
No. 452 Wen Jing Road
Minhang Development Zone
Shanghai 200245
Telephone +86 21 2403 7288
Fax +86 21 6462 1234

Editor: Veerle Dufour

insulation@huntsman.com
www.huntsman.com/insulation