Building a Sustainable Future

The BASF House - UK Project

BASF
The Chemical Company

Building a sustainable future with innovative chemistry

BASF is committed to energy efficiency and saving resources by developing innovative solutions. This can only be achieved through joint efforts by politics, society, science and business. In its role as The Chemical Company, BASF is dedicated to using energy efficient production processes at its major sites worldwide. In 2007, BASF invested £1.4 billion in research and development and approximately one-third of this figure was dedicated to energy efficiency, and saving resources.

Who We Are

BASF is the world's leading chemical company. Our portfolio ranges from chemicals, plastics, functional solutions, performance products, agricultural products, oil and gas. As a reliable partner to all industries, our high-value products and intelligent system solutions help our customers to be more successful.

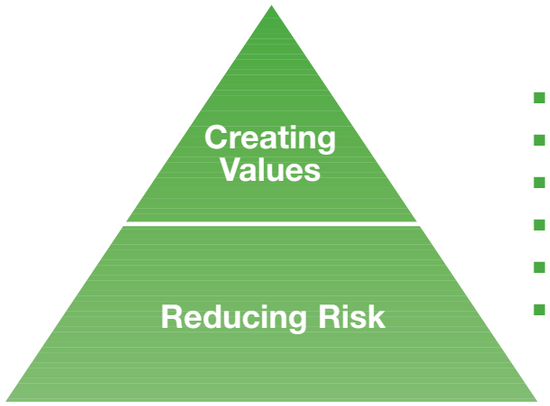
What We Achieve

Our goal is to use our products and services to successfully shape the future of our customers, business partners and employees. Through profitable growth we aim to consistently increase the value of our company.

How We Shape The Future

We develop new technologies and use them to meet the challenges of the future and open up additional market opportunities. We combine economic success with environmental protection and social responsibility. This is our contribution to a better future for us and for coming generations.

BASF 2015 "ENSURE SUSTAINABLE DEVELOPMENT"



- Integrated sustainability in customer relationships
- Develop new target groups and markets
- Identify relevant sustainability issues
- Develop tailored solutions
- Reduce reputational risks
- Transparent communication

Public Recognition for Sustainability and Transparency

Dow Jones Sustainability Indexes Member 2007/08

- BASF shares included in top sustainability indexes such as DJSI World

sam 2008 gold class

- BASF included in the Global 100 list of the world's most sustainable companies for the 7th year running

World Business Council for Sustainable Development

- BASF is a member of the World Business Council for Sustainable Development

UK GREEN BUILDING COUNCIL Founding Member

- BASF as a founding member of the UN Global Compact

THE GLOBAL COMPACT WE SUPPORT

The UK Code For Sustainable Homes

The Code for Sustainable Homes introduces new mandatory minimum levels of performance across five of the key categories:

- Energy efficiency/CO_2
- Water efficiency
- Use of Materials
- Surface Water Management
- Household and Site Waste Management
- Pollution
- Health and Well-being
- Management
- Ecology

The Government is committed to cutting carbon dioxide emissions by 60% by 2050, relative to the 1990 levels. However, building sustainable homes is not just about cutting CO_2 levels – how we build and use homes also has an impact on the environment. In April 2007 the Code for Sustainable Homes replaced Ecohomes for the assessment of new housing in England. This environmental assessment method is based on Ecohomes and many house builders who currently use Ecohomes will find the credit system of the code familiar. One of the key differences between Ecohomes and the Code is that Ecohomes is based on the overall rating for the site, built up from various elements including location, ecology and amenities. The Code assesses the sustainability of individual dwelling types against the specific design categories. Site wide issues are also considered and the results are by dwelling type.

The Creative Energy Homes Project

The University of Nottingham

The Creative Energy Homes project is a showcase of innovative state of the art energy efficient homes of the future being built on the University Park at Nottingham.

Six houses will be designed and constructed to various degrees of innovation and flexibility to allow the testing of different aspects of modern methods of construction.

The BASF House is the first to be completed. The build took just 25 weeks during a very wet and cold winter.

The project aims to stimulate sustainable design ideas and promote new ways of providing affordable, environmentally sustainable houses that are innovative in their design.

Achieving the CODE and a ‘Passivhaus’ for the UK

Energy and Carbon Dioxide Emissions

Energy Efficient Design

The collaboration between the School of the Built Environment at the University of Nottingham and BASF started as part of a research and dissemination project which explored the application of the German ‘Passivhaus’ Standard to other countries in Europe. The success of the Passivhaus Institute in developing and implementing an approach to house design which is not only very energy efficient, but also meets year-round comfort criteria, naturally led to the question of whether this is applicable in other countries and other climates.

From April 2008 every new residential property will require an Energy Performance Certificate for the Building Control Officer or Accredited Inspector. This will include:

- The energy efficiency of the dwelling
- The carbon emissions figure
- The cost of lighting, heating and hot water per annum
- Recommendations on ways to improve the home's energy efficiency

In the UK, as part of the Creative Energy Homes Project at Nottingham University’s School of the Built Environment, BASF, helped by its customers and partners, has built a house to demonstrate how BASF raw materials and products can be used to create an energy efficient and affordable home. This house, whilst initially experimental, has been designed by Derek Trowell Architects to function as a conventional dwelling.

In designing the BASF House in Nottingham, BASF has taken into consideration a number of issues currently affecting the construction industry and how these could be overcome:-

✔ Energy Efficient and to have as near as possible Carbon Zero emissions

The total annual heating load is around 1200Wh which translates into 12.5kWh/m^2. The house complies with the Passivhaus standards of 15kWh/m^2 and can be called a 1.5l house. This demand will be met by a renewable source of energy: biomass.

✔ Affordable and Economical Design

Materials selected to balance the cost of building an energy efficient house against the requirement to make the house affordable to a first time buyer, based on whole life performance cost and energy use. Alternative and new methods of construction selected to ensure a fast track build to speed up the house build process.

✔ Address the issue of Shortage in Skilled Labour

Alternative methods of construction such as Insulated Concrete Formworks and Structural Insulated Panels were selected over traditional brick and block work construction for a new source of labour.

✔ Lack of Available Building Land

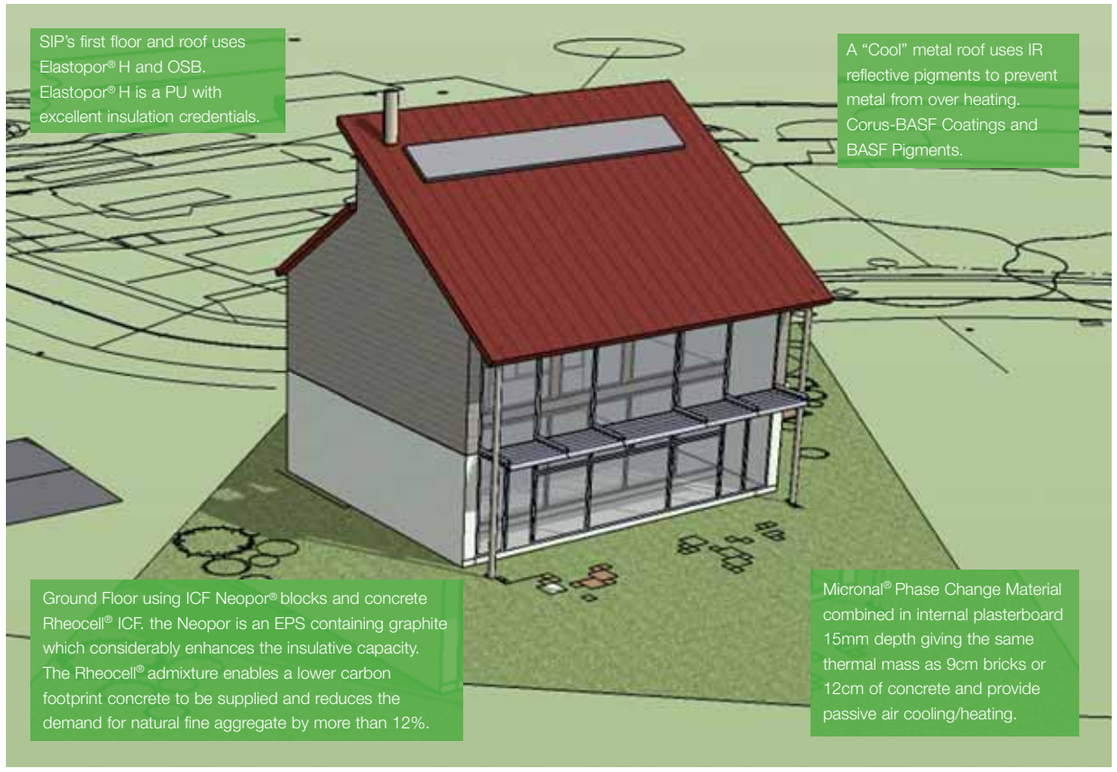
The BASF Materials and Products selected in the project demonstrate the flexibility of alternative building materials designed to exceed Code Level 4 and their suitability for semi-detached, multi-storey and terraced design.

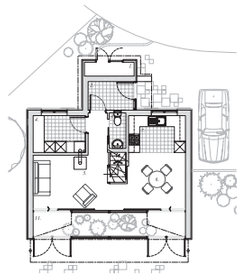
✔ Offer Heating and Cooling Solutions to ensure comfortable living

An affordable Ground Air Heat and Cooling Exchange system and renewable energy sources have been incorporated into the design to provide an effective, affordable heat and cooling source. The careful design of the ventilation system of the house ensures that the house can achieve comfortable temperatures naturally by combining solar gains, natural ventilation and thermal mass provided by a new phase change material suitable for light-weight buildings. The energy use within the house is to be optimised by using WebBrick technology. This system will allow the University to oversee and control the ventilation, heating, lighting, security and blinds remotely via the internet, or, from inside the house. The house will be occupied by students as a living experiment to experience how comfortable life is within a house designed to exceed code level 4.

The BASF House - UK Project

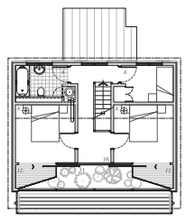
The key effect of the design criteria means the house has a compact floor area and relies as much as possible on passive solar design. In essence the design is extremely simple. The house has highly insulated north, east and west walls with the minimum number of openings compatible with acceptable daylight levels. The southern elevation consists of a fully glazed two-layer sun space. A number of different opening apertures of various configurations ensure that both of the glazed screens to the sun space can be opened or closed to facilitate heating or cooling. The space will contribute to heating by the admittance of solar gain and for air pumped into the building below ground in the winter to pre-heat the space. The sun space will contribute to cooling by the admittance of pre-cooled air in the summer from below ground and by minimising the effects of solar gain through enhanced natural ventilation utilising a stack effect, induced by creating a low-pressure zone above the mechanically opening vents below ridge level.





Ground Floor Plan

Designed For Climate Protection



First Floor Plan

- Ventilation
- Internal Planning and Flexible Space
- Thermal Mass
- Solar Shading

Building Fabrics and Materials

The design of the house limits heat loss throughout the building. All materials have been responsibly sourced to ensure lower environmental impact over their life cycle.

Solar Collection and Glazing

Windows

Practically 100% of the south facing façade and approximately 23% of the whole north façade are windows (frame plus glass). There are no windows on the East and West elevations. This then enables the house to be built also as a terrace or semi detached unit. REHAU and Astraseal have provided the structural glazing and windows for the house.

The southern facing roof slope houses solar collectors, which will provide around 80% of the house's hot water heating requirement. These have been provided by Hoval.

U-Values of Windows

South Elevation: Internal curtain wall (double glazed): 1.7 W/m^2°C
External curtain wall (double glazed): 2.7 W/m^2°C

North Elevation: Double Glazed windows: 1.66 W/m^2°C

U-Value of Walls

The walls and roof have a maximum U-Value of 0.15W/m^2°C

Solar Area

A unique solar area has been designed by REHAU and the project design team to ensure the house benefits from the heat of the sun but prevents cool air from affecting the inside temperature.

To prevent overheating, the metal louvre system on the south elevation provides summer time solar shading from the high summer sun. Solar access is provided in the winter months.

The Porch

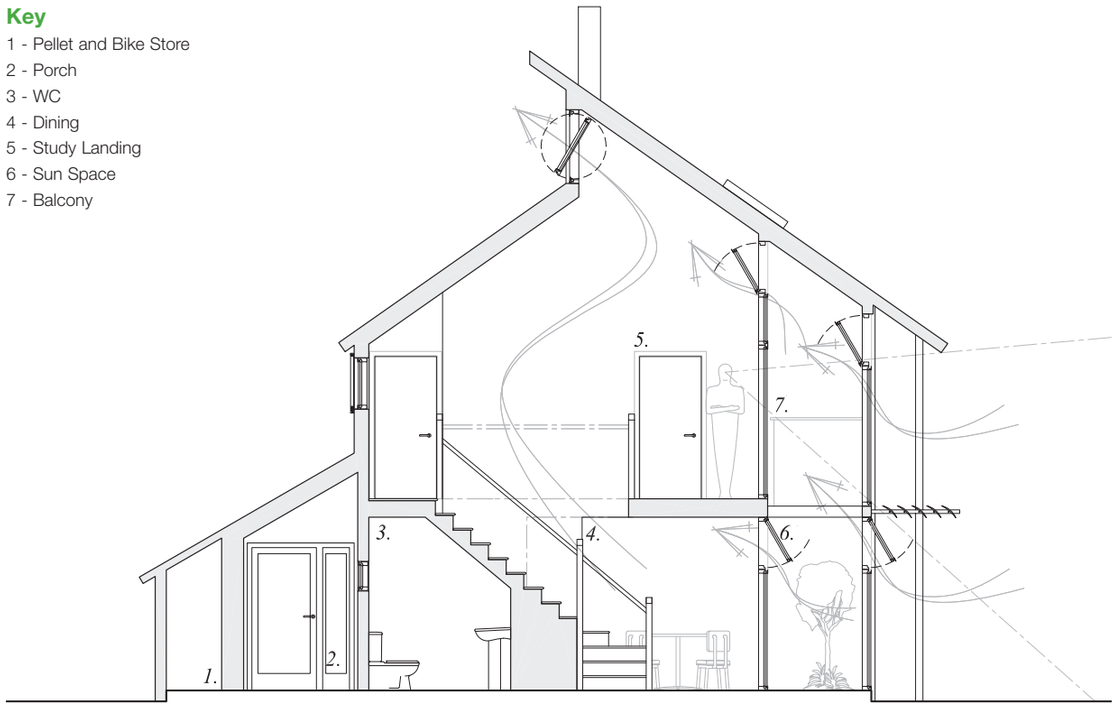
The use of a Biomass boiler will provide an additional heat source for the house. This boiler requires a pellet store, which has been located in the small porch to the north elevation to allow deliveries from the point closest to the access road. The single storey porch also creates a buffer zone between the outside and the heated interior and storage for bicycles.

Health and Well being: Daylight

The house has been designed to improve the quality of life in the home by utilising good daylight. This also then cuts the energy required to light the home.

Key

1 - Pellet and Bike Store
2 - Porch
3 - WC
4 - Dining
5 - Study Landing
6 - Sun Space
7 - Balcony



BASF Insulation Solutions

BASF is one of the largest suppliers of raw materials to the construction industry for insulation materials.

Energy-saving homes with BASF technologies contribute worldwide to lowering CO_2 emissions. BASF insulating materials such as Styropor®, Neopor®, Styrodur® C (XPS) and Elastopor® H help to reduce energy consumption and conserve resources.

The BASF expertise in Germany to use innovative materials to build homes according to energy efficient methods has been transferred to other countries. From its own property company, LUWOGE and consultancy LUWOGE consult show homes in Germany, Italy, France, the United States and South Korea demonstrate how energy and money can be saved in the long term. An appropriately improved insulation level, combined with phase change materials is a simple, cost effective means of increasing comfort and drastically reducing the heating demand in cold countries and the cooling demand in hot ones.

Roof and Walls

In order to minimise fabric and infiltration losses, high levels of insulation were selected for the house. This achieved a u-value of 0.15 for the walls and roof respectively.

EPS Insulation

Neopor®, an expandable polystyrene (EPS), is the innovative refinement of the classic BASF invention for insulation and packaging, Styropor®. Foams made of Neopor® are silver-grey because they contain graphite, which considerably enhance the insulating capacity. Foam manufacturers can save up to 50% raw material for the same lambda value and installers can work with panels that are 50% lighter in weight or up to 20% thinner.




Foundations

Roger Bullivant's have supplied the sub-structure for the house using a new foundations solution called System First. This system uses driven steel piles, topped off with pile caps cast into shuttering. These points are then spanned by lightweight steel formers that then carry a grid of shallower trays and Neopor insulation boards. In-situ concrete then completes a homogenous, load-bearing floor with excellent U-Values. Although this system is no faster than a beam and block installation, there is no requirement for a crane or other mechanised lifting device as all the components are low in weight.

Ground Floor: ICF

BASF Neopor® Insulating Concrete Formwork

For the ground floor walls the BASF Neopor® insulating concrete formwork (ICF) system, is based on lightweight CFC-free expanded polystyrene moulded blocks made from BASF Neopor®. These blocks were assembled and supplied by Logix to create the shape of the building, including window and door openings. The core was then filled with a pumpable concrete which contains a specially formulated BASF concrete admixture; Rheocell ICF mix, supplied by Bardon Concrete.

- Nominal density 25kg/m^3
- Nominal thermal conductivity: 0.030 W/(m-K)

Once set, the concrete becomes a monolithic structure and the formwork remains in place as thermal insulation, with U-Values ranging from 0.30 w/m≤k down to 0.11 w/m≤k, ideal for zero energy buildings.

Sustainable Concrete Solutions

BASF Rheocell ICF Mix

This new, pumpable ICF concrete mix enables a lower carbon footprint concrete to be supplied because it reduces the demand for natural fine aggregate, such as sand by more than 12% over traditional concrete. This Rheocell ICF mix also improves the thermal and acoustic qualities of suitably designed concrete.

The keys to admixture sustainability:

BASF's Construction Chemicals division is the leading supplier of chemical systems and formulations for the construction industry. Continuous innovation and tailor-made solutions ensure its customers are more successful. Its Admixture Systems business unit provides a comprehensive range of technologies which is backed up by expert consulting and professional services improving the quality, safety and economy of construction.

Ready mixed concrete has to fulfil a variety of requirements, depending on its end user, its field of application and the environment in which it is placed. For producers, economical concrete production is vital, whereas contractors need concrete with long workability and easy placing characteristics, and engineers are mainly concerned with high durability.

- Increased fluidity: reduces noise and energy requirements during placing
- Auditable reductions in energy and therefore CO_2 levels
- Optimised mix design: reducing embodied carbon dioxide and energy by enhancing the effectiveness of the cement component
- Reduced permeability: increases the durable life of the concrete with an associated long term environmental benefit
- Reduced damage from harsh environments: including marine, freeze-thaw and sub-zero situations, giving longer life
- Improved quality: better finish and reduced service life repair

Air Tightness/Thermal Bridges

A common failing in housing is air leakage and cold bridges. The monolithic structure of ICFs provides a significant reduction of the number of joints in a wall structure and requires simple detailing for windows and doors which significantly reduces the risk of air tightness failures.

External Render Systems for ICFs

Since the integration of the RELIUS Group in early 2007, BASF Coatings has offered construction paints for interior and exterior applications as well as external wall insulation systems in Europe.

ICF's are becoming increasingly popular for many projects due to the speed of construction, energy saving benefits, design versatility and sustainability. Relius Render Systems are ideal for application to ICF structures.

- Cement based, polymer modified, reinforcement layer incorporating fibreglass mesh for increased crack resistance
- Relius Silicone and Acrylic based finishing renders do not require over painting. They are vapour permeable yet weather resistant
- Relius Silicone and Acrylic renders are supplied with Relius Algosilan fungicide. Delays the onset of algae growth on finishing renders
- Relius Express grade silicone render allows application of finishing layer in temperatures from +1°C.
- Relius Silicone and Acrylic renders are available in over 500 colours
- Relius render systems have been applied to EPS substrates for over 30 years and offer proven performance with many millions of square metres completed

First Floor: SIPS

Structural Insulated Panels

Elastogran

The Elastogran Group is one of the worldwide leaders in polyurethanes (PU). As part of the BASF Group, we have over 40 years' experience in the PU industry. Elastogran is the market and technology leader for polyurethane systems and polyurethane special elastomers, as well as the leading supplier of polyurethane basic products.

Elastopor® H - Rigid Foam Systems

Elastopor® H is a closed-cell polyurethane rigid foam used for many applications in the field of heat and cold protection due to its excellent insulation properties.

This "made-to-measure insulant" boasts extremely low thermal conductivity levels matched by no other conventional insulant. Good mechanical properties and excellent adhesion mean the material has a wide range of applications. Its insulation properties are very high even when thin.

Elastopor® H systems are a significant component of multi-layer construction elements (known as sandwich panels) featuring a polyurethane insulating core and diffusion-resistant metal coatings. These are used as facade or roofing elements in the building of cold stores, warehouses and factory buildings as well as in the building of containers and vehicle super-structures. Sectional gate elements, doors and garage doors are also produced with an insulating PU core. These metal composite elements are manufactured in continuous twin belt and intermittent (press) production.

Elastopor® H insulation elements with flexible coatings (e.g. aluminium, paper) are used in housing construction for sloping, flat-roof, cavity wall and floor insulation. Elastopor® H's excellent mechanical properties mean it can also be used in areas subject to pressure like parking decks, terraces and roof gardens.

A prefabricated timber insulated sandwich panel containing rigid polyurethane foam insulation has been used on the house. This material has been chosen because of its lightweight, high insulation factor and the ability to prefabricate off-site non-rectangular shapes i.e. to the gable walls. The roof is constructed of the same material. This avoids the need for a separate roof structure, as one would need for a traditional build.

The use of these materials creates a highly insulated and energy efficient quick to erect building envelope. For this project Elastogran customer SIP Building Systems Ltd., manufactured these panels and SIP IT Scotland carried out the installation.

- Reduced energy consumption
- Lower energy bills
- 90 percent less air leakage than timber stick-framed structures
- No thermal bridging or convection looping

Air Leakage Testing

The new Part L1A Regulations came into effect on 7 April 2006 and concentrates on the Conservation of Fuel and Power within New Dwellings. All new dwellings will require an Airtightness Test to achieve the standard. During the design stage a great deal of attention was given to the details ensuring high-quality finishing, air-tightness and avoidance of heat loss through thermal bridges.

Thermal modelling by the University of Nottingham and Energist highlighted sections of the building which could be susceptible to air tightness failings. To prevent this from happening additional preventative measures were undertaken on the first floor to address this.

Additional Insulation

Springvale Platinum EPS Insulation

An additional layer of insulation was added internally to the SIPs panels and internally and externally to the ICF to ensure a U-Value of 0.15 was achieved. Springvale Platinum EPS insulation was used to do this. The product used here was similar to the ground floor foundations, where eight cubic metres of Springvale Platinum Floorshield EPS 120 high-grade insulation had already been used at 120mm thickness to provide high levels of thermal performance.

Springvale Platinum is a rigid, light-weight insulation board with a closed cell structure that incorporates BASF's Neopor® graphite component, enabling it to deliver high insulation values. The product is supplied in various grades, depending on the compressive strength requirements and in standard board sizes of 1200 x 2400mm.

Springvale Platinum is manufactured without the use of CFC's or HCFC's. It has zero ODP (Ozone Depletion Potential) and zero GWP (Global Warming Potential). Using the BRE environmental profiling system, Platinum scores as few as 0.043 Ecopoints over a 60 year lifespan. For the upper storeys, this was then overclad with Knauf's Futurepanel with SmartBoard® installed in all south facing rooms' ceilings.

PCI Pecidur®

Within the bathroom area, PCI Pecidur® tile backer boards were used instead of Neopor® on the SIPs sloping ceiling panels & walls as a waterproof and insulating solution. This additional insulation was required to achieve a higher U-Value and ensure airtightness was maintained.

As part of the BASF group PCI are specified throughout sports, leisure, housing, retail and health care facilities for tiling and contract flooring solutions whether traditional methods of construction or offsite modular build techniques are applied.

Cladding and Roofing

PLASTICERAM®

The first floor and roof required a lightweight, durable, waterproof cladding. Colorcoat Urban® by Corus was selected. When used in conjunction with Confidex Sustain™ it provides the world's first "cradle to cradle" Carbon Neutral building envelope. Standing seam steel clad roofing, whilst not particularly common in housing in the United Kingdom, is widely used elsewhere in Europe and the USA and is similar in many ways to traditional lead rolled roofing.

Solar Heat Management

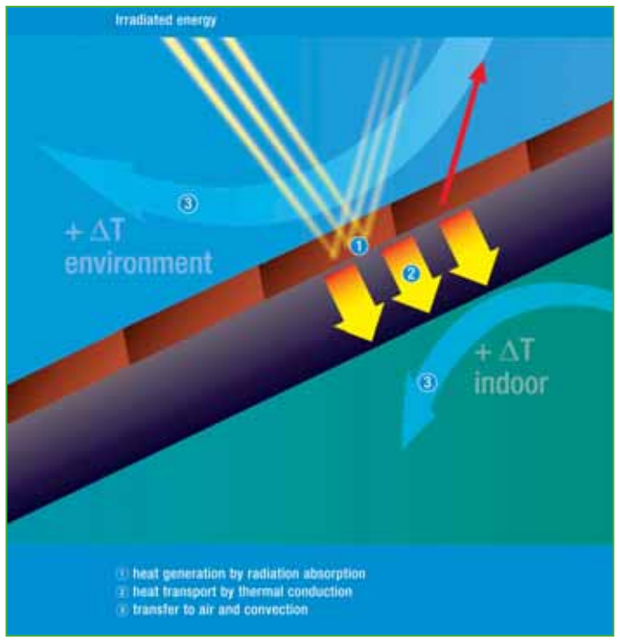
The low carbon Colorcoat Urban® roof from Corus features a BASF Coil Coating infused with specially selected BASF pigments that have solar heat reflective properties which can contribute to reducing any local environmental heat island effect, a growing problem in urban areas particularly highlighted by the Greater London Authority.

Traditional roofing materials absorb solar energy, generating heat that is transported by thermal conduction into the roof and by convection to the surrounding air. Due to the reflective properties of the roof, the BASF House absorbs less solar energy so less heat is available to be released when the temperature drops, which can affect local micro-climates.

The project at Nottingham is one of the first UK applications of a coated roof using heat management pigments on a single dwelling domestic property. The system uses a new enhanced version of BASF's Coil Coating, PLASTICERAM®. The new coating features superb UV durability and corrosion protection as well as offering solar reflective capability. Using their in-house developed computer program, CoolSim®, BASF calculates the best combination of pigments to add to a chosen paint colour to maximise solar reflection.

A terracotta colour has been used at the Creative Energy Homes Project site, in keeping with the traditional roofing tile used in the area. However, in response to the demand for a matt colour range suitable for the urban environment. BASF Coil Coatings and Corus have developed a range of different matt colours that open up new possibilities in urban building design and aesthetics.

With a U-Value of only 0.15, the low carbon environmental credentials of the roof are backed by Corus who can provide full traceability and composition information for all elements of the material and system. Even when compared to using eco-concrete roof tiles, specifying a Colourcoat Urban® roof saved almost 2 tons of CO_2. The roof is BS6920 approved, drinking water safe, contains 20% recycled content, is 100% recyclable and has a 40 year BBA certificate.



Phase Change Materials

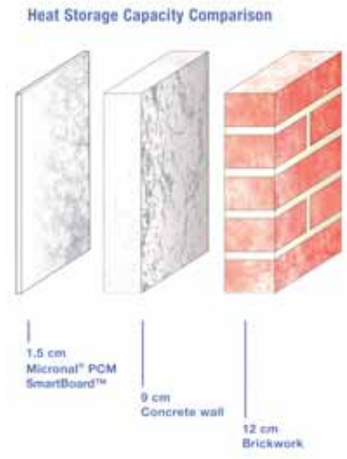
Micronal® PCM and SmartBoard™

Now that all new builds have to be highly insulated to meet the code for sustainable homes, the energy cost for cooling these houses down is of great concern.

To overcome this issue, SmartBoard™ a Micronal phase change material modified plasterboard has been used internally within the BASF house to help regulate the temperature. Incorporating BASF's PCM materials into the design is a new way to reduce heat build up in properties providing in this way an alternative solution to using air conditioning.

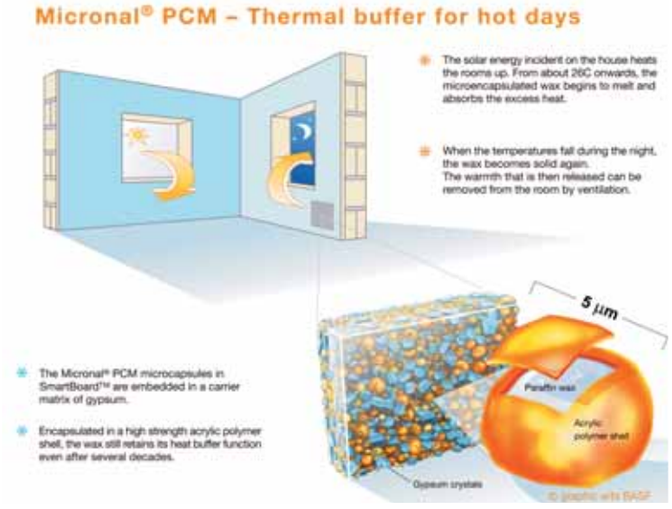
Microscopically small polymer spheres contain in their core a storage medium of waxes. On heating and cooling, the wax in the reservoir capsules melts and solidifies, respectively. When the temperature rises, the phase changing materials absorb heat. When the temperature falls, they emit heat. During the phase change, the temperature remains constant. This stored heat which is 'concealed' in the phase change is known as latent heat. It is a reversible process which occurs within the melting range of the wax.

A building material modified with Micronal® PCM is capable of providing an active temperature management. Typically, it keeps the air temperature in office spaces and living rooms almost constant at the melting point level throughout the period of phase change. Nature, through it's day to night temperature differential, ensures a cycle sequence of 'melt and solidify'. Day-time peak temperatures are lessened, with low night-time temperatures used to dissipate heat from the building through pervading the room with night-air, at no charge.



A Micronal® PCM SmartBoard™ only 1.5 cm thick features a thermal storage capacity identical to that of 9 cm concrete or 12 cm brickwork! Thus, it is the ideal building material for both refurbishment and modern lightweight construction.

Once the room temperature rises to above melting temperature the microcapsules begin their 'work'. Surplus heat is dissipated into the ceiling to be stored there. As a consequence, temperature peaks are cut off, thus ensuring a more uniform room temperature. SmartBoard™ is available in the UK through Knauf at two switching temperatures of 23°c and 26°c. Smartboard™ 23°c was used in the ceiling of the south facing rooms in the BASF house.



Materials: Finishing Elements

The BASF product portfolio ranges from chemical, plastics, performance products, agricultural products and fine chemicals to crude oil and natural gas. As a reliable partner to virtually all industries, BASF's intelligent system solutions and high-value products help its customers to be more successful. BASF develops new technologies and uses them to open up additional market opportunities. It combines economic success with environmental protection and social responsibility, thus contributing to a better future.

By working with these BASF divisions the design team has been able to specify a range of materials for the house which have been responsibly sourced.

Plasterboard – Futurepanel

The plasterboard for the house was supplied by Knauf. Their new Futurepanel was specified throughout the house because it is the industry's first Carbon Neutral Plasterboard. The Knauf Futurepanel combines excellent sound and fire resistance with 'green' credentials that are a positive response to the government's Code for Sustainable Homes. Knauf Futurepanel is a premium plasterboard with a core made from at least 10% recycled gypsum and the rest from the most sustainable sources available. The liners are made from 100% recycled paper. Knauf Futurepanel is a 10kg/m^2 board and can be substituted for standard wallboard in partition and lining specifications, giving identical or better system performance.

Timber

The softwood timbers used in the house have been treated with Wolsit KD20, a wholly organic wood preservative from Dr Wolman GmbH. Wolman has been at the forefront of development in industrial wood preservation since its creation by Dr Karl Heinrich Wolman more than a century ago. The timber was treated by Harlow Brothers in the double-vacuum process. This process injects preservative into an envelope of protection around each component and results in service lives of many decades by protecting against attack from xylophagous insects and fungi.

Stairs

Kloepping TSS were selected to provide the bespoke stairs, oak supporting beams and the balconies balustrades within the house.

External and Internal Doors

The house also includes thermally efficient, engineered timber, external doors manufactured by Manse Masterdor Ltd. and Leaderflush Shapland interior door frames, both of which use BASF's PermaSkin® coating system. PermaSkin® is a new and unique system for finishing of three dimensional timber products using a weatherable, high performance thermoplastic film. This cost effective system produces a long life, maintenance free finish in a single step and retains the original appearance of the wood grain.

Styles
Based on Luran® S materials used in external applications for over 30 years, the polymer ASA used in Permaskin® provides very high resistance to weathering and discolouration.

Prefabrication
Manse Masterdor door sets are prefabricated with a tailored fit made before arrival to site.

Secured by Design
Manse Masterdor Ltd. provides the largest range of Secured by Design door sets on the market, as well as the Masterdor double door. Masterdor exceeds PAS23/24 Bsi tests, meet the requirements of Part M of the building regulations, and fire check versions have also been successfully tested to BS476 Part 22.

Airtight
The Manse Masterdor door set consistently achieves the highest exposure category in testing, showing it is one of the most airtight door sets on the market.

Renewable Timber
The Manse Masterdor is also engineered from renewable timber material, which utilises converted coppiced cropwood, specifically grown for this purpose in managed forests. All timber used in Masterdor construction conforms to L.A.21 sustainability requirements.

Access for All
To consider the main recommendations of the DDA and requirements of the Approved Document M (2004 edition) and BS8300:2001 in relation to access systems, the Manse Masterdor door solutions where chosen to ensure access for disabled people.

Tiling

As part of the BASF group, PCI has provided the complete specification for all tiling and contract flooring requirements within the BASF House. Key requirements in product selection were sustainability and affordability. As a result, affordable tiles were sourced locally from the Nottingham branch of East Midlands Ceramics, natural stone was sourced from a local quarry and a local tiler & flooring contractor were used.

PCI also supplied grouts and adhesives for the tiling for the ground floor's downstairs toilet, kitchen and solar area. PCI Nanolight® was used extensively in the project because of its high yield and coverage.

Flooring

BASF's technologies for flooring also extended into the upstairs bedroom carpets with a 100% BASF granulate Polyamide carpet being supplied by Balta Industries. This was chosen because of its low maintenance and cleanability. The ground floor flooring was supplied by BASF's customers Polyflor and entrance matting by Bonar Floors. All of which were fixed using PCI flooring adhesives and levellers and selected for their fast installation, affordability and low maintenance costs.

Kitchen

Paula Rosa cabinets and worktops were selected for the kitchen. Paula Rosa is currently working towards ISO14001 accreditation.

The kitchen cabinets are made from melamine faced chipboard with dowel and glue pressed construction in a “Lean Manufacturing” environment. All the chipboard used carries FSC certification. This type of kitchen was selected because it makes use of timber and wood trimmings and waste not otherwise useable. The drawer system is guaranteed for life of the kitchen and is recyclable energy and water efficient kitchen appliances were supplied by Beko.

Low to Zero Carbon (LZC) Technologies

To reduce carbon emissions and atmospheric pollution by encouraging local energy generation from renewable sources to supply a significant proportion of the energy demand.

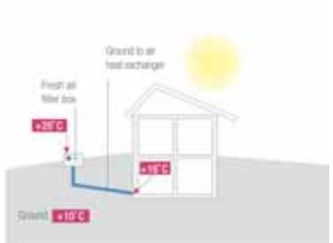
Heating and Cooling

Meeting the Code for Sustainable Homes level 6 relies upon the use of renewable technologies to produce energy to power, heat and cool new build houses.

From the outset of the BASF house project it was recognised that a limited amount of renewable technologies would be incorporated into the design. This approach has demonstrated that a typical 20 homes development, based upon the BASF design, can be built for £70,000. This provides specifiers and housebuilders with a realistic airtight, thermal efficient building which exceeds code level 4 at an affordable build cost.

Ground-Air Heat Exchanger

One of BASF's key partners in the project is REHAU who are supplied their Awadukt Thermo® ground-air heat exchanger system for controlled ventilation. Fresh air is drawn through an underground network of pipes and is then either pre-heated in the winter or pre-cooled in the summer by exploiting the energy stored in the ground.



Operating principle of the air/heat exchanger in Summer

Operating principle of the air/heat exchanger in Winter

REHAU has developed the first ground to air heat exchanger with an antimicrobial inner layer which, as well as saving both costs and energy, will ensure a considerable improvement to the quality of air.

Biomass Boiler

The BASF House will be thermally efficient, using its passive house design to provide heat, but a biomass stove has been installed to ensure the comfort of the occupants. This will also provide an additional hot water supply on winter days. This system will allow the University of Nottingham to carry out research into this field.

The advantages of using locally grown biomass as feedstocks in domestic heating are very important. The BASF House will be using a boiler which runs on renewable energy from the waste meal of rape seed. This will be added to the the boiler on a regular basis to provide top up heat for the residents. The Baxi boiler can also run on a variety of different fuel sources allowing the houseowner to choose the most cost effective fuel at the time. A suitable multi-heat flue was supplied and installed by Dunbrik Flues.

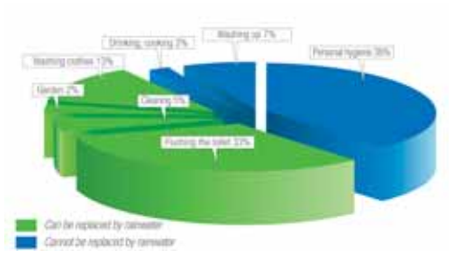
Solar Power

Solar power will provide up to 80% of the hot water using Hoval's Solkit® solar system with its revolutionary LowFlow technology.
This is a compact system for solar-powered DHW generation. It is combined with solar collectors which are suitable for all roof types or for wall mounting. Available with either 250 or 470 litre DHW capacity.

Water Conservation and Rainwater Harvesting System

Hertel's crew excavated the ground to the front left of the BASF plot to enable REHAU's Raurain Rainwater collection tank to be lowered into place. The REHAU Raurain rainwater harvesting system will enable rainwater to be collected from the BASF House's roof, stored and pumped back into the house to be used instead of drinking water for the machine washing of clothes, flushing of toilets, household cleaning and watering of the garden. Used this way, rainwater not only saves valuable drinking water but cuts bills too.

A person living in the UK consumes on average 130 litres of potable (drinking quality) water each day. Of this 130 litres of water used over 50% is used in applications where drinding water quality is not necessary:



Permeable Paving

Water entry, infiltration speed and rainfall intensity, duration and frequency have had a great bearing upon the type of SUDS required for the house. Aggregate Industries' Rainwater Harvesting System utilises both hard and soft surfaces for collecting and storing rainwater that would otherwise have gone into the drainage system, into the ground or be lost to the atmosphere through evaporation. A variety of solutions are available from Aggregate Industries and are being demonstrated around the house. These include a new permeable concrete solution from Bardon Concrete and BASF Admixtures Division.

Bio Diversity

BASF has led the way for a Bio Diverse strategy for the whole of the creative homes project. By teaming up with BASF's Sustainability Manager, University of Nottingham and landscape designer Sarah Hawkins, measures have been put in place to encourage the promotion of Bio Diversity within the grounds. These measures will be implemented during 2008. These will include solutions for composting, use of mulches, letting part of the area go wild, selecting plants to conserve and harvest water, encourage wildlife, birds and beneficial insects to the gardens. Good planting conditions are essential to establish plant growth. Planting is to take place in the spring. The concept of an allotment area has also been proposed for the site.

Waste Management

With the introduction of the Pre-treatment of Non-Hazardous Waste Regulations 2007, it is now a legal requirement for all UK businesses to demonstrate that they are segregating recyclable materials from their waste prior to landfill.

Household Waste Storage and Recycling Facilities

Veolia Environmental Services have been servicing the University of Nottingham for several years. During this time they have made significant improvements to recycling activities at the University, introducing various different initiatives and campaigns to raise awareness at the University. These facilities will be extended to those homes used within the Creative Homes Project. All houses have an adequate internal and external storage space for household and recycling waste in accordance with the criteria set out in the Code for Sustainable Homes.

Construction Site Waste Management

A site waste management plan was produced and implemented for the BASF House site. Veolia Environmental Services were the appointed licensed external contractor.

Minimising Construction Waste

Appropriate measures were put in place to sort, re-use and recycle construction waste.

ICF and SIPS materials were specified for the house because they promote resource effiency. By using these materials instead of traditional bricks and blocks has significantly reduced the amount of waste generated on site.

Composting

Home composting facilities have been provided for in the garden of the house.

House Management

Home User Guide

To encourage the home owner/occupier to understand and operate their home efficiently and to make the best use of local facilities, BASF have created a Home User Guide.

Considerate Constructors Scheme

Best practice site management principles were adopted on site. Many of the contractors used on site were certified under the Considerate Constructors Scheme or other locally or nationally recognised schemes.

Putting safety first Hertel were selected to supply and manage the scaffolding and electrical programme for the BASF site project. Hertel combines a large number of activities for its clients by capturing best practices, utilising resources better and driving improvements through multi-discipline and multi-site contracts. At the BASF Seal Sands production plant, Hertel's full range of project, maintenance and support services have been used because of the outstanding service which they provide. For this reason they have been used on the BASF House project.

Construction Site Impacts

Site management procedures were put in place to monitor, report and set targets to mitigate environmental impact.

Selection of Suppliers and Partners

To balance the choice of materials, colour and composition of the house with the need to fulfil a challenging brief the selection of suppliers and partners was fundamental to the success of the project. By being aware of new technologies and science available the BASF house has been built using suppliers and partners who are experts and innovators in their field.

Energy Efficiency and Monitoring

The house will initially be occupied by University staff or students and carefully monitored, but it has been designed to function as a conventional dwelling. This real life experiment will provide the University of Nottingham, BASF and industry with vital data on the advantages and disadvantages of living in an airtight, highly insulated structure.

To meet the low budget remit, a completely different approach was required from the more traditional systems, where cost of entry is prohibitive.

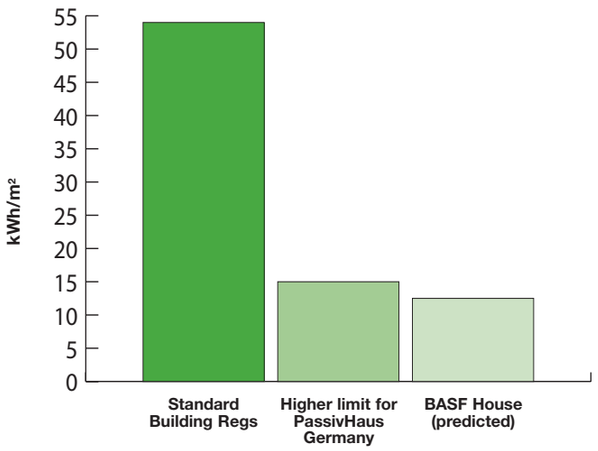
The WebBrick® system was chosen for its affordability, flexibility, expandability and future integrity, and provides benefits that developers, home owners, University research groups and other building system manufacturers truly value as each extend their experimental research into Eco-homes.

The WebBrick® system currently oversees and controls the ventilation, heating, lighting, security, and blinds. It can additionally interface with the entertainment systems but in this particular house this was not considered essential at the outset.

Smart meters have been installed to measure the use of resources in the house, i.e. electricity and water, with the data being presented on a touch screen panel mounted in the kitchen. This same touch screen also provides a user interface with a menu of options for controlling the home. Similarly home PC's, office PC's and many 'off the shelf' internet gadgets like smart phones, PDA's and internet phones can be used to securely control and monitor the Eco-house from inside, or indeed anywhere in the world.

Elsewhere the house lighting system, which includes mains power battery backup, maximises the use of low energy, low voltage LED (light emitting diode) lighting technology.

Annual Heating Demand



Supplier and Partners

Key Partners:

corus
LOGIX INSULATED CONCRETE FORMS
REHAU
WebBrick Systems
PAULA ROSA KITCHENS
BAXI
Hoval
hertel
Roger Bullivant
DEREK TROWELL ARCHITECTS
The University of Nottingham
BASF The Chemical Company

Partner:

masterdor
Leaderflush Shapland
dunbrik flues domestic flue & chimney systems
energist sustainable energy solutions
Tarmac
BARDON CONCRETE
AGGREGATE INDUSTRIES

Key Supplier:

Ideal STANDARD INTERNATIONAL
SBS SIP BUILDING SYSTEMS
KNAUF DRYWALL
springvale
GRAHAM HOLMES Astraseal
Harlow Bros Ltd
stoneguard
BEKO cook clean cool
SOPHIA CONTRACTING

Supplier:

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Image courtesy of Derek Trowell Architects

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