THINKING AHEAD

Sarnafil®

Sika®

SUSTAINABILITY AND THE BUILT ENVIRONMENT - OUR RESPONSIBILITY

TAKING A HOLISTIC VIEW
The changes in our natural environment are well documented. So is the much researched and debated impact the human race is having on the planet. Within these debates, attention is focused on a wide range of issues, including the main greenhouse gases – carbon dioxide (CO_2) levels, methane (CH_4), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs) – deforestation, biodiversity, renewable energy, waste management, recycling and the impact of the built environment.

Whilst every aspect of our business and private lives impacts on these concerns, the construction industry has a unique opportunity to impact positively on most, if not all, of these issues. In new construction a holistic consideration of many of these factors can be made, optimising the design of new towns and cities to complement the natural environment.

REDUCING THE ENVIRONMENTAL IMPACT OF BUILDING
The buildings within these new urban developments can be more thermally efficient. They can work with nature to manage or utilise rainfall for the benefit of the local and wider community. They can harness the power of nature to generate renewable energy, be it solar, wind or the earth's own heat (geothermal), utilising the energy on site or feeding it back into the National Grid. Overall they can be designed and operated to reduce their impact on the planet, reduce the operational costs to business and provide a better working environment.

THE SUPREME REALITY OF OUR TIME IS...
THE VULNERABILITY OF OUR PLANET.
JOHN F. KENNEDY (1917–1963), 35TH US PRESIDENT, SPEECH 28TH JUNE 1963

THE QUICK WIN SOLUTION
However, with long gestation periods for new development, and less than 2% of the built environment being new construction, the quick win solution to individual concerns such as CO_2 emissions will have to be made through the refurbishment and upgrading of the existing building stock. In many cases significant carbon reduction can be achieved through simply increasing the thickness of thermal insulation at roof level and re-waterproofing. Modern rigid thermal insulation boards provide high thermal values per mm thickness; attachment systems such as metal and plastic combination fasteners eliminate heat loss through thermal bridging; and vapour control layers provide control of air leakage.

Regardless of whether a project is new construction or refurbishment, there are a number of constants that need to be considered when evaluating the environmental performance of the components used within the construction. These include longevity, reliability, maintenance requirements, suitability and, significantly, though often overlooked, the quality control of the installation.

SIKA'S OBJECTIVE
Throughout this document Sika aims to address the main 'green' issues faced by the construction industry on an increasingly regular basis. In addressing issues such as legislation, environmental assessment methodologies and product and production assessment, the document relates these issues to the key economic, social and environmental elements of sustainability.

One term that will not be used in this document is 'environmentally friendly'. Very few man-made products have a zero or near-zero impact on the environment and that includes roofing systems. Everything the construction industry does, and every product it uses, has an impact on the environment. Sika's objective is to ensure that its systems and products create minimal impact on the environment whilst meeting the functional requirements of clients, specifiers, contractors and nature.

OUR CITIES ARE GROWING QUICKLY HOWEVER, WITH LESS THAN 2% OF THE BUILT ENVIRONMENT BEING NEW CONSTRUCTION, THE QUICK WIN SOLUTION TO CONCERNS SUCH AS CO_2 EMISSIONS WILL BE MADE THROUGH THE REFURBISHMENT AND UPGRADING OF EXISTING BUILDING STOCK.

GREEN BUILDING COUNCIL
Sika are a member of the UK Green Building Council (UK-GBC). The UK Green Building Council is a membership organisation campaigning for a sustainable built environment - one that minimises negative environmental impacts while maximising benefits for people everywhere.

UK GREEN BUILDING COUNCIL
Founding Member

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BUILDING NEW SOLUTIONS ON EXISTING KNOWLEDGE

ABOVE: **ABERDEEN UNIVERSITY**
THE ROOF OF ABERDEEN UNIVERSITY'S CHEMISTRY BUILDING WAS THERMALLY UPGRADED USING SARNAFIL AND SARNATHERM INSULATION, REDUCING CARBON EMISSIONS AND ENERGY COSTS.

LESSONS FROM HISTORY
Every continent on Earth has examples of the human race harnessing and working with the Earth's natural resources for millennia. Our ancestors found ways to manage water to irrigate crops and avoid flooding. They designed naturally ventilated building to keep them cool in the summer. In warm climates they painted them white to reflect the sun's energy and in cooler climates they insulated them with soil and plants. All of this ancient knowledge can be utilised, adapted and developed to ensure that roofing systems are designed to be not only long lasting and durable, but also complementary to the economic, social and environmental triple bottom line of sustainability.

SIKA – LEARNING AND LEADING
With 98% of the built environment existing, it is unlikely that changes to the new build regulations will make a significant change to our impact on the planet in the short and medium term. Refurbishing our existing buildings, however, can have a major impact, benefiting the occupants, the local community and wider society. In both new build and refurbishment applications, Sarnafil roofing systems can play a significant part in helping to reduce our impact on the planet. Sarnafil thermally broken fasteners help reduce heat loss; SarnaTherm insulation provides thermal performance; Sarnavap vapour control layers control air leakage; and Sarnalites harness natural daylight. Used in conjunction with the Sika Sarnafil MAP HL* AutoCAD format standard details, thermally modelled by the BRE to provide calculated values, these products enable designers to create sustainable buildings with a high environmental performance.

KEEP HEAT IN, AND OUT
Perhaps the biggest contribution we can make to reducing CO_2 emissions is to use less energy in the first place. One of the simplest ways to achieve this is to increase the insulation levels of our buildings, both new and existing, and minimise losses at junctions (see MAP HL details). Sarnafil roofing systems provide a significant number of benefits when it comes to increasing the thermal values of a building. They can accommodate almost any thickness of insulation, in excess of 500mm of rigid insulation being achievable. Insulation can be of a cut to falls design, aiding drainage of the roof.

MANAGE AIR MOVEMENT
But increasing thermal performance is only one part of reducing our CO_2 emissions. We need to ensure that the heated or cooled air in the building stays inside for as long as possible whilst maintaining appropriate ventilation. Avoiding air leakage at all penetrations and junctions is at least as important as increasing thermal values, especially at perimeter roof/wall junctions, BRE research has shown that 30% plus of all energy loss through air leakage occurs here. To prevent this Sarnafil has thermally modelled details to minimise air permeability and heat loss, a comprehensive range of easily sealed vapour control layers, and the unique, vapour sealable, thermally insulated Double L rainwater outlet.

*Until Government DCLG introduces an approval mechanism, Sarnafil Minimised Air Permeability and Heat Loss (MAP HL) details are the closest you can get to a Part L/SBSA Accredited Detail (ACD).

REFLECT THE SUN
The benefit of solar reflective materials and colours has been known and understood in warm climates around the world for millennia, and with urban density increasing, the Albedo or urban heat island effect (the solar heating of urban environments), is impacting on UK cities at an ever-increasing rate. A significant contribution to reducing the Albedo effect can be made by simply replacing dark roof surfaces with a lighter colour, ideally white. See the solar characteristics of roofing membranes table below. Ronnen Levinson & Hashem Akbari's December 2007 report 'Potential Energy Savings and Environmental Benefits of Cool Roofs on Commercial Buildings' demonstrates that by changing from a relatively low solar reflectivity light grey membrane to a higher reflectivity white membrane, large energy cost savings could be made, illustrated in the table below. Reflecting the sun can significantly reducing emissions of carbon dioxide (CO_2), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and mercury (Hg).

HARNESS SOLAR ENERGY
Of course, solar energy can be harnessed as well as reflected, and over the past years more than five megawatts of electricity-producing solar systems have been installed on Sarnafil roofs worldwide.

NATURAL DAYLIGHT
Harnessing natural daylight with SarnaLite rooflights will reduce energy usage and CO_2*. Using SarnaLites will ensure that the rooflights are covered by the Sarnafil guarantee.

*

National Association of Rooflight Manufacturers - Designing with Rooflights and Controlled Artificial Lighting to Reduce CO_2 emissions – supporting the requirements of Building Regulations Part L2A & L2B.

SARNAFIL ROOFING CAN PROVIDE OPPORTUNITIES FOR CONTROLLING OR HARNESSING SOLAR ENERGY. OVER FIVE MEGAWATTS OF ELECTRICITY-PRODUCING SOLAR SYSTEMS HAVE BEEN INSTALLED ON SARNAFIL ROOFS IN RECENT YEARS.

SOLAR CHARACTERISTICS OF ROOFING MEMBRANES	SOLAR REFLECTANCE	EMITTANCE	SOLAR REFLECTANCE INDEX
Sarnafil 9016 SR	0.90	0.85	112
Sarnafil EnergySmart Light Grey	0.49	0.90	57
Sarnafil Patina Green	0.32	0.90	34
Black EPDM	0.06	0.86	- 1
Smooth Bitumen	0.06	0.86	- 1
White Granular Surface Bitumen	0.26	0.92	28
Dark Gravel on BUR	0.12	0.90	9
Light Gravel on BUR	0.34	0.90	37

CUTTING THROUGH THE ‘GREENWASH’

EVOLVING LEGISLATION
Legislation in the UK, particularly in the construction industry, is now helping to protect the environment and attempting to reverse some of the damage that is causing global warming. The government’s ongoing amendments to Approved Documents L of the Building Regulations (England and Wales) and Scottish Building Standards Agency (SBSA) Technical Documents Section 6 have introduced improvements in thermal values, whole building calculations, air leakage testing and a focus on thermal bridging of elements and their connections. All of these tougher regulations are there to reduce the carbon emissions from buildings in line with agreed local, European and international targets. This has included the refurbishment of heated/air-conditioned buildings suggesting an increase in thermal performance to meet new construction standards on most buildings, where more than 25% of the roof area is refurbished.

BRE
Approved Documents L only provides a common platform on which buildings can be designed, and does not take account of a wide variety of additional environmental considerations. To consider these, and to help with the design of class leading buildings, the BRE produces a suite of environmental assessment methods that interlink.
www.bre.co.uk

PRODUCT ASSESSMENT BY ECOPOINTS
To assess an individual product’s impact on the environment, the BRE carries out a process known as environmental profiling. The certified environment profile scheme has been in operation since 2002. This process involves assessing the processing of one tonne of a manufactured product against 13 environmental impact criteria. Each of these criteria is then measured as a unit contribution before a weighting is applied and the outcome expressed in points. The total number of points accrued are then added together and expressed as an ‘Ecopoint’ rating for the product. ‘Ecopoints’ enable the comparison of a product or system with the impact of the average European person, who is deemed to have a 100-point impact per year.

ECOPOINT RATING FOR GENERIC SINGLE PLY MEMBRANES

IMPACT CATEGORY	UNITS OF MEASUREMENT	GENERIC PVC 1.2MM THICK	GENERIC FPO 1.2MM THICK
Total Ecopoints		14.33	11.35
Climate Change	t CO_2	5.53	4.90
Water Extraction	mw	1.21	1.87
Mineral Resource Depletion	t	0.33	0.98
Stratospheric Ozone Depletion	kg CFC-11	0.58	0.90
Human Toxicity	t 1,4-DB eq	1.08	0.83
Ecotoxicity to Fresh Water	t 1,4-DB eq	1.22	0.82
Nuclear Waste	mm^3	2.59	0.41
Ecotoxicity to Land	kg 1,4-DB eq	0.58	0.22
Waste Disposal	t	0.21	0.15
Fossil Fuel Depletion	t oil eq	0.81	0.14
Eutrophication	kg PO_4	0.11	0.10
Photochemical Ozone Creation	kg C_2H4eq	0.05	0.02
Acidification	kg SO_2 eq	0.01	0.01

Source: BRE environmental profiling for SPRA input into the Green Guide for Specification, August 2007. Four SPRA manufacturer members contributed to the generic PVC figures and two to the generic FPO. Sika Sarnafil was a contributor to both generic categories.

SIKA HAS ALWAYS TAKEN A DETAILED LONG-TERM HOLISTIC APPROACH TO SUSTAINABILITY RATHER THAN FOCUSING ON FASHIONABLE ISSUES AND UNSUBSTANTIATED HEADLINES.

When assessing ‘Ecopoint’ figures for individual products, it is important to remember that they are for an individual element, and that the construction of major building elements will generally include more than one product. When this is the case, as in flat roofing, it is generally recommended that the Green Guide for Specification is used as this contains whole element ratings based on common roof construction specifications.

The table on page 6 shows the Ecopoint ratings for both generic PVC and FPO based single ply membranes. The output data is based on annual figures from four Manufacturer members of the SPRA (Single Ply Roofing Association), one of which is Sika Ltd. Whilst the headline figure shows a difference between PVC and FPO, the impact of the individual assessments should be considered and matched to the individual project or client requirements. For example, whilst the manufacture of PVC provides a higher contribution to nuclear waste due to the countries in which it is manufactured, FPO depletes mineral resources at a higher rate due to its base polymer being over 90% hydrocarbon (fossil fuel) based.

ABOVE: **ROBIN HOUSE CHILDREN’S HOSPICE** SARNAFIL ROOFING CONTRIBUTES TO THE HIGH ENERGY EFFICIENCY OF THIS UNIQUE BUILDING IN BALLOCH, NEAR LOCH LOMOND.

YOU MUST BE THE CHANGE YOU WISH TO SEE IN THE WORLD.
MAHATMA GANDHI (1869–1948)

CUTTING THROUGH THE ‘GREENWASH’

SPECIFICATION TO CONSTRUCTION
The Green Guide to Specification uses Life Cycle Assessment to provide environmental ratings for common specifications of individual major construction elements such as a roof, wall, floor, etc. The process utilises the ratings calculated in the Environmental Profiling (Ecopoints) process and adds into the assessment the impacts of transport to site, installation, maintenance and disposal at end of life. The resulting output of the whole specification is expressed as an A+, A, C, D or E rating. Typical whole roofing element specification ratings, in the Green Guide for Specification, are shown in the table below. www.greenbooklive.com

SARNAFIL ROOFING SYSTEMS ACHIEVE LOW ‘ECOPOINT’ SCORES AND CAN PROVIDE EXCELLENT CONTRIBUTIONS TO BREEAM RATINGS.

WHAT GOOD IS A HOUSE, IF YOU HAVEN’T GOT A DECENT PLANET TO PUT IT ON?
HENRY DAVID THOREAU (1817–1862)

BRE WHOLE ROOF SPECIFICATION RATINGS

PRIMARY WATERPROOFING	RATING	ELEMENT NO
EPDM Single Ply	A+	1212540001
TPO Single Ply	A+	1212540004
PVC Single Ply	A+	1212540066
Asphalt	A	1212540002
Polymer Modified Reinforced Bitumen	A+	1212540005
Liquid Applied Roofing	A+	1212540066
Aluminium, mill finish standing seam (steel inner)	A	1212550001
Composite panel, (steel inner and outer)	A+	812550001

Typical BRE Green Guide ratings for waterproofing, insulation, vcl, steel deck and steel trusses. Metal systems exclude vcl. Green Guide ratings will vary according to individual specification: consult a BRE assessor for project specific ratings. Source: Green Guide for Specification.

BREEAM AND THE CODE FOR SUSTAINABLE HOMES
The BRE Environmental Assessment Method (BREEAM) is an environmental assessment method for entire buildings, not individual building elements or materials. The family of assessments includes specific assessments for offices, ecohomes, courts, industrial buildings, prisons, retail units/ shops, schools, multi-residential, international and bespoke constructions. It also includes the Code for Sustainable Homes, a mandatory assessment for all new housing in England, Wales and Northern Ireland, while EcoHomes is still valid for Scotland. BREEAM assesses the overall performance of buildings, awarding credits in each area according to performance.

The process then uses a set of environmental weightings to enable the credits to be added together to produce a single overall score of Outstanding, Excellent, Very Good, Good or Pass. Due to the wide nature of the assessment, every individual building must be subject to an individual assessment by a BRE licensed assessor.

ABOVE: **BP HQ, SUNBURY ON THAMES** THIS BREEAM-ASSESSED, SARNAFIL-ROOFED BUILDING ACHIEVED AN ‘EXCELLENT‘ RATING. THE HIGHEST ACHIEVABLE WHEN IT WAS BUILT.

PERFORMANCE PROVEN OVER TIME

WOOD AND VINYL* ARE AMONG THE MOST SUSTAINABLE OF BUILDING MATERIALS.
DR PATRICK MOORE,
GREENPEACE CO-FOUNDER, MAY 2008

SIKA – THE WATERPROOFING MEMBRANE PIONEER
Since the foundation of the company in 1910, Sika has taken a holistic view of the manufacture of materials, recognising that the manufacturing, design, specification and installation process is intrinsically linked with ensuring long-term environmental performance. Beginning by identifying the problems associated with traditional flat roofing materials in service performance, in 1958 the company's polymer chemists engineered plastic roofing membranes to suit specific roofing applications – engineering not only the membranes but also the machinery with which they would be manufactured. Using state of the art technology of the time, they designed roofing membranes that were flexible in use, easy to install and long lasting.

EVOLVING MATERIALS TECHNOLOGY
These membrane formulations, and the fundamental design principles of the production equipment, are as relevant today as they were then. However, as time, technology, and research moved forward, potential health problems were identified with minority components used within the membrane, leading to the replacement of cadmium as a stabiliser in 1985, and the replacement of lead in 2000. Both of these changes were made ahead of any legislation and today Sarnafil G and S membranes contain only a safe lead substitute as a stabiliser, helping them achieve their low environmental profile (see page 6).

Additional environmental improvements were made to Sarnafil G and S membranes in 1990 with the introduction of a unique lacquer coating. Born out of extensive research and development, this water-based lacquer seals the upper surface of the membrane, which improves its life expectancy further, reduces the retention of airborne pollutants and provides an element of self cleaning during rainfall.

BBA CERTIFIED LIFE EXPECTANCY "IN EXCESS OF 40 YEARS"
The combination of expert Swiss polymer engineering, continual ongoing research and development and contractor training has created a range of market leading roofing systems.

To help demonstrate this, in the summer of 2006, samples were taken from the nineteen year old Sarnafil roof on Technical Building K at London Heathrow airport and the twenty year old Baptist Church in Bedford. These samples were sent to the British Board of Agrément (BBA) for testing and assessment as part of a five-year programme aimed at extending the Sarnafil G/S durability statement.

The membrane samples were artificially aged and tested in accordance with the standards for new membranes. These results were assessed alongside test data from a thirty-six year old Sarnafil membrane from a site in Switzerland and the results of a worldwide 40-roof study. Considered together, the test results enabled the BBA to award Sarnafil membranes what was then the longest period durability statement for a single ply roofing system.

*Vinyl is an abbreviation of vinyl chloride and commonly used in the USA as a generic term for a variety of forms of PVC.

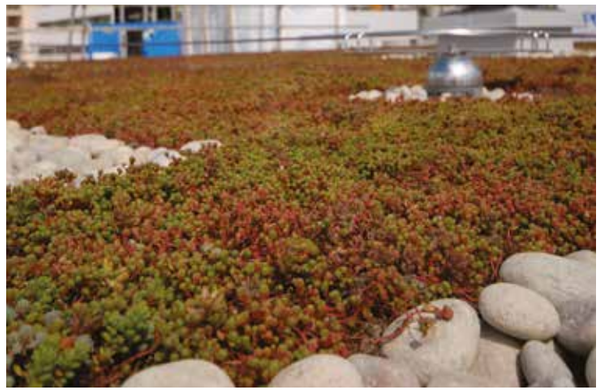
STUDY NATURE, LOVE NATURE, STAY CLOSE TO NATURE. IT WILL NEVER FAIL YOU.
FRANK LLOYD WRIGHT (1869–1959)

"The resultant BBA Certification for Sarnafil G and S membranes stated: The product has been in use in Switzerland and the UK since 1964 and 1980 respectively. The BBA has examined the oldest available sites where a material of similar composition has been installed. Tests conducted on naturally aged material taken from existing sites and naturally aged material which has been subjected to further ageing confirm satisfactory retention of properties indicating that a life in excess of 40 years can be achieved with periodic maintenance."

RECYCLING
Sarnafil has proactively recycled factory production waste back into new roofing membrane since production began in 1960. However, as with many high quality, long life products, the percentage content of recyclate is relatively low as this ensures that whole life performance is maintained while providing a good environmental profile. Higher volumes of recyclate could be used, but this would reduce the durability of the membrane and increase the environmental impact. Generally recyclate is used in less critical elements such as protection and walkway.

ABOVE: **STANSTED AIRPORT**
IN THE LATE EIGHTIES, SARNAFIL ROOFING WAS SPECIFIED FOR THE TERMINAL BUILDING AT STANSTED AIRPORT. WITH PERFORMANCE PROVEN OVER TIME, SARNAFIL WAS ALSO SPECIFIED FOR FURTHER CONSTRUCTION AT STANSTED IN 2001 AND 2008.

GREEN ROOFING - BEAUTIFULLY FUNCTIONAL



QE2 HOSPITAL, BIRMINGHAM (LEFT)
THIS SEDUM-COVERED SARNAFIL ROOF PROVIDES PRACTICAL ENVIRONMENTAL ADVANTAGES INCLUDING CONTROL OF RAINWATER DISCHARGE, SUPPORT FOR BIODIVERSITY AND IMPROVED LOCAL AIR QUALITY.

ON AESTHETICS ALONE, THE CASE FOR GREEN ROOFING IS A POWERFUL ONE. HOWEVER, THE ENVIRONMENTAL ADVANTAGES ARE THE DRIVERS BEHIND MOST GREEN ROOF SPECIFICATIONS.

GREEN ROOFS – A PROVEN SUCCESS STORY
Perhaps the ultimate lesson we can learn from nature, and our European colleagues, is the utilisation of green roofs to help solve a myriad of environmental issues. Using over thirty years of experience in Switzerland and Germany, green roof systems bring benefits in biodiversity, thermal insulation, water management, solar gain, pollution reduction, social amenity and reduced whole life costs to Sarnafil roofing systems.

SUPPORT FOR BIODIVERSITY
Green roofs can be designed to support specific insect, animal and/or plant species, providing habitat and feeding grounds. they can be designed purely for flora and fauna or for humans to enjoy visually, or even to provide all of these functions.

HIGH THERMAL INSULATION
The contribution to the thermal insulation properties of the roof will vary according to the seasons, being greater in summer when they are fairly dry and negligible in winter when they are wet or sodden. But taken as an added bonus the contribution can be significant, with many examples around the world where, regardless of wetness, they help stabilise the internal temperature of the building. They also benefit adjacent overlooking buildings in the summer, where evapotranspiration of the moisture within them cools the air passing the windows above.

ENHANCED WATER MANAGEMENT
All forms of green roof that utilise a growing medium will hold water to feed the plants. But in most cases, especially in extensive and biodiverse designs, the majority of the water will drain from the roof. However, unlike hard landscaped surfaces and exposed roof waterproofing, roof drainage will take significantly longer to commence and will happen at a greatly reduced rate and volume. This helps manage incident rainfall on a site, enabling surface water from other areas such as car parks and pavements to drain ahead of the roof, reducing flood risk on site and downstream.

CONTROL OF SOLAR GAIN
The plant life and growing medium on the roof absorb solar energy, utilising it for photosynthesis rather than storing it for release when the sun goes down. This provides a reduction in the Albedo (urban heat island) effect, reducing summer cooling costs.

POLLUTION REDUCTION
Plants and growing medium absorb atmospheric pollution and carbon dioxide from the atmosphere, and as long as a sustainable plant community is established, the plants will always absorb more CO_2 than they will create during the night or release when they die.

GREEN ROOF ORGANISATION (GRO)
Sika is an active member of GRO, which is a partnership of industry stakeholders coming together to develop guidance for specification, design and manufacturing, installation and maintenance of Green Roofs.

GRO has developed the Green Roof Code of Best Practice for the UK, which is recognised as a code of best practice and as such it should be used to guide behaviour relating to green roof design, specification, installation and maintenance.

As the code is the result of unpaid technical cooperation across the UK green roof industry, due to the manner in which this document was created, it can be considered to be the result of professional expert work.

ISO14001, EMBODIED ENERGY AND WHOLE LIFE COSTS

THE STARTING POINT FOR A BETTER WORLD IS THE BELIEF THAT IT IS POSSIBLE.
NORMAN COUSINS (1915-1990)

ISO 14001 ACCREDITED PRODUCTION FACILITIES
All Sarnafil roofing membranes are manufactured in our production facilities in Düdingen and Sarnen, Switzerland, which are ISO 14001 accredited. An additional benefit of manufacturing in Switzerland is its energy production, 85% of which harnesses the forces of nature through hydropower. This significantly reduces greenhouse gas emissions (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs), and reduces the nuclear waste figure in the generic PVC Ecopoint assessment in the table on page 6.

LOW EMBODIED ENERGY
Embodied energy is a measurement of the amount of energy required to produce a tonne or square metre of a product. Typical examples of embodied energy figures can be found in the Inventory of Carbon & Energy (ICE) report produced by the Department of Mechanical Engineering at the University of Bath in 2006. This report creates an inventory of building materials with values of embodied energy and carbon coefficients. Some of the results can be seen in the table opposite, together with Sarnafil figures.

Generally, the lower the embodied energy of a product, the less it will contribute to global warming. The method used to manufacture Sarnafil membranes results in a low embodied energy, with the amount varying according to membrane thickness. However, when assessing the embodied energy of each membrane it is important to balance the increased value against the increased life expectancy of thicker membranes.

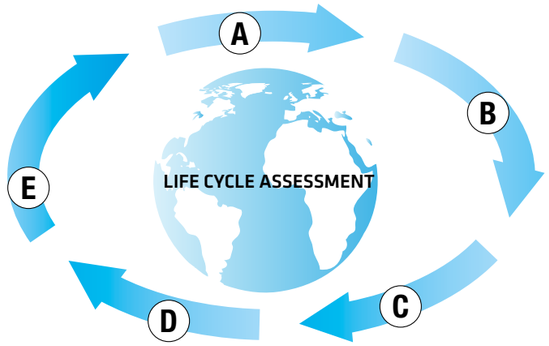
LOW WHOLE LIFE COSTS
A whole life cost evaluation enables the assessment of different systems, from initial construction through cost in use, over a defined period. This is important, as a product with a low installed cost and a short life may require high maintenance or an earlier replacement than a longer lasting product with a higher initial installation cost. These facts are best demonstrated in the Royal Academy of Engineerings' November 1998 study 'The long term costs of owning and using buildings', which established a basic cost model for the design and construction cost of a building (the Capital Cost), the cost to run and maintain the building over its life (the Cost in Use) and the Business Cost to operate the building (staff, equipment, desks, etc).

CAPITAL COST	**1**
COST IN USE	**5**
BUSINESS COST	**200**

Source: Royal Academy of Engineering study, 'The long term costs of owning and using buildings', November 1998.

This investment model demonstrates that the use of a long life, low maintenance Sarnafil roofing solution has the potential to reduce the Cost in Use, ultimately providing a low whole life cost solution that meets the needs of the triple bottom line (economic, social and environmental) requirements of sustainability.

THE SIKA LIFE CYCLE APPROACH TO ROOFING



THE SIKA ROOFING LIFE CYCLE APPROACH
Which impact categories and resource indicators are most relevant for roofing?
As a standard approach, Sika evaluates all impact categories and resource indicators deemed as important according to the relevant standards. For Roofing Cumulative Energy Demand (CED), Global Warming Potential (GWP), and Photochemical Ozone Creation Potential (POCP) are considered to be most relevant. Others, such as Use of Net Fresh Water are less significant for roofing and hence not included in this publication.

Which life cycle phases are most relevant for roofing?
From a 'Cradle to Gate' perspective, the majority of the potential impacts are connected to the raw materials **A**, that are used to produce **B** the roof waterproofing layer and the other roofing system components. From a 'Cradle to Grave' perspective, the use phase **D** and the end-of-life phase **E**, have the most significant influence on the overall sustainability performance of roofing applications, due to their contributions to save and / or create energy, to avoid carbon emissions and to save resources at the end-of-life. The leverage of all of these potential benefits is a long lasting functionality and durability.

What is included in the Sika roofing LCA's?
The LCA data in this brochure refers to 1 m^2 of the roofing systems/membrane and is either based on a cradle to gate, or on a cradle to grave approach.

Who performed and reviewed the Sika roofing LCA's?
The Sika Roofing LCA's have been performed internally by the Sika Corporate Product Sustainability Group, using the state of the art GaBi software from PE International. The LCA model was reviewed by the Swiss Federal Laboratories for Materials Science and Technology (EMPA), the leading independent research institute.

RAW MATERIAL AND PRODUCTION: A,B
Energy and resource efficient roofing systems: Sika provides roofing systems that use less energy and resources in comparison with competitive technologies.
Climate protection roofing solutions: Sika provides roofing systems with a low Global Warming Potential. This means a reduced Carbon Footprint.

APPLICATION: C
Air quality roofing solutions: Sika can provide low Volatile Organic Compound (VOC) and VOC-free roofing options, which help to avoid summer smog.

USE AND MAINTENANCE: D
Saving energy: Sika roofing systems can save energy by incorporating high performance thermal insulation.
Saving energy: Sika solar reflective membranes help save energy by increasing the albedo and as a consequence reducing the cooling energy demands and contributes to the reduction of the urban heat island effect.
Generating energy: Sika SolaRoof™ systems allow you to produce energy right on top of your roof, whilst Sika solar reflective membranes also improve photovoltaic panel efficiency.
Improving the microclimate: Sika green roofing systems help to improve the microclimate and to mitigate the development of urban heat islands, as well as helping manage water run-off from roofs.

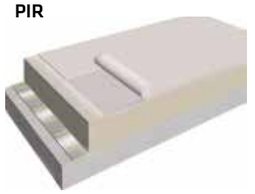
END-OF-LIFE: E
Recycling: Recycling at the end-of-life means closing the material cycle which allows the saving of resources.

1) In the LCA's, neither the roof construction (steel deck, concrete deck, soil, plants etc.), nor capital goods (e.g. machinery) were considered.

DESCRIPTIONS OF ROOFING SYSTEMS COVERED IN THE LCA'S

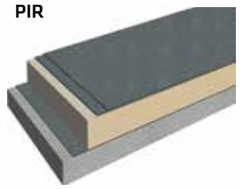
ADHERED ROOFS

Thermoplastic membrane / PIR



- PVC membrane Sarnafil® G410-12 Felt adhered to the insulation with Sarnacol® 2142 S
- PIR insulation 135 mm bonded to the vapour control layer with Sarnacol® 2162 UK
- Self adhesive vapour control layer Sarnavap® 5000E SA
- Concrete deck

Bitumen 2 - layers / PIR



- 2-layers modified bitumen (5.0 and 3.5 mm)
- PIR insulation 135 mm bonded to the vapour control layer with adhesive
- Vapour control layer mod. bitumen 2.7 mm
- Primer
- Concrete deck

MECHANICALLY FIXED

Thermoplastic membrane / PIR®

- PVC membrane Sarnafil® S327-15EL mechanically fixed with Sarnafast® SBF and Sarnafast® Washer
- PIR insulation 135 mm
- Vapour control layer Sarnavap® 2000 E
- Steel deck

EPDM 1.5 mm / PIR

- EPDM 1.5 mm mechanically fixed with fasteners and washers
- PIR insulation 135 mm
- Vapour control layer PE 0.3 mm
- Steel deck

2-layer metal / PIR

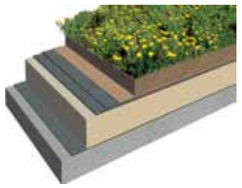
- Top layer metal panel, steel
- Fixings and spacers
- PIR insulation 135 mm
- Base layer metal panel

GREEN ROOFS

Thermoplastic membrane / PIR

- Soil with plants
- Drainage layer
- FPO membrane Sarnafil® TCG 66-15
- PIR insulation 135 mm
- Vapour control layer
- Concrete deck

Bitumen 2-layers / PIR



- Soil with plants
- Drainage layer
- 2-layers modified bitumen (5.0 and 3.5 mm)
- PIR insulation 135 mm
- Vapour control layer mod. bitumen 2.7 mm
- Concrete deck

LCA comparison of popular roofing systems and technologies: in order to allow correct comparison, the comparison of all of the roofing systems is based on the same thermal insulation type (PIR/PUR boards), with the same thermal resistance (RD = 5 (m^2 · K) / W).

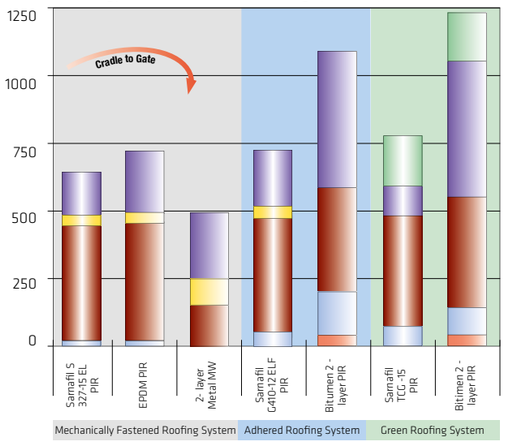
1) In the LCA's, neither the roof construction (steel deck, concrete deck, soil, plants etc.), nor capital goods (e.g. machinery) were considered.

LCA RESULTS FOR CUMALATIVE ENERGY (CED)

CHALLENGE:
THE DEMAND FOR LIMITED RESOURCES IS INCREASING. WORLDWIDE THE DEMAND FOR RESOURCES INCLUDING OIL, COAL, NATURAL GAS, IRON ORE AND COPPER IS INCREASING, DRIVEN BY A GROWING POPULATION AND HIGHER SPENDING AND PURCHASING POWERS. ON THE OTHER HAND, THESE RESOURCES ARE LIMITED, OR THEIR EXTRACTION IS GETTING MORE AND MORE COSTLY. EFFICIENT AND INTELLIGENT USE OF LIMITED RESOURCES IS ONE OF THE MAIN CHALLENGES FOR FUTURE GROWTH.

LCA RESULTS FOR POPULAR ROOFING SYSTEMS 1)

Cumulative Energy Demand (CED) for 1 m² roofing system [MJ/m²]



You can contribute to saving energy and resources by choosing Sika roofing solutions that:

- Have low CED (Energy & Resource Efficiency Solutions)
- Have a wide range of both sustainable and cost effective roofing systems to match your requirements
- Provide superior durability, together with additional benefits in the use phase

Green layers Waterproofing layer Reinforcement (LAM) Fasteners / Adhesives Insulation Vapour control layer

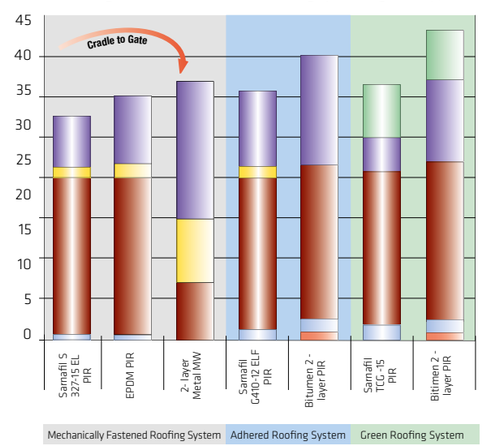
1) LCA values may vary, depending on the products formulation (e.g. due to local fire regulations) and production site, as well as on the datasets from the available LCA databases.

LCA RESULTS FOR GLOBAL WARMING POTENTIAL (GWP)

CHALLENGE:
THE EARTH'S CLIMATE IS CHANGING FASTER THAN EVER BEFORE. THE CONSEQUENCES ARE MANYFOLD AND AFFECT US ALL. CLIMATE PROTECTION IS ONE OF THE MOST IMPORTANT TASKS FOR THE FUTURE. BY 2050 THE WORLD WILL HAVE TO REDUCE ITS GREENHOUSE GAS EMMISSIONS BY 80%. TO ACT NOW IS CRUCIAL, BECAUSE A COMPLETE OVERHAUL OF CURRENTLY USED ENERGY SYSTEMS NEEDS TO BE FINANCED AND REALIZED WITHIN LESS THAN TWO GENERATIONS. DECISIVE ACTION IS NEEDED URGENTLY.

LCA RESULTS FOR POPULAR ROOFING SYSTEMS 1)

Global Warming Potential (GWP) for 1 m2 roofing system [kg CO2-eq./m²]



You can contribute to protecting our climate by choosing Sika roofing solutions that:

- Have lowest GWP (Climate Protection Solutions)
- Have a wide range of both sustainable and cost effective roofing systems to match your requirements
- Provide superior durability, together with additional benefits in the use phase
- Can be easily used to overlay existing roofs

Green layers Waterproofing layer Reinforcement (LAM) Fasteners / Adhesives Insulation Vapour control layer

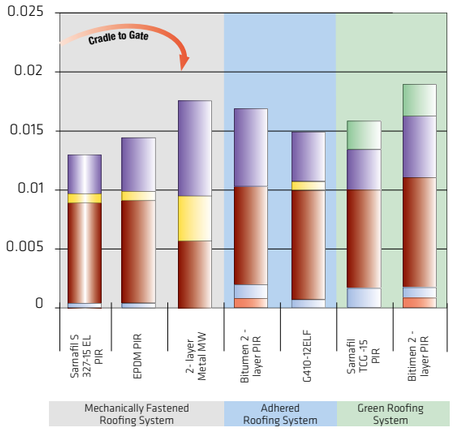
1) LCA values may vary, depending on the products formulation (e.g. due to local fire regulations) and production site, as well as on the datasets from the available LCA databases.

LCA RESULTS FOR PHOTOCHEMICAL OZONE CREATION POTENTIAL (POCP)

CHALLENGE:
IMPROVE AIR QUALITY AND MAINTAIN A SAFE ENVIRONMENT. PHOTOCHEMICAL OZONE CREATION POTENTIAL (POCP), OR SUMMER SMOG, IS THE FORMATION OF REACTIVE CHEMICAL COMPOUNDS, E.G. OZONE, BY THE ACTION OF SUNLIGHT ON VOLATILE ORGANIC COMPOUNDS (VOC) AND NITROUS OXIDES (NO_X). IT IS COMMON IN LARGE CITIES, WHERE HIGH AMOUNTS OF VOC AND NOX ARE RELEASED (E.G., INDUSTRIAL AND AUTOMOBILE EMISSIONS), ESPECIALLY DURING SUMMER WHEN THERE IS MORE SUNLIGHT. SUMMER SMOG MAY BE HARMFUL TO HUMAN HEALTH AND ECOSYSTEMS. THE WELL-BEING OF HUMANS AND ECOSYSTEMS NEEDS TO BE ENSURED.

LCA RESULTS FOR POPULAR ROOFING SYSTEMS [1)]

Photochemical Ozone Creation Potential (POCP) for 1 m² roofing system [kg C_2H_4-eq./m²]



You can contribute to reducing the summer smog by choosing Sika roofing solutions that:

- Have low POCP (Air Quality Solutions)
- Provide superior durability, together with additional benefits in the use phase

■ Green layers ■ Waterproofing layer ■ Reinforcement (LAM) ■ Fasteners / Adhesives ■ Insulation ■ Vapour control layer

[1)] LCA values may vary, depending on the products formulation (e.g. due to local fire regulations) and production site, as well as on the datasets from the available LCA databases.

CONCLUSIONS FROM THE LCA RESULTS FOR POPULAR ROOFING SYSTEMS: CRADLE TO GATE

CHALLENGE:
NUMEROUS ASSESSMENTS HAVE PROVEN THAT SARNAFIL ROOFING SYSTEMS PROVIDE ROOFING SOLUTIONS THAT MEET THE THREE PILLARS OF SUSTAINABILITY. ECONOMICALLY THEY REQUIRE LOW MAINTENANCE AND HAVE A LONG LIFE, WITH A BBA CERTIFIED LIFE EXPECTANCY "IN EXCESS OF 40 YEARS"*. SOCIALLY THEY MINIMISE IMPACT BY PROVIDING CONTINUOUS LONG-TERM PROTECTION OF THE OCCUPANTS, AND THE LONG LIFE MINIMISES REPLACEMENT REQUIREMENTS. ENVIRONMENTALLY THEY HAVE LOW EMBODIED ENERGY AND A LOW ENVIRONMENTAL PROFILE, DEMONSTRATED BY AN A+ RATING IN THE BRE GREEN GUIDE FOR CONSTRUCTION AND CODE FOR SUSTAINABLE HOMES.

* for full details see Sarnafil BBA certificates

ENERGY EFFICIENCY SOLUTIONS

- Sika roofing systems based on thermoplastic PVC and FPO single ply membranes have a low Cumulative Energy Demand (CED). This holds true for mechanically fastened, adhered and green roofing systems.

RESOURCE EFFICIENCY SOLUTIONS

- Same as Energy Efficiency, Resource Efficiency is measured by the Cumulative Energy Demand (CED).
- Sika roofing systems based on thermoplastic PVC and FPO single ply has low Cumulative Energy Demand (CED) and classify as Resource Efficiency Solutions.

CLIMATE PROTECTION SOLUTIONS

- Sika roofing systems based on thermoplastic PVC and FPO single ply have a low Global Warming Potential. This means a reduced Carbon Footprint for a solution that is here to last.

AIR QUALITY SOLUTIONS

- Sika roofing systems based on thermoplastic PVC and FPO single ply have a distinctly lower Photochemical Ozone Creation Potential (POCP) than the other roofing technologies compared. This means reduced summer smog potential.
- You can contribute to preventing summer smog by choosing high performance and low impact Sika roofing systems.

SIKA FULL RANGE SOLUTIONS FOR CONSTRUCTION:

WATERPROOFING

CONCRETE

REFURBISHMENT

DISTRIBUTION

SEALING AND BONDING

FLOORING

ROOFING

INDUSTRY

WHO WE ARE

Sika Limited is part of the global Sika Group, specialising in the manufacture and supply of chemical based products for construction and industry. Sika is a world-leader in its field with subsidiaries in more than 80 countries, 15,200 employees, and annual sales of CHF 4.8 billion (£3.3bn). We are also committed to providing quality, service, safety and environmental care.

In the UK, we provide market-leading solutions for concrete, waterproofing, roofing, flooring, refurbishment, sealing & bonding, and industry, and have manufacturing sites in Welwyn Garden City, Preston, and Leeds with 700 employees and a turnover of £190 million.

bsi. ISO 9001 Quality Management

bsi. ISO 14001 Environmental Management

bsi. OHSAS 18001 Occupational Health and Safety Management

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