SUSTAINABLE BUILDING WITH PLASTICS NATURALLY
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The world of house building has been changing since 2002. From Europe came the Energy Performance Directive for buildings that required us to better insulate our energy-hungry buildings, and thus to emit fewer greenhouse gases. On 2012, there is a new version of this directive that requires us to design and build all new buildings and major renovations so that they consume almost no energy for heating and ventilation. All this by 2020, which, considering the planning and design phases for buildings, is just around the corner. It goes without saying that this will bring about fundamental changes to the building process in Belgium. Buildings will have to perform better, and multiskilled teams will be badly needed. But energy saving is only a part of the (r)evolution. If we want our children and our grandchildren to have as much prosperity as ourselves, then we must build sustainably. It is not only energy-efficient, but also care for environmental aspects such as the depletion of raw materials and biodiversity, with respect for the social aspects and attention to the economic impact, and this at both a local and international level.

As construction is a very material-intensive process, the building products also play a fundamental role. In view of the increasing airtightness of buildings and the associated dependency on ventilation systems, emissions of hazardous materials from building products to the interior environment will become increasingly important. My departments are working hard on this. Insulation is also becoming increasingly important. To this end the building sector must develop new designs on a material and product level. I am thinking of window frame profiles and insulation materials, both ideal areas for the plastics sector to innovate and profile themselves. Less and more efficient use of raw materials, and a more harmonised lifetime of products is another fundamental product aspect in order to reduce the dependency on raw materials.

The above points also appear in a range of new legislative and voluntary European initiatives. The Eco-design Directive is now looking at all products that affect energy consumption, such as insulation materials and windows. Both the European Ecolabel and European standards are developing methods to evaluate the sustainability of buildings. Hazardous materials are analysed in REACH and European methods are being developed to evaluate the emissions of hazardous materials into the air, soil and water. There are also the European green government purchases aimed at stimulating sustainable products.

It is clear that the plastics sector can play an important role in all these developments. Despite the fact that today plastics primarily originate from finite oil derivatives and require all kinds of additives, these building products also have clear benefits such as lightness, long lifetime, good insulation properties, and recyclability in equivalent applications. The voluntary VinylPlus initiative is a very good step in the right direction, for example to replace hazardous materials in PVC and to perfect efficient and effective recycling systems, but the challenge is still great. Such initiatives, if they are successful, can be an example for other plastics and materials.

"If we want our children and grandchildren to have the same prosperity as ourselves, then we must build sustainably."
WHAT IS SUSTAINABILITY?
Global warming, which is also linked to the increasing world population and the environment, presents us with exceptional problems and challenges. It is high time to manage our energy, raw materials and drinking water more wisely. In the building sector in particular, giant leaps forward can be taken here.

Sustainability is a job for us all. It is a concept that draws its definition from the Brundtland Commission. Sustainability goes much further than just the lifetime of materials. The definition also covers the integration of a building into its environment, the compactness of the design, the building shell (insulation, airtightness), the choice of techniques (heating, ventilation, lighting, etc.). Sustainability is also determined by a transport requirement that often arises from the location of a building with respect to work, shops, schools, sports facilities, etc.

Policymakers and scientists are researching how materials can be used more sustainably instead of just throwing them away. Materials are no longer examined from cradle to grave, but from their cradle to their next cradle, their cradle after that, and then the cradle after that, and so on. In this way we create a closed circuit. This is called the cradle-to-cradle principle.

Sustainability can only be assessed in the context of the entire lifecycle. Given their particular properties, plastics score particularly well in this respect, certainly during their usage phase. The desire is thus twofold: on the one hand to make the use phase as long as possible, and on the other to recycle the product as many times as possible so that a new usage phase can be repeatedly realised with the same raw material.

The sustainability of materials should not be determined only by the energy needed for the production phase. The energy needed for transport, assembly, building in, end of life phase, etc., must also be taken into account. The impact of building materials must be considered on the basis of EPD’s (Environmental Product Declarations). This data is based on internationally recognised ISO standards, and in addition to the environmental impacts and energy consumption, also take account the lifetime and maintenance of building materials.

As Belgium is renovating its housing stock at the rate of around 1% per year, and the impact of a house is felt over a period of 50 years or more, the plastics sector advocates the strictest possible E-level for new constructions and for thermal insulations of the existing buildings envelopes.

‘Sustainable development is about meeting the needs of the current generation without jeopardising the needs of future generations.’

(Commissie Brundtland)
What is sustainability?

The building sector alone is responsible for 40% of total European energy consumption.

Nevertheless, Europe has very few fossil fuels and imports around 50% of its energy, generally from politically unstable regions. This causes highly fluctuating energy prices that negatively affect the European economy, and thus also our prosperity. From the perspective of the energy triangle, and to reduce its energy dependency, Europe must manage energy more efficiently and increase its share of renewable energy. The European objectives for 2020 emphasise this in particular.

The building sector alone is responsible for 40% of total European energy consumption. At the same time, it also causes 36% of total CO2 emissions of the EU. The building sector, together with transport, is thus the area in which Europe must make the most important energy savings. Urgent action is required: the average energy consumption of a Belgian household is 3.4 kWh/m² per year. This is 73% higher than the European average. It must be clear that there is still a great deal to be done. Belgium is now building lots of houses with an annual energy level of 80 kWh/m² or less. This helps reduce the European average, which today is 203 kWh/m² on an annual basis. This clearly shows that it is not a question of ‘capability’, but a question of ‘will’.

Europe has already taken various initiatives to promote efficient energy consumption. For example, the European market for building products has been harmonised by the Construction Products Directive (CPD). This directive will soon be replaced by a European regulation. However, Europe is aware that governments play an exemplary role. Hence the Green Public Procurement initiative was launched, to spur governments to pay more attention to environmental criteria in public purchases. Europe promotes the use of eco-materials in the private sector through the Eco Label Directive and strives for optimum energy efficiency through the Eco Design and Energy Performance of Buildings Directive. Europe also emphasises the importance of the building sector in this respect. Currently the EPBD (European Energy Performance of Buildings Directive) wants new buildings to be Near Zero Energy Houses by 2020. Governments must achieve these objectives by 2018.

In building terms this means tomorrow! This brings us to the last question: how can we improve the energy performance of existing buildings?

The initiative primarily rests with the member states themselves. They must draw up an energy efficiency plan to demonstrate how they intend to meet the European objectives. It is clear that to manage energy more efficiently, not only are very high quality building materials required, but also a more effective method for (dis)assembling and recycling them after their period of use. In order to evaluate building materials, Europe is also promoting the evaluation of the building as a whole, as well as its economic, social and ecological impact. In this respect building materials play a crucial role. Their impact will be reported via Environmental Product Declarations that will enable the identification – with regard to the entire building – of which material is the most sustainable on an ecological level for the project in question.

Only such a general approach will enable us to take real sustainable decisions, and to ensure that we do not just replace one problem with another, or transfer the problems of one city to the next. It is indeed our common purpose to preserve the sustainability of the European market, instead of passing this sustainability to another market.

VICTOR JOSÉ ARGUÉS – Head of the Construction Department of the Directorate-General for Enterprise and Industry of the European Union
What is sustainability?

Undoubtedly plastics in construction will also play an important role in the future.

These energy challenges are now having, and presumably even more so in the future, a great impact on everybody involved in the building process: suppliers, designers, workers, public authorities and the property developers themselves. In the space of a few years in many cases building methods will have to change quite drastically. Of course every change means opportunities and risks.

It is important that in this change process particular attention is paid to the technical quality of materials, systems and implementation in Belgium. For decades in Belgium we have applied the BEnOR and ATg systems, respectively aimed at increasing the quality and confidence in the market for the products (via BEnOR) and systems (via ATg). Within the uBAtc/Butg we are working flat out to meet these new challenges. In collaboration with all important parties, it is the intention to arrive at pragmatic approaches to guarantee the technical quality and fitness for purpose of products and systems.

In parallel with the above technical concerns, there is growing attention on sustainable building, i.e. building and renovating that take account of the social, financial and environmental aspects, so that the use of energy, space, water and materials is optimised.

Sustainable building covers a very wide range of areas of interest that are currently not covered by BEnOR and ATg, as they are primarily targeted at the technical quality.

Sustainable building requires an integrated approach. After all this is an extremely broad concept: from energy-efficient building and low CO2 emissions, to the use of environmentally-friendly materials, managing water economically, comfort, access and affordability.

This issue concerns all countries. Hence international cooperation is important. In this respect the CSTC/WTCB participates in various standardisation committees on an international (ISO TC 59 SC 178) and European (CEN TC 350) level. In the Belgian context the Centre, as the co-initiator of the VALIDEO project, ensured that the subjects of labelling and certification in the field of sustainable building were placed on the political agenda.

Plastics are important for the building sector. Over the last decades, the use of plastics has increased, primarily on account of their specific properties and potential (such as weight, ductility, thermal performance, etc). Undoubtedly plastics in building will also play an important role in the future, whereby the way in which the environmental challenges are met will be of decisive importance.
What is sustainability?

'The difference between 'sustainable' and 'not sustainable' must be determined on a rational scientific basis.'

How can sustainable building and sustainable materials be measured?

This is not so simple, as sustainability covers many aspects and must be evaluated on the level of the whole building. It is thus not easy, if not impossible, to provide an unequivocal answer. When it comes to energy for example a comparison is not difficult, as we have a unit, i.e. the number of kilowatt-hours. For water it is rather complicated, and for materials it is particularly complicated, as we must look at the entire lifecycle. Indeed, very many different factors are at play that we cannot really compare properly. The water or energy consumed to make the materials for example. The possible exhaustion of raw materials and also the health aspects of the material. A considerable misconception is that a one-dimensional list of sustainable materials can be drawn up, in the same way as the results of a bicycle race.

Sustainable building forms part of sustainable development.

We must learn to build with the awareness that everything is finite: energy, materials, space, water, etc. We must always be aware that building has an enormous impact on our social fabric and our mobility.

The 'sustainability' aspect is often approached from intuition, from an emotional instinct. Based on this instinctive perspective, natural materials are sustainable and synthetic materials are not. This is not correct. The difference between 'sustainable' and 'not sustainable' must be determined on a rational, scientific basis. Take renewable materials for example. Renewability is one factor, just as recyclability for example. Of course that is a positive factor, but it is not the only factor that plays a role. In the first place a material must be able to 'do its job'.

A regrowable or recycled material must satisfy the same requirements as another material, and it must be able to provide the necessary guarantees for this. From an intuitive point of view you might be somewhat suspicious of plastics, but if you look at the entire lifecycle, including maintenance, then plastics turn out to have many strong cards in their hand with regard to sustainability.

TO SIMONS – Director Centrum Duurzaam Bouwen (Sustainable Building Centre)
Policymakers, industry, non-governmental organisations and end users agree that building practices must evolve into more sustainable concepts and designs. However, there is discord over how sustainability is best assessed. And what resources are best used to guide property developers, specifiers, designers, architects and policymakers in making well considered sustainable choices.

In order to apply the principles of sustainable building, account must be taken of the three pillars of sustainability. A balance must be struck between environmental and social protection, but also economic development. And not only must the entire lifetime of the building be taken into consideration, but also its impact on its environment.

The basic principles of the sustainability of buildings are set out in the international standard, ISO 15392 Sustainable Development in Building. The standard recognises the mutual interrelationship between the three pillars of sustainability, the dynamic equilibrium between them, and the fact that a positive impact on one pillar may constitute an adverse effect for another pillar.

It is thus necessary for the effect of every decision on each pillar to be examined. Only in this way can a balanced and unprejudiced view of the sustainability of buildings be created.

Various countries have already developed a model to evaluate the sustainability of buildings. Many of these assessment methods are based on the very first models, i.e. the American LEED® or the English BREEAM®. A detailed analysis shows that both models focus mainly on the environmental pillar. They barely take any account of the other two pillars of sustainability: economic and social development.

The latest models such as the German DGNB® or the French HQE™ attempt to systematically take account of both pillars. According to the ISO 15392 principles it is wrong to evaluate on the basis of one pillar alone - generally the one that relates to environmental impact - and to generalise the results to determine sustainability. Unfortunately such an approach has become a matter of course, such that decisions on the sustainability of buildings are limited to assessments of the environmental impact.

Reliable evaluation methodologies for objectively assessing buildings are also very complex and consequently barely affordable. Their bureaucratic accreditation is also laborious.

Hence methods have been developed to simplify the evaluation and decision-making. But in this way, sustainability is limited to the choice of materials and the total building concept is not evaluated. Such an approach is typical of most guides on the sustainable use of materials and most Type I eco-labels.

This simplified approach does not satisfy the principles set out in ISO and EN standards. Indeed, ISO and EN stipulate that every comparison on the sustainability of building materials must be done by considering the building material in the whole of a building, and with its entire lifecycle taken into account.

1 This approach quickly shows that you should not determine the sustainability of building materials but of building, by also taking certain characteristic properties of building materials into account.


4 King Sturge, 2009

5 DGNB is an abbreviation of Deutsche Gesellschaft für Nachhaltiges Bauen. In other words the German Sustainable Building Council. More info on: www.dgnb.de

6 HQE stands for Haute Qualité Environnementale (High Environmental Quality) or in full the Association pour la Haute Qualité Environnementale des Bâtiments. It is the French platform for building and fitting out sustainable houses, created in 1996. More info on: www.assohqe.org
Evaluation models for building materials do not take any account either of the principle used by the Sustainable Building Task Force of the European Commission, DG Enterprise. This states that "building materials cannot be evaluated as a standalone product. Buildings with the 'greenest' assessment may use building materials with a higher environmental burden, as."

The risk is real that simplified evaluation methods, in the form of guides, for example, on the sustainable use of materials lead to the selection of building materials on the basis of an incomplete sustainability assessment. In addition, no attention is paid to the economic or social assessments. Thus much needed innovation is curbed, and sustainability is discouraged instead of stimulated.
What is sustainability?

Various massive passive houses are a fact today. The construction of a first massive passive hotel demonstrates that the concept can also be perfectly applied to other buildings. The many benefits provide the impetus for many opportunities and projects in the future.

Many builders consider building a passive house with ceramic blocks building materials and rigid polyurethane insulation panels. The combination of traditional ceramic building materials with the economic and ecological benefits of a passive house is decisive here.

More information on this concept is available on www.massiefpassief.be

The concept of massive passive buildings is also catching on for non-residential buildings. The first massive passive hotel in Flanders is coming in Heusden-Zolder and is being built entirely according to the principles of massive passive building and Belgian building traditions.

This hotel will be highly energy-efficient and a model for a sustainable building.

Motivation of the property developer
Entrepreneur André Vandebosch:

“I have long been sceptical about sustainable building. When I was invited to an information session at the Steunpunt Duurzaam Bouwen (Sustainable Building Initiative) I thought I would meet lots of people with long beards and goat’s wool socks who would try to convince me to save energy come what may.

But nothing could have been further from the truth. After a very clear presentation I understood that good insulation is very important so as not to waste energy, and thus also to save money”, he says.

“By keeping the building costs and energy costs as low as possible, we can also offer the rooms at a lower price, as high energy costs are of course passed on to customers. The hotel will be somewhat more expensive to build, but from what I save on my energy bills the extra cost will pay for itself within a few years."

Materials used
The outside walls are based on a conventional insulated cavity wall. The inner skin is made from ceramic bricks. Bricks have a high thermal inertia, such that they heat up more slowly during the day and release their heat more slowly at night. They thus always ensure a pleasant interior temperature without large temperature fluctuations. Moreover, the ceramic walls can be easily made airtight by plastering the inside. Polyurethane cavity insulation (2 x 82 mm) is put in the walls, in two adjacent layers. The outer cavity skin is constructed from ceramic facade stones.

The flat roof and floors are also insulated with polyurethane, also in two adjacent layers. The combination of sustainable insulation and a professional installation guarantees a perfect insulating shell, without thermal bridges.
What is sustainability?

De voorzitster van deze UN commissie, de Noorse politica Gro Harlem Brundtland, verbond duurzaamheid in haar rapport aan het milieu, in economisch en sociaal aspect.

“A bio-ecological building material can be sustainable, but so can a building material of a non-biological origin.”

Thus, we should not only focus on the production phase. The environmental impacts of all previous processes (raw material extraction, raw material transport to the factories) and of all subsequent processes (transport of building materials to the site, installation, usage phase, and end of life) must be examined. Only after that can you say whether product A is better than product B from an environmental point of view.

An ideal instrument for charting the environmental impacts over the entire lifecycle is an environmentally-oriented lifecycle analysis (LCA). During an LCA an inventory and evaluation are done of all input flows (consumption of raw materials, water and energy), output flows (waste, by-products, emissions into the air, soil and water), as well as the potential integral environmental impacts over the entire lifecycle (damage to human health, impact on the quality of ecosystems and the depletion of raw materials). The field of play for doing LCA studies has been set out by the ISO in its standards 14040 and 14044 (ISO, 2006).

In addition to the LCA analysis, when choosing sustainable building materials designers can also be guided by the LCA-based classification systems (such as the British Green Guide to Specification and the NIBE classification system), the information available in commercial LCA databases, the Environmental Product Declarations (EPD’s) for building materials (such as the Environmental Profiles of the BRE, the MRPI’s of the Netherlands, the INIES datasheets of France, etc).

TO CALL A MATERIAL ‘SUSTAINABLE’ PURELY ON THE BASIS OF THE RAW MATERIAL FROM WHICH IT IS MADE, IS NOT CORRECT. A MATERIAL MUST BE EXAMINED FROM THE PERSPECTIVE OF ITS ENTIRE LIFECYCLE: HOW IS IT MADE? HOW IS IT USED? HOW LONG DOES IT LAST? IS IT STILL RECYCLABLE?

It is notable that the results of LCAs and EPD’s in various studies and programmes often differ greatly from one another. This is because the number of parameters to be compared in such studies and systems is sometimes very large. In order to obtain meaningful results in comparative LCAs, many elements play an important role: functional unit, system boundaries, the analysis method of the lifecycle, reference flows, reference lifetime, usage and end of lifetime scenarios, etc.

The results of LCAs and EPD’s are not always comparable because the interpretation of these parameters is not always unequivocal. For example, take the definition of the functional unit. In comparative studies of building materials, the functional unit must always be the same for all materials examined. But for the same functional unit, every material can have a different practical realisation. In addition, the quantitative nature of a functional unit generally eliminates the non-quantifiable functions of a product from the comparison. Hence the great importance of transparency in reporting the results of LCA studies and in drawing up rankings on the basis of environmental impacts, in order to be able to place the conclusions and certain rankings of materials in the right context.

CAROLIN SPIRINCKX – Project manager sustainable houses and buildings, Transition Energy and Environment Unit, VITO
What is sustainability?

It consists of an imposing stone station building and a steel platform roof. The main stone building is a design by Louis Delacenserie who, on the request of King Leopold II, was inspired by the station building of Lucerne and the Pantheon in Rome. The highest point of the station is a 75 metre high dome.

The steel roof over the platforms was designed by engineer Clement van Bogaert and is 43 metres high. At the time this height was needed to accommodate the steam of the locomotives. The platform is 186 metres long and 66 metres wide, and provides space for 10 dead-end tracks.

In the middle of the twentieth century the building was in such poor condition that demolition was considered. However, in 1975 it obtained the status of a listed building. But the condition of the building quickly deteriorated such that on 13 December 1985 the NMBS (the Belgian railway company) decided to close Antwerp Central on 31 January 1986 for safety reasons, and quickly started restoring the platform roof and facades. One week later, on 20 December 1985, the NMBS decided to do the necessary restoration work.

The restoration of the splendid platform roof started at the end of March 1986 and lasted until the end of September 1986. The principle was respect for the historical heritage. The two vault foundations on the zoo side were strengthened and the vault end on the Berchem side completely renovated. In order to restore the original grandeur of the steel elements, they were replaced or repaired and painted in a burgundy colour.

Instead of the roof covering of zinc, asbestos cement and glass, copper and polycarbonate sheets were used. Thanks to the use of polycarbonate sheets the building could be adapted to the requirements of a modern station in a major city, while preserving the original style. Since the Second World War the weight of the glass covering had caused constructional stresses. A V2 bomb damaged the 12,000 m² great hall, such that the substructure was warped.

By choosing polycarbonate glazing for the renovation, the stress problems could be solved. As polycarbonate sheets are elastic and weigh 40% less than glass, no extra supporting pillars needed to be fitted, which would have harmed the character of the monumental architecture. The maintenance friendliness, good fire resistance and resistance to weather effects and temperature fluctuations were also deciding factors in selecting polycarbonate sheets.

Hail or snow do not cause any damage to polycarbonate.

‘When looking at the whole project, we are convinced that the steel roof over the platforms was restored in the most sustainable way,’ says Paul Van Aelst, spokesman for NMBS Holding. ‘The use of polycarbonate sheets were able to limit the environmental impact of the work thanks to its longer lifetime and the avoidance of extra supporting pillars.’
SUSTAINABLE BUILDING WITH PLASTICS
Building and renovation must be done as environmentally-friendly and sustainably as possible. It is a misunderstanding to think that this cannot be done with plastics. Sometimes on the contrary. This book will make it clear that the exceptional properties of plastics make an important and even essential contribution to a sustainable world.

Bakelite, the very first synthetic plastic in the world, is already more than 100 years old. Now, a good century later, plastics are making an essential and increasing contribution to our quality of life and comfort.

Since 1907 Belgium has been a world leader with regard to the processing and production of plastics per head of population. Our country manufactures innovative electrotechnical applications on a large scale such as telephones, electric sockets, light switches and cameras.

Thanks to their unique, specially developed range of properties (their light weight, their great design flexibility, their insulating properties and recyclability), plastics contribute to a more efficient use of energy and the preservation of natural raw materials.

This publication shows the extraordinary role that plastics play in sustainable development. It aims to show the great potential of innovative products, systems and technologies by which plastics can further increase their contribution to a more sustainable society.

1 In Belgium plastics makes the greatest positive contribution to our balance of trade before the steel sector and the automobile sector. In other words, plastics are important for our prosperity.
2 It has often turned out in the past that plastics make technologies affordable and thus available to everyone. In this respect plastics have already played a big part in agricultural, industrial and digital developments. Their support in the current sustainability developments is again of vital importance.
Every material of an animal or vegetable origin is actually a mixture of polymers. A polymer is a large molecule that consists of a long chain of equal parts, called monomers.

Since the 19th and 20th centuries, science and industry have continually developed new polymers. Initially this development was targeted at offsetting the scarcest of existing products. Bakelite was originally intended to replace the expensive shellac.

As the experience with plastics increased and more types were developed, the emphasis was placed elsewhere: not so much on the replacement of “existing products” but on the optimisation of the product properties. As a result of their added value, plastics make some products more water resistant, others less fragile and others less maintenance intensive.

Thanks to continuous technological innovation, plastics are now lighter, stronger and better utilisable than ever before. This results in a very wide area of application - from the packaging industry to the transport world and modern technologies, to medicine and the building world - while looking to use less oil and energy resources for the production of them.

Plastics offer a higher standard of living, ensure a higher level of healthcare and make information media accessible to an increasing proportion of the world population.

But above all plastics offer more safety and increased comfort for all users. To this end products have been increasingly attuned to one another. In construction for example, they are looking at how building products can be connected together optimally in a sustainable way. The result: a more sustainable and higher-performance building.

1 Shellac is a natural raw material extracted from the secretion of the lac bug. It is a thermoplastic material.

In the 16th century the Portuguese used it as a sealing wax to replace the softer wax. In the beginning of the 19th century it was used in photography, later as an electrical insulating wax for both switchboards.
Some plastics are elastic and soft, others rock hard. One plastic is heat resistant, the other deforms with the application of heat. Some plastics are foamy and as light as a feather, others very dense. One plastic is transparent, the other completely opaque. These many types of plastics - each with their own qualities - are processed into one thousand and one products that increase our comfort and quality of life.

Plastics are present in all areas of our daily lives. In Belgium the use of plastic and rubber articles are 19% in the packaging sector, 18% in construction, 17% in the transport sector, 14% in compounds, 13% masterbatch and recycling, 8% in the electronics and electrical sector, 5% in sleeping comfort and furniture, 3% in medical aids and 3% in household articles.
PACKAGING
Plastic is pre-eminently suitable for flexible packaging (foils, films, bags, sachets, cylinders and tubes), rigid packaging (bottles, tubs, buckets, crates, pallets, boxes, posts, trays) and packaging foam (expanded polystyrene, extruded polystyrene, polyurethane foam, polyethylene foam and polypropylene foam).
More than other packaging, plastics protect against perishing, so that fewer preservatives are needed and the waste food mountain is reduced. Plastic packaging is also distinguished by its light weight. As a result they save raw materials in production and transport. Comparative studies show that plastic packaging scores just as well and even better than alternative packaging, both with regard to cost and environmental impact.

without plastics the weight of packaging would increase by a factor of four, and the waste volume by a factor of 3.5.
Plastic packaging ensures that 220 million tonnes of CO₂ are saved every year, primarily thanks to plastic bottles (97 million tonnes of CO₂) and plastic films (67 million tonnes of CO₂).

BUILDING MATERIALS
In construction too, plastics are much sought after. Some plastics on account of their light weight and good insulating qualities, others because they are thin and airtight, others because they are waterproof. Plastic is used for insulating and covering façades, roofs and floors. Flue gas outlets, rainwater pipes and roof gutters are made of plastic. Plastic is also used in bathrooms, kitchens, doors, pipes, glazing spacers, building sheets, profiled plates and window and door profiles. Plastic reinforces concrete and is found in foundations.

The use of plastics in insulation applications or for generating renewable energy results in extraordinary user benefits.

TRANSPORT
The most important plastic components produced for cars, trains, buses and aircraft comprise insulating or decorative films, safety glass films, profiles, comfort foam for seats, head and arm supports, interior trim, bumpers, hubcaps, handles, mirror housings, fuel tanks, brake fluid reservoirs, air ducts, cables, etc.
Recent car models also contain more than 100 kg of plastic. Plastics reduce the weight of a car, such that fuel consumption falls. According to estimates, in Western Europe every year 8 million tonnes of oil is saved thanks to the use of lightweight plastics for car components. This corresponds to an annual CO₂ reduction of around 28 million tonnes. At the same time plastics increase the safety and comfort of the occupants.

A car bumper made of lightweight plastic materials instead of heavier materials saves four times as much energy over the lifetime of the car as is consumed for the production of the plastic components.

ELECTRICITY & ELECTRONICS
As they insulate so well, plastics are also essential for electrical and electronic applications. This goes from simple cabling and domestic appliances to mobile telephones and DVD players. The latest developments in plastics make devices smaller and lighter.

Thanks to plastic, computers and telephones are substantially more compact, lighter and cheaper and are thus easier to carry and more affordable for everyone.

FURNITURE
Belgian companies are prominent in Europe in the production of polyether foam and latex foam for mattresses, seats and cushions. Plastics also enjoy a good reputation for the production of garden furniture and furniture covers.

HOUSEHOLD ARTICLES
Buckets and freezer bags for example, crates, brushes, food processors, kettles and toasters are plastic.

MEDICINE
The endless possibilities of plastics have opened up the way for medical developments that were inconceivable 50 years ago. In addition to orthopaedic applications (prostheses), plastics are now also used in heart surgery and for visual and hearing aids. After all, plastics have the unique property of being compatible with the human body. In the medical world plastics are also proving their worth in catheters, syringes, sterile sets for surgery, hygiene films, medical packaging, etc.

SPORTS
The tracks on which athletes run during the Olympic Games, sports shoes, bicycles, clothing, protection (helmets, kneepads), balls, etc. Without the help of plastics the top performances in sport would be as good as impossible.

AGRICULTURE AND HORTICULTURE
Agriculture and horticulture use plastics for seed trays and pots, covering sheets for the soil, film, greenhouse film, boxes and crates for the transport of plants, packaging and fertilizers, components of irrigation systems, agricultural machines and tools. Plastic-based substrates ensure a larger and earlier harvest, more efficient groundwa ter control and better protection of our food. Thanks to films, a higher return can be achieved with fewer pesticides and fertilizers.

1 Plastics Europe - Denkstatt - study.
2 Plastics Europe - Denkstatt - study.

With Plastics
I have no problem in saying that plastic solutions for the details can play a very important role.

But all components are very important. Repetitive details, such as the glazing and profiles used for them have a considerable impact on the whole project. Often we choose aluminium profiles that now cause no thermal bridges. We accept aluminium profiles for a conventional building or a more or less low-energy house.

But when we want to reach the level of a passive building, super-low or zero-energy building, all small details that are used repetitively and continuously - such as the profiles for the glazing - have an incredibly large impact.

For us it is of essential importance to take account of the entire lifecycle of a building. The energy required for the production of materials only has a very small impact compared to the entire lifetime of a building. Studies that compare how many houses are built or renovated in Europe show - to our amazement - that Belgium is in the last place.

We thus build and renovate very little. The lifetime of our buildings is thus far above the average of the lifetime of certain components.

When setting priorities it is of decisive importance to examine the energy efficiency of a building over 50 to 70 years for example, which is needed to meet the passive house standard. Okay, maybe you can insulate with cellulose, but only after you have calculated the efficiency of the building. It is the height of stupidity to build a building with materials such as cellulose or wood, and then not to meet the passive house standard.

It is also ridiculous to use materials that are said to be ecological, but which are not classified or certified. I am thinking here of insulation materials whose efficiency has not been proven in the area of vapour-proofing and their lifetime for example.
Plastics as a material are a component of a larger whole and their utility or lack of utility must always be viewed in this wider context.

How can a finite fossil raw material lead to a sustainable product? Do plastics, on account of their fossil origin, contribute to climate change? Is this not just a question of replacing fossil raw materials with biological raw materials, such as corn or sugar cane? It is not easy to be able to see the wood for the trees.

First of all the question of whether a material can be sustainable. In principle there are very few bad materials, there are however good and bad applications of materials. Are there bad plastics? Sometimes, yes. Just think of the softeners commonly used in flexible PVC or certain flame retardants that are sometimes used as an additive in plastics. Often this is a loaded discussion, where in the event of doubt the principle of precaution must always be applied transparently. For the rest of the cases we thus have to evaluate whether the plastics are used in ‘good’ or ‘bad’ applications, and whether no other materials can be used for the same application that have a lower or equivalent environmental impact over their lifetime. Renewable materials that are reused or recycled can certainly be used as an alternative.

What then are the good and bad applications of plastics? The relevant question to ask here is whether the plastics in a certain application lead to a preservation of a function or service. What social need does a plastic application meet? As a simple example we can look at a roof gutter and the entire rainwater management system of a house. Receiving and reusing rainwater clearly fulfils a sustainable social function, thus the use of certain plastics here can be regarded as sustainable. As a material a roof gutter is a component of a larger whole and their utility or lack of utility must always be viewed in this wider context.

Is a plastic that fulfils a sustainable function, such as the roof gutter for example, sustainable by definition? Not necessarily. If the application means that after use the material is immediately disposed of as waste, we have a problem. Currently worldwide we consume almost 300 million tonnes of plastics per year. This is around 50 kg per person. In other words, every year the throughput of materials (and thus energy) is gigantic and in itself is fundamentally not sustainable. This is not a question of fossil versus renewable raw materials. Such a throughput of materials is not tenable in either case. The most important thing is for the volume of this throughput to fall sharply. Some people talk of a necessary reduction of the throughput of materials, including plastics, by a factor of 10. This can partly be realised by dematerialisation (e.g. by offering services instead of products), and partly by closing circuits. High quality recycling reduces the linear throughput of plastics.

A ‘good’ application is thus an application in which the materials used are recycled again. The eco-design aspect is prominent in the foreground here. An eco-design is a design that enables subsequent high quality recycling. Recyclable does not mean that the materials are actually recycled. ‘The proof of the pudding is in the eating’ also applies here. The use of recycled plastics in applications is thus what it is about.

However, in a physically growing global economy there will always be a demand for ‘fresh’ primary materials. How can this demand be met sustainably. Ideally it is done on the basis of waste materials (renewable or otherwise) or other residual products such as CO2. This last item in particular offers interesting prospects: imagine yourself in an industry that turns a problem (CO2) into a solution.

In conclusion, sustainable plastics are plastics that:

/ do not contain any toxic components
/ preserve a function or service in their application
/ enable intensive reuse or recycling in eco-design applications
/ are preferably produced from residual or waste materials

Plastics thus certainly have the potential to be sustainable or more sustainable. Sustainable applications, the use of good quality recycled materials and chain management (from producer via demolisher, sorter, recycler to designer) are all elements that contribute to the sustainabilisation of the use of plastics. The challenge is essentially to create the necessary cooperation between a number of links in the value chain in order to make this possible together.

JEROEN GILLABEL – Policy assistant sustainable material management, Bond Beter Leefmilieu
When you think about buildings, you generally associate them with bricks, concrete, glass, cement, wood, etc. But plastics are now ubiquitous in modern buildings. Just think of products such as paint and varnish, or polystyrene and polyurethane foam for insulation or synthetic windows and doors.

After all, plastic is light, strong, corrosion resistant and durable. Durability means a saving in maintenance, and the low weight enables fast and cheap implementation. Plastic is also a very good insulator. Because it is easy to maintain and waterproof, plastics are a hygienic choice for floor coverings. Plastics are also excellent sealants.
that both properties are combined into one mate-
erial. As a result, the chemical resistance and me-
chanical properties improve such as tensile strength
and dimensional stability, but primarily has
good weathering properties.

**HDPE** (high density polyethylene) is the most commonly used PE and is a thermoplastic with high toughness, mechanical strength and dimensional stability, but primarily has good weathering properties.

**LDPE** (low density polyethylene) has a more crystalline structure than HDPE and is characterized by a high level of branch-
ing.

**PEX** (cross-linked polyethylene) consists of carbon and hydrogen atoms that polymerize at low pressure. This leads to linear chains or a crystalline structure that can be easily adapted. PEX pipes consist of HDPE (sometimes also LDPE) in which the crystalline molecules (which are normally linear chains) (long enough to one another without being connected together) are connected together. As a result, the chemical resistance and me-
chanical properties improve such as tensile strength and bending strength (less brittle).

**XPS** (extruded polystyrene) or expanded polystyrene, is a polymer that can be extruded or foamed and is used for thermal insulation. It is lightweight, has good thermal insulation properties, and can be easily adapted to various shapes.

**PUR** (polyurethane) is a thermoset polymer that is widely used in the production of foams, adhesives, and sealants. It is characterized by its high strength, flexibility, and durability.

**ROOF GUTTERS**
- PVC
- Polyester

**SKYLIGHTS, EXTENDED SKYLIGHTS**
- PIR
- PMMA (Plexiglas)

**ROOF SEALANTS**
- PVC
- PUR
- TPO
- EPDM

**FLOOR COVERING, FLOOR FINISHES**
- PVC
- Cast floor systems: PMMA, epoxy, PUR

**WALL AND CEILING COVERING PROFILES, INDOOR WINDOW SILLS, WINDOW FACING PROFILES, ROLL-DOWN SHUTTERS, SHUTTERS, IN-
SECT SCREENS**
- PVC

**TERRACE DECKING**
- WPC

**ADHESIVES AND POINTING CEMENTS**
- Putty
- PIB
- Bitumen cement
- Acrylate
- Polysulphide
- PUR
- Hybrid polymers
- Silicones

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1 PVC: polyvinyl chloride, a thermoplastic. PVC facade panels are primarily used because of their durability and wear resistance in outdoor environments. They require no special maintenance. In this way they enable quality projects to be realised at a low cost.
2 PP stands for polypropylene and was developed in the early 1950s by Phillips. This polymer only consists of carbon and hydrogen atoms. PP is resistant to oil-
vortex, bases and acids. It can be easily and weld-
ed together with other polymers. High-poly-
prolylene (HDPE) consists of linear molecules such as ethylene and has a high level of branch-
ing. Since HDPE has a more crystalline structure than LDPE, it is characterized by a high level of branch-
ing.
3 High density polyethylene consists of carbon and hydrogen atoms that polymerise at low pressure. This leads to linear chains or a crystalline structure that can be easily adapted. PEX pipes consist of HDPE (sometimes also LDPE) in which the crystalline molecules (which are normally linear chains) (long enough to one another without being connected together) are connected together. As a result, the chemical resistance and me-
chanical properties improve such as tensile strength and bending strength (less brittle).
4 XPS stands for polyurethane. XPS is a polymer that can be extruded or foamed and is used for thermal insulation. It is lightweight, has good thermal insulation properties, and can be easily adapted to various shapes.
5 PUR (polyurethane) is a thermoset polymer that is widely used in the production of foams, adhesives, and sealants. It is characterized by its high strength, flexibility, and durability.
6 Roof gutters, pipes and accessories in PVC for rainwater drainage.
7 WPC stands for polyolefin plastic. WPC facade panels are primarily used because of their durability and wear resistance in outdoor environments. They require no special maintenance. In this way they enable quality projects to be realised at a low cost.

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Plastic insulation (EPS, XPS, PUR) primarily comes in the form of insulating panels, with or without facings membrane on the top and bottom. But plastic insulation is also used in building elements such as sandwich panels (PUR, EPS, XPS), insulating formwork (EPS) or for insulation sprayed or injected in situ (PUR foam or EPS granules).

_Thermal insulation_

In order to reduce the energy consumption of a building, compactness and good orientation play an essential role. But just as important is good thermal insulation: once a building is warm, it comes down to keeping the heat inside. To this end it must be properly thermally insulated. In a well insulated building the heating requirement is much lower, which results in a substantially cheaper energy bill.

Moreover a smaller and thus cheaper heating system will suffice. Thermal insulation also increases comfort: reducing draughts and the distribution of lower temperatures, and during summer insulation helps prevent overheating.

It is important here for an insulating shell to be constructed around the entire building. Thus not only the roofs and outside walls need to be insulated, but also the floors and doors, gates and windows. With a new construction this is no problem, but in an existing house a lot is still possible.

Plastic insulation has the best insulation value of all existing insulation materials. This is because they consist of 98% insulating air. An equivalent insulation value can be achieved with a smaller insulation thickness: thus less material is used.

Plastic insulation performs during the total lifetime of the building, and meets the strict requirements imposed by the ATG and ATG/H approval.

In a typical building the equivalent energy needed to produce plastic insulation materials is saved after one year due to the reduced consumption of gas or heating oil. Over a period of 30 years a quantity of energy is saved that is up to 60 times greater than the energy needed to produce these insulation materials.

**INSULATION OF FLAT ROOFS**

**New construction**
Flat roofs are divided into two types: inverted roofs and warm roofs.

With a warm roof the insulation (PUR/PIR, EPS) is fixed under the waterproofing membrane.

With a flat inverted roof the insulation is on top of the waterproofing membrane. For this application only XPS is used and a layer of ballast is always placed on top of the insulation.

**Existing building**
If the roof waterproofing membrane is still in good condition, insulating sheets (XPS) can be placed on top of it according to the principle of the inverted roof, or a PUR foam can be sprayed on it.

An existing roof can also be insulated according to the warm roof principle (PUR/PIR, EPS).

Panels of rigid polyurethane foam (PUR/PIR) or expanded (EPS) or extruded polystyrene (XPS) are excellent materials for insulating flat roofs. In addition to their excellent insulation value they are resistant to high pressure, and can easily be walked on after installation. Thanks to their high insulation value, these panels are quite thin. Plastic insulation panels also have good vapour resistance properties.

**INSULATION OF PITCHED ROOFS**

Both with new buildings and with an existing building, a pitched roof can be insulated in three ways:

+ On the inside, either between the rafters or under the rafters, parallel to the purlins.
+ On the outside of the roof (also called a sarking roof)
+ Insulation of the attic floor. This is the easiest solution when the space under the roof is not used.

Rigid foam panels of extruded polystyrene, expanded polystyrene or polyurethane are rigid and sufficiently pressure resistant to be fitted directly to the rafters (sarking roof) from the outside. The plastic insulation panels are light and have very good insulating properties.

Moreover, most panels are sufficiently vapour resistant and airtight, such that a waterproof layer is rarely needed. For an easy interior finish, there are plastic insulation panels on plasterboard that can be directly painted or papered.
Application of plastic: concrete sandwich panels insulated with polyurethane.

Cameleon organises stock clearance sales of major brands of off-the-peg clothing, accessories, shoes and decorative articles.

For the new building in Woluwe-Saint-Lambert - a sales area of 8,000 m², warehouses and logistics areas of a total of 4,500 m², offices and spaces for inventory and samples of a total of 1,500 m², and a photo studio - it was decided right from the start that the project must be distinctly ecological.

To this end the outlet company concluded a partnership agreement with MATRicel (spin-off from the Université Catholique de Louvain) and the Architecture and Climate research unit of the Université Catholique de Louvain.

The partnership resulted in a building with, among others, a facade of concrete sandwich panels, a high level of insulation, natural ventilation and cooling, a green roof, deeply penetrating natural light and collection of rainwater.

Every choice was tested against an analysis to reduce the ecological footprint and save energy. On the basis of this comparative analysis, the facades were constructed with self-supporting sandwich panels 30 cm thick. They are composed of two cavity skins of prefabricated concrete, each 11 cm thick, with 8 cm of polyurethane between them.

These elements used to be frequently used in the building industry and are gaining increasing success in other types of residential buildings. According to the comparative life cycle assessment, these sandwich panels with polyurethane score very well on account of their thermal performance, the low environmental impact of their production, and their high percentage of recyclable materials.

The panel is 99.42% concrete that can be reused on other building sites as rubble. The polyurethane can be easily separated from the concrete and processed in waste-to-energy plant.

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**INSULATION OF OUTSIDE WALLS**

With a massive construction there are two main types of outside wall: solid walls and cavity walls. Both types occur in existing and new buildings.

**New construction**

Solid walls are preferably insulated on the outside. For new constructions with cavity walls, filling the cavity is the most recommended solution. By using plastic insulation, the wall construction can be thinner and the thermal results are better.

Plastic insulation also enables other building systems, such as EPS building blocks filled with concrete, sandwich elements of wood, metal or concrete with a core of PUR, EPS or XPS.

Foam panels of PUR, EPS and XPS absorb next to no moisture. Also thanks to their good thermal insulating properties and their pressure resistance, they are an energy-efficient solution for solid walls and cavity walls.

**Existing building**

With an existing solid outside wall, the thermal properties can be improved in two ways: by insulating the outside or the inside.

Outside insulation is the best solution from a physical point of view. However, insulating the outside is not always possible.

For interior insulation there are composite panels that consist of a plastic foam panel bonded to plasterboard.

An existing cavity wall - just like a solid wall - can be insulated on the outside or inside. With a cavity wall there is also a third possibility for improving the thermal performance, i.e. by filling the cavity. This is fast and effective, at least if the work is done by experts. With a small cavity thickness, the outside or inside of the cavity wall can be insulated in addition to the cavity.

There are different types of plastics on the market for cavity insulation injected in situ: Injected PUR, white or grey EPS beads and UF foam. Thanks to their favourable insulation value, they can greatly improve the thermal insulation of cavity walls.

**FLOOR INSULATION**

A great deal of heat also escapes through an uninsulated floor. When there is a cellar or accessible crawlspace under the floor, the underside can be insulated: This is the easiest. When the floor consists of a reinforced concrete floor slab on solid ground, there is only one possibility: insulation on the top. An old tiled floor on mortar on a sand bed is best broken up.

Floor insulation can be done with foam panels (PUR, EPS, XPS) or PUR injected in situ.

Plastic foam not only has a favourable lambda value\(^1\), but is also more resistant to pressure than other insulation materials.

**Acoustic insulation**

Acoustic insulation can be realised through the use of heavy building materials (masonry, concrete), but it is simpler and cheaper to insulate walls, roofs, floors, and ceilings with a combination of plasterboard and an insulation material with an open structure. This is called the ‘mass-spring-mass’ system. This system is based on acoustic decoupling: two layers of building materials (the masses) that are separated by air or an insulation material (the spring). The sound makes the first layer vibrate; the insulation between the two layers acts as an acoustic absorber, after which the attenuated sound is passed on to the second layer.

The plastics sector also has a solution for acoustic insulation: panels of polyurethane, melamine, or polyester foam, with hollow or corrugated forms. They are light and absorbent: the sound can penetrate into them where it is damped. There are also elastic EPS panels that can be used as contact acoustic insulation in floating floors.

\(^1\) Plastics are often used to interrupt the thermal conduction in metals for example. This occurs because plastics have a low thermal conductivity. The thermal conductivity of a material is reflected by the lambda value and is expressed in [W/m.K].
Application of plastic: wind turbines, PV panels, expanded polystyrene for thermal insulation, EPDM and silicones for airtightness.

Studies and simulations have shown that the total demand during the four summer months in which the “zero emission” polar base will be manned is approximately 7000 kWh/month, and for the eight winter months around 2000 kWh/month. For the energy consumption 54 MWh per year is assumed. This comes down to an average annual energy consumption of 51 kWh/m².

For the power generation for the Princess Elisabeth Station, the International Polar Foundation, the designer and builder of the station selected a hybrid system that can use solar and wind power at the same time. In the event of little wind, solar power can be used and vice versa. The nine wind turbines can withstand the extreme conditions of Antarctica and remain operational the whole year round.

For the optimum utilisation of solar power, there are photovoltaic solar panels on the walls of the station, and freestanding modules on the garages. The PV installation is good for a total production of 52.26 kWh (up to 800 W/m² sunshine).

The station has a wooden frame covered with nine layers: (from the inside to the outside) a woolen felt as a finishing layer, an aluminium foil as a water vapour shield, Kraft paper, a layer of laminated spruce, 400 mm insulation, another layer of laminated spruce, a 3 mm thick moisture barrier, a foam layer and finally a steel plate. The cold thus first has to penetrate a wall of around 53 cm before reaching the inside. Polystyrene on a graphite base was chosen for the thermal insulation material. Thanks to the excellent insulation level the entire skin has a U-value of 0.07 W/m².K.

In order to prevent air leaks, the joints between the wall modules were carefully sealed with an insulating foam. An EPDM layer guarantees the airtightness of the skin around the station. The windows are sealed with silicones specially selected for their resistance to UV radiation, remain permanently elastic and have a long lifetime.
People tend to associate plastic windows and doors with how it was just after the Second World War. Indeed the rise of plastic windows and doors started with the re-construction of Europe. Due to an enormous scarcity of wood, a replacement product was urgently sought. Because PVC satisfied a few basic properties and its production could be industrialised, PVC became the replacement product for wooden windows and doors.

Plastic windows and doors is now already 70 years old. Over all these years PVC windows and doors has evolved into a fully fledged product that merits frequent use because of its properties. Plastic windows and doors not only ensures a long lifetime, but also satisfies the most stringent requirements imposed by the ATG certificate.

Plastic windows and doors also performs well on an environmental level. The studies below are based on an LCA in which the entire cradle-to-cradle approach has been followed.

In Austria, the Chemistry and Technology Research Institute compared the environmental cost of a window frame of 3.5 by 1.3 metres made of PVC, aluminium and wood. This showed that the lifecycle assessment for PVC and wooden frames came out just as favourably.

The University of Barcelona also did a total lifecycle assessment of the three types of window profiles, thus from the preparation of the raw materials up to the processing of the waste. The lifetime of the frames was set at 50 years. The study shows that PVC frames perform the best over the entire lifecycle: they have the lowest energy consumption and fewest CO2 emissions.

Also very important for the property developer and the environment are the insulating qualities of the window frame. PVC has intrinsically better thermal properties. Of all the usual frame profiles, PVC frame profiles generally lose the least heat. PVC profiles have a better lambda value than external windows and doors of hardwood, medium hardwood or heavy softwood.

PVC profiles also have a long lifetime. They do not rust or rot, and are resistant to mould, bases, non-oxidising acids, salts, mineral greases and oils. PVC frame profiles thus behave excellently in the most aggressive atmospheric conditions, such as coastal zones and industrial regions. This makes PVC pre-eminently suitable for outdoor applications where a long lifetime is extremely important. PVC frame profiles also need no special maintenance. This is not only an economic benefit, but also a benefit for the environment. This is primarily a consideration for buildings whose maintenance must be contracted out, such as public buildings, schools, hospitals, social housing and apartments.

PVC Building products are strong but nevertheless light. As a result they are easy to lift. Their light weight also yields savings in transport. Moreover, PVC can be recycled a number of times without losing its mechanical properties. At the end of their usage cycle, PVC profiles are ground into granules or powder and used again in PVC products such as window sills, prefabricated slats, walls and ceiling coverings pipes.

In March 2000, the entire PVC industry signed up to a 12 year voluntary undertaking to strive for a more sustainable future of its products and production processes over their entire lifecycle. To this end Vinyl 2010 was formed (www.2010.org).

This programme covered the continuous improvement of production processes and products, investments in technologies, the reduction of emissions and waste, as well as the stimulation of waste was collection and recycling.

One of the objectives of Vinyl 2010 is to add lead-free stabilisers to PVC by 2015. Since 2010, all members of Federplast have produced completely lead-free products. With regard to this objective Belgium is the leader.

In relation to Vinyl 2020, it was also decided to recycle 200,000 tonnes of post-consumer PVC waste in Europe by the end of 2010. In 2019, 260,000 tonnes of PVC waste was recycled and this target has thus been amply met. The successor to the Vinyl 2020 programme is called Vinyl Plus. One of the ambitious objectives of this programme is to recycle 800,000 tonnes of PVC in 2020.

02.4.2 / WINDOWS AND DOORS

The table here shows how the average Uf-value for standard PVC frame profiles has fallen over the last few years. For passive houses there are PVC systems with even lower Uf values.

PVC windows and doors owes its success to their burglar resistant properties (spring back after a break-in attempt), their acoustic resistance, simple maintenance and long lifetime.
Also with regard to colours, plastic windows and doors has come a long way. Today plastic windows and doors satisfies all requirements set in the technical specification STS 52.3. This document forms part of an ATG (technical approval) for plastic windows and doors in Belgium. The requirements contained in this STS 52.3 cover the colour, bonding, ageing, cracking of the lacquer coat, initial impact resistance of the lacquer coat and tensile strength after ageing. The requirements are stricter than those of Qualicoat for example.

In order to give PVC profiles the appearance of wood they are provided with a protective and decorative film. The colour stability requirements are contained in STS 52.3.

For unicolours, either a film, a lacquer coat or a PMMA layer can be applied. Its bonding and durability are comparable to those of metal windows and doors.

With wood or metal windows and doors, plastic is increasingly providing the thermal break. This is done either by injecting air chambers so that a better insulation value is obtained, or by rolling in strips of aluminium split condut. As a result the proportion of plastic in windows and doors has increased substantially over the last 10 years.

The Uw value of the window is also determined by the spacers. They used to be made of aluminium. By using ‘warm edge’ spacers and gluing them with polyisobutylene, up to 9% less heat is lost at the edges of the glazing.

For an aesthetic result it is important that the form, style and colour of profiles are harmonised to the style of the facade. The most durable are white or cream-coloured PVC frame profiles that are coloured through the bulk. In principle they do not require any protection. Also ‘pure natural’, thus without any surface treatment, is highly resistant to weather and wind. They are also the easiest to repair.

With regard to subsidies, plastic windows and doors is discriminated against. Some towns or municipalities only grant a subsidy for windows and doors of different raw materials. Some regions even go so far that they penalise the use of PVC windows and doors. Property developers who select it do not even get a subsidy deduction.

This position is underpinned by single value scores that assess the impact of building materials, without taking account of their usage phase or end of life. Municipalities here are copying an obsolete assessment model that was replaced a few years ago on an international level by the European CEN TC 330 vision.

In Belgium (year 2011) in order to qualify for an insulation subsidy the Uw value of a window must be less than 2.0 W/m².K.

For the price of windows of another material, plastic windows can be made with a Uw value of 1.5 W/m².K, which means an extra saving of 25%. By not subsidising these plastic frames, the authorities are overlooking a substantial potential energy saving.

The entire building sector endorses the importance of sustainable building and recognises the energy and CO₂ impact of our housing stock. The building sector is calling for the evaluation of sustainability to be done on a building level, in accordance with the vision of Europe. This call was sent to all ministers concerned of all Belgian regions, in the hope of gaining their support.

1. Add references to sources as needed.
2. Add a reference to the Qualicoat website for more information.
3. Add a reference to the STS 52.3 document.
4. Add a reference to the ATG technical approval.
5. Add a reference to the PMMA layer.
6. Add a reference to the ‘warm edge’ spacers.
7. Add a reference to the aluminium split conduct.
8. Add a reference to the Unicolour layer.
9. Add a reference to the Lacquer coat.
10. Add a reference to the PMMA layer.
11. Add a reference to the ATG technical approval.
‘In the Eighties in the Netherlands we used qualitative preference lists for separate building products, specifying what was and what was not allowed.’

The Netherlands has evolved from single-value models (single digit scores) to the evaluation of the environmental impact of building materials on a building level.

Thus rather black-and-white and without any differentiation. In the Nineties the LCA was set up primarily on the level of materials and building products. In addition, the Nationaal Pakket Woningbouw (National Housing Construction Package) - developed by and for the building sector - came along with long lists of measures targeted at individual products. The preference lists remained, but, just like the National Package, were more often based on LCA results.

At the end of the Nineties the Dutch Association of Building Suppliers (Nederlands Verbond van Toeleveranciers in de Bouw - nVTB), supported by the Ministry of VROM (Environment), unveiled the Environmentally Relevant Product Information (MRPI®), an Environmental Product Declaration (EPD), type III. This means based on LCA according to the later ISO 14025 standard (and ISO 14040/44). At the end of the Nineties the first calculations of complete buildings were done, including the usage phase and maintenance, doing justice to the assessment of products in their application. On the basis of the first experience with models such as GreenCalc and EcoQuantum, the Buildings Material-Related Environmental Profile (MMg) concept standard was developed. Just before the finish, however, in 2001 it was not possible to convert this proposal into a definitive standard. The reasons for the failure lay in the complexity of building assessments, combined with the idea that the material environmental performance was something imposed from above, such that there was not a support base among all players.

Hence there was a switch to simpler instruments based on LCA and targeted at a stimulation policy. Examples of this are gPR (municipal sustainable building practice directive Tilburg & W/E consultants) and the Toolkit of project developers, housing corporations, municipalities, power companies and SenterNovem. Narrow (energy) and broad (sustainability) labels, also targeted at communication to consumers, are in development.

In 2004 the MRPI® manual was converted into the NEN 8006 standard.

The energy performance (EP) standard has been in the Buildings Decree for a considerable time. Every new house or utility building must satisfy it. An investigation that showed that the environmental impact with the same EP can vary greatly, brought about the need to harmonise the various LCA-based models in use. This led to the current system, that has been brought under the Building Quality Foundation (Stichting Bouwvaliteit - SBV) with a ‘Determination method for the material-related environmental performance of buildings and civil works’ and a national database that contains both the LCA-environmental information and data on the product composition. All relevant parties are involved in this development. Suppliers can include environmental data on their products.

In February 2011 the ministry concerned announced that the material-related environmental performance had been incorporated in the Dutch Buildings Decree and is thus a regulation. The Determination Method uses NEN 8006 (product level) as a starting point, and indicates how to calculate the environmental performance on a building level. This method largely fits in with the most recent relevant European standards: prEN15804 EPD (2011) corresponds to NEN 8006 and prEN15978 (2011) is the counterpart of the Determination Method. prEN15942 comm.b2b (2011) corresponds to the MRPI® format.

HARRY VAN EEWIJK – Cluster manager sustainable production IVAM, Amsterdam
Rheinberger, located in Pirmasens, was once the largest shoe factory in Germany. The company was set up in September 1882 by Eduard Rheinberger and in the early Fifties had around 2,800 employees. The last shoes were manufactured there in the mid Nineties. Then the production, together with the remaining 250 employees, was moved to Schwanheim. The factory was still used as a warehouse for a while, but around the turn of the century was left empty.

In 2007 the city of Pirmasens started to convert the former factory site into a park. Together with public-private investors the factory building, now a listed building, was redeveloped.

The great challenge was to thermally insulate the seven storey high facades without changing their original appearance. The almost 1,000 windows were manufactured from steel and had 12 subdivisions. For the replacement, a system of structural glazing with PVC profiles was chosen. The dividers could be bonded onto the glazing so that the original look of the building could be preserved as much as possible.

Another important advantage is that the turning part of the frame is completely covered with glass, such that it is not visible on the outside. Because steel reinforcements were no longer necessary in the rotating parts, the frames on the inside look much more slender.

In the early design phase, frames of plastic and aluminium were built in for comparative purposes. In view of the expected maintenance costs, wood was not an option. Compared to aluminium, plastics turned out to be substantially price-friendlier and have better heat-insulating properties.

Compared to the original steel windows with single glazing, the current PVC windows with super-insulating glazing - Uw value of 1.3 W/m².K - save around 78,600 litres of heating oil each year. For the entire complex, this means a reduction of CO2 emissions of 244.5 tonnes per year.
Plastic is also a sustainable solution for piping systems (supply and discharge). Not only do thermoplastic pipes have a proven lifetime of more than 100 years, plastics are also very easy to work with compared to materials such as concrete and stone-ware. The pipe lengths are easy to change and by using double sleeves the residual waste is greatly reduced. The little construction site waste, as well as the excavated old pipes, can be 100% recycled without problems.

That plastic pipes are actually returned and reused is guaranteed by Kurio Recycling. Kurio (KUnststofRIOol) is a non-profit association set up by Belgian producers of ther-moplastic piping systems for the purpose of collecting and recycling excavated plas-tic pipes into new products with a useful and sustainable application. In time this will lead to a reduction of the waste mountain. The quantity of material to be recycled is low due to the long lifetime of PVC, PE and PP, but will increase in the future. Kurio Recycling is anticipating this by already closing the circuit. Thus PVC-U can be recycled up to 7 times without losing its properties. The recycled material can be used as an intermediate layer in a three-layer pipe, for window sills, wall coverings and acoustic barriers.

Another important benefit of plastic pipes is their light weight. This means an energy saving in transport, and also makes the pipes easy to handle, without heavy lifting facilities and machines being required.

Contrary to rigid - and thus fragile - pipes, plastic pipes are also in an excellent po-sition to accommodate settling in the soil. As a result, and thanks to the extremely small tolerances in the production processes, pipe connections will leak much more slowly such that the risk of pollution in groundwater and soil is substantially redu-ced. Also the risk of groundwater penetrating the leaking or burst sewers is much lower. Studies on various sewer systems in use for many years have demonstrated that, in comparable operating conditions, the risk of damage to flexible (plastic) pipes in sewer applications is only one fifth of that of rigid pipes (of concrete or stoneware). Because plastic enables greater lengths, the pipes also require fewer connections which further reduces the risk of leakage.

The light transport weight and the simple and fast installation ensure an ecologically and economically effective whole.

Plastic pipes are colour coded, which also favours the environment. For example rainwater (RWA) is often drained away in grey pipes, and household waste water in pipes of a red-brown colour. Household waste water is called DWA (Dry Weather Drainage). DWA must be cleaned in a sewage treatment plant (RVZI) before the water can be put back into circulation. Today the aim is to completely separate both piping systems (RWA and DWA) from one another. The colour codes help rule out mistakes here. In a completely separated system heavy rainfall does not overload the sewage system (DWA). When the sewage system is overloaded, the waste water is poured into rivers, also called overflows. Avoiding this over time will further spare the environment.

The grey/red-brown colour distinction also makes piping systems particularly suitable for constructing separate systems in integral water management. The sepa-ration of rainwater and waste water, as well as the useful reuse and/or infiltration of rainwater are the key factors in an efficient and sustainable water policy.

Municipalities that want to utilise their budgets wisely would do well to invest in sustainable and high-quality plastic piping. They can be replaced much more quickly - and thus much more cheaply - than traditional materials such as con-crete or stoneware, without affecting the required performance. Although the price of the sewer pipes constitute 20% of the total cost of sewer replacements on average (the bulk of the costs are for breaking up the road), thanks to the instal-lation speed and the durability of plastic, plastic is the most effective material. Moreover, plastics are highly suitable for new installation techniques, and in view of their recyclability they are extremely environmentally friendly.
In addition to the production and distribution of drinking water, the Vlaamse Maatschappij voor Watervoorziening (Flemish Water Supply Agency – VMW) is responsible for making sewer connections, laying the municipal sewer system and the operation of it.

In the early phase the experiments were rather rash and we had a lot of lessons to learn. We had many problems with the first injection-moulded PVC sleeves for example. Due to the high residual stresses and an additional stress as a result of the rigid adhesive bond of the sleeve to the pipe, there were frequent breakages after a few years.

We quickly recognised that technological development must be coupled with a thorough understanding of the behaviour of materials and with sound quality control. This led to investments in research on sustainable pipe materials. In this respect the BECETEL research laboratory played a pioneering role.

In order to be able to guarantee the sustainability of our piping network, we work together with the accredited research laboratory BECETEL. It monitors the mechanical and long-term behaviour. We ourselves also impose stringent standards and requirements. For pressure pipes, for example, recycled materials must not be used, only reworked materials (max 3%) from the actual production site. We promote the reuse of used materials, but then only for applications that are not heavily loaded such as manhole covers, frames, supporting frames and anchor bases for fire hydrant posts.

Today more than 30% of our total pipe network (around 30,000 km) is plastic piping. Some parts are already older than 50 years. Condition measurements and existing plastic pipes demonstrate that a minimum lifetime of one hundred years is feasible, certainly with regard to the current generation of plastic pipes.

IR. JOS ROBEYNs - Head of the materials technology unit of the VMW
With its new regional office in Torhout, the West-Vlaamse Energie Maatschappij (West Flanders Energy Agency – WVEM) wanted to present an example of a sustainable and energy-efficient building.

The ecological office complex that Crepain Binst Architecture NV and VK Engineering designed is a metaphor of a forest: a multitude of slender concrete trunks with a green crown on them in which a range of energy-saving techniques have been integrated. With an energy level of 660, the eco-office is far below the E80 legal standard.

The double facade acts as a passive and active energy source. Between the outer shell and the thermally insulated inner shell there is an open vertical air cavity in which the air is heated by the incident sunlight. When the windows are opened in between seasons, the heated cavity air can be utilised to ventilate the office areas. In summer the chimney effect in the open facade cavity ensures the natural removal of the solar heat received by the facade.

The architects also translated the energy-efficiency into the green-coloured glass panels in the outer shell. The 3 different shades and the 3 different transparency levels, aside from their particularly expressive character, also give the building a maximum transparency and natural light without direct incident sunlight.

The integrated photovoltaic cells are also green, literally and figuratively. The screen-printed drawing is an enlargement of a photovoltaic cell.

The glazing panels were fastened to the aluminium frames using a fast and neutral cured two-component silicone cement. This cement offers an excellent strength/flexibility ratio and remains particularly stable over a large temperature range (from -55°C to +150°C).

Thanks to the adhesive, the total weight is much less than with mechanical fasteners. The proven durability and low maintenance costs also make this adhesive remarkably cost effective.

Application of plastic: among others bonded glazing panels, PE-xA plastic pipes for concrete core activation.

The climate control is done with an underground borehole thermal energy storage system (BTES), a heat pump, and concrete core activation (CCA).

The photovoltaic solar cells integrated in the facade supply the primary pump of the BTES field with power, such that the office can be cooled without extra energy consumption.

Furthermore the offices are equipped with energy-efficient light fittings, daylight control and presence detection. A green roof and reservoirs around the building ensure the collection of rainwater.

Thus Infrax West saves around 40% energy and almost 180 tonnes of CO2 every year.

The efficiency of the various energy saving techniques can be monitored online on www.infrax.be/ekokantoor.

© Crepain Binst Architecture
In order to meet the European objectives (Near Zero Energy Houses in 2020), the importance of good insulation, an airtight building shell and well thought out ventilation is increasingly being recognised. The more airtight the building, the lower the heat losses and the lower the risk of damage due to moisture and draughts. At least if both the insulation, airtightness and ventilation have been correctly implemented and are attuned to one another. However, airtight building requires more attention to the quality of the interior air. When we make our houses airtight, the air replenishment is no longer driven haphazardly by natural forces such as wind and accompanying draughts, but we ourselves determine the rate of air replenishment according to the measured air quality.

Currently the energy level of a newly constructed house is around E80. Until recently it was E100. This change has been possible by implementing building works according to the approved manner. For a near zero energy building an E-level of 40 or 30 must be achieved. This requires a different way of building and the use of new technologies that we (almost) do not yet apply today.

Thus the building shell of a house today is increasingly important. In order to counteract heat losses and avoid thermal bridges, the insulation layer must be constructed without interruption.

But a house must also have an uninterrupted airtight layer. This represents a complex challenge, as building components such as plastered walls, cast floors and the joinery must be completely airtight. This means good communication between the various subcontractors is extremely important.

But the property developer/occupier is also important. For example, he must not pierce the plaster layer to hang a photograph. As a solution he must choose a piping cavity or fasten with glue.

The same applies to an airtight screen. An airtight screen may not be pierced unless the holes are finished with special accessories such as sealing rings.

Safeguarding an airtight layer makes us look at pierced joints in a different light. In a building 33% of all joints are nailed or screwed, 32% of joints are welded, lasered or soldered. Barely 3% of joints are glued. Nevertheless properly glued joints provide a better guarantee of an airtight layer.

The EPB decree also places higher requirements on window joints. In new buildings a joint of approx. 2 cm is always preserved (see Technical Notice 234 of the CSTC/WTCB). For encasements, the property developer can gain up to 10 E points by using PUR foam, tapes and an acrylate cement (for an airtight and vapour-tight seal on the inside, optimum thermal and acoustic insulation in the middle, and weather and wind protection on the outside). This is shown by tests done in 2010 in the Testcentrum voor Gevelelementen (Test Centre for Facade Elements) of the University of Ghent.
Application of plastic: polycarbonate for the facade and rooflights.

In 2010 this project was praised by the panel of the Gentse BIS trade fair as a paragon of sustainable urban conversion.

A rundown garage in the middle of a residential district in Saint Gilles (Brussels) was converted into a sports centre, the first floor became a night school, and the caretaker’s lodge was given the company of two additional residences. The property developer (Saint Gilles council) and architects (joint-venture AgwA + Ferrière Architecten) made multiple use of polycarbonate for aesthetic and economic reasons, both as a facade material and for the renovation of the rooflights in the roof of the former workshop, and for the interior facades of the former offices.

By preserving the existing structure, little energy needed to be wasted on demolition and transport, fewer new materials were needed, and consequently a lot of money could be saved. Where possible, the original or recyclable materials were given priority. The design and finish are minimalist, but particularly well tended. Thanks to the ‘bridge construction’ on top of the existing garage, the new whole forms a stack of horizontal layers. This structure is in sharp contrast to the neighbouring terraced houses and accentuates the public character of the sports centre and night school.

In order to further strengthen the identity of the building, and also to respect the very limited budget, polycarbonate was used in a creative way in the front facade. Polycarbonate panels are not only cheaper than glass, they also provide the aesthetic advantage that they can extend over the entire facade, both over the concrete structure and the openings for the windows.

This contributes to the fresh uniform appearance of the facade.

In order to allow natural light inside, the large rooflights were preserved, but the energy-inefficient glass was also replaced with polycarbonate panels. Polycarbonate has twice the insulating value of double glazing, but is lighter and more affordable.

Polycarbonate is also stronger than glass, and thus extremely suitable for burglary and vandalism prevention.
Adhesives have already proven their importance in the generation of renewable energy. Thanks to adhesives, wind and solar power installations have a longer lifetime. The materials used cannot be joined together using piercing techniques, as that would reduce their strength. Thanks to adhesives lighter materials can be used for the installations.

It is beneficial for both society and the environment to maintain buildings properly. Indeed, good maintenance substantially extends the lifetime of buildings. It prevents premature demolition and replacement, which has an important impact on the environment. Bonding with carbon-fibre reinforced polymers is a new technique that helps to repair weak spots in infrastructure works. The technique has many advantages: the light weight, the low recess depth, corrosion resistance and the fast and efficient application. Carbon-fibre reinforcement is primarily applied to strengthen existing structures whose load must be increased or whose function is to be changed.

Depending on the application different types of adhesives and sealants can be used: putties, plastic sealants, plasto-elastic sealants and elastomeric sealants.

**PUTTIES**

These are made from drying oils and synthetic resins, and are primarily known for their application as a glazing joint. When renovating historical buildings putties are still sometimes used for their ‘traditional’ look. Because putty can be painted over, the glass seal disappears into the joinery. Putties are now being increasingly replaced by sealant.

**PLASTIC SEALANTS**

For construction they primarily consist of synthetic sealants and bitumen sealants.

*Polyisobutylene sealant* are made from polybutene to which drying oils are added. Polyisobutylene sealant ensure an airtight seal for expansion joints with low mechanically loads. A few days after application this sealants forms a dry skin that can be perfectly painted over. The underlying sealant is protected against further drying out by the skin and thus remains plastic. However, over time the sealants continues hardening into the bulk until it has completely hardened. As a result it loses its function and must be replaced.

Polyisobutylene is one of the few sealants that is suitable for renovating old butylene joints. Oils are not compatible with the modern types of sealants.

*Bitumen sealants* are manufactured from bitumen. They are used for roofs, in combination with other bitumen-containing products (such as sooting).

**PLASTO-ELASTIC SEALANT**

*Acrylate sealant* consist of an acrylate mass in a water dispersion. Painters and plasterers can use them indoors for sealing connecting joints such as wall/ceiling, wall/skirting and wall/wall. Acrylate sealants can be easily painted over with most water-based and solvent-containing paints. Today there are also acrylate sealants for outdoor applications.
Elastomeric sealants

**Polysulphide sealants** are among the first elastic sealants that can accommodate up to 25% movement. Originally polysulphide sealants were used in one-component form for sealing joints; today they are used in joints - primarily in the petrochemical industry and petrol stations - that must be resistant to chemical products such as petrol and active chlorine. Polysulphide sealants are also used as a second barrier in insulating glazing.

**Polyurethane sealants** composed on the basis of PUR are one and two component systems that often form the sealing joints between facade elements. Elastic bonds in construction, such as for facade panels that require a high mechanical resistance and good elastic properties, are often implemented with a paintable PUR sealant.

**Hybrid polymers** such as MS polymers were initially sold as high strength adhesives for facade panels for example, but also increasingly as a sealant for expansion joints. Just as with PUR sealants these products combine elastic properties with paintability.

**Silicones** made from silicone polymers are inorganic such that they are not affected by UV. They are used for sealing facade connections and expansion joints, glazing joints, joints exposed to strong UV, joints with high temperature fluctuations and joints in bathrooms. Silicones have the big advantage that they remain elastic with temperature fluctuations from -50°C to +200°C. They come in two major families: neutral (alkoxy, oxime, and benzamides) and acetic acid silicones.

Silicones are used worldwide for bonding glazing onto underlying facade elements. The US Steelworkers Union building in Pittsburgh was constructed in 1958 with structural bonded glazing. These silicones still present no traces of ageing. They still contribute to improved airtightness and reduced thermal bridges in the building. As a result the use of silicones yields an energy saving that exceeds the energy requirement to produce them by many times.

On account of their elastic properties silicones are also used for gluing hurricane-proof or bombproof glazing. Also in regions with an increased risk of earthquakes, facade systems are constructed with structural bonded glazing. For example the Center Tower in California has survived various earthquakes over the last 20 years, the largest of which was 7.3 on the Richter scale, without any damage or victims.

For aesthetic reasons structural bonded glazing is increasingly being used in energy-sustainable buildings. Thus the West-Vlaamse Energiemaatschappij (West Flanders Energy Agency) in Torhout opted for a double-walled facade system. The structural bonded glazing enables the integration of larger glass areas, while the double-walled facade system enables openings to be incorporated in the energy-sustainable building, such that overheating is prevented in the summer.
Application of plastics: bonded structural glazing with integrated PV cells.

In addition to being an essential structural component of a building, the facade is also an important component of the visual communication.

Today a facade is also increasingly a statement of the ecological commitment of the property developer. The solar facade of the mountain station built into the rocks of the Klein Matterhorn, commissioned by Zermatt Bergbahnen, is a splendid example of this.

The Klein Matterhorn, a 3,883 metre high mountain in Switzerland, is the highest viewing point in Europe. There is no cable car that takes tourists to a higher point. The view is breathtaking: you look out over thirty-eight 4000 metre peaks such as the Breithorn and the Matterhorn, and over the frozen but clear world of glaciers and eternal snow.

The mountain station is often used as a starting point for trips to the top of the western part of the Monte Rosamassif such as Castor and Pollux. Zermatt Bergbahnen AG has undertaken for some years now to protect the environment better and invest in buildings that are distinguished by their sustainability and energy efficiency. Thanks to the excellent thermal insulation and the triple glazing the energy demand has been substantially reduced.

The 22 kWp PV system integrated in the southern facade generates around a third of the total energy requirement of the building. The intermediate station, Trockener Steg, at 2,929 m high, also has a facade-integrated photovoltaic system of 35 kWp.

For its concern for the environment and the use of solar power, Zermatt Bergbahnen AG received the European Solar Prize in 2010.

The structural glazing with the integrated PV modules was fixed to the facade with adhesive. This was done for two reasons: by gluing, the fastening and sealing could be done in one operation, and any point loads and stresses are transferred to a load-bearing building component.

In this way energy savings and the benefits of gluing could be perfectly combined with one another.

On the roof of the world the glues used are also proving their extraordinary durability. Both the facade and the bonding are exposed to the severest climatological conditions - UV radiation, temperature differences and high wind - and yet it does not move an inch.

Both the facade and the bonding are exposed to the severest climatological conditions - UV radiation, temperature differences and high wind - and yet it does not move an inch.

The solar facade of the mountain station built into the rocks of the Klein Matterhorn.
Roof membranes can be secured in three ways: mechanically, with ballast and bonded. For the mechanical fastening of the membranes to the underlying plastic insulation, plastic plugs and short screws are increasingly being used instead of metal distribution plates and long metal screws. The use of plastic and adhesives greatly reduces the risk of thermal bridges and around 5% less heat is lost.

An additional advantage of plastic plugs is a better clamping of the roof membrane to the thermal insulation. This results in a higher pullout strength so that fewer fasteners are required.

Depending on the thickness, plastic roof membranes have an expected lifetime of 25 to 35 years. The lifetime is increasing. Over the last 15 years, the lifetime of PVC has increased by 50% for example. In addition to their technical qualities, roof membranes based on PVC-P also have important aesthetic qualities. They can perfectly copy the upright joint of zinc roofs. In contrast to zinc, plastic today is not a scarce product. Plastics are also cheaper and cause less noise in a hailstorm.

To recycle the roof membranes, the European plastics sector has voluntarily got behind Roofcollect®, a collection and recycling initiative for discarded roofing material. In 2008, 954 tonnes of roof membranes were recycled, in 2009 it was 1,297 tonnes. The target for 2010 was 1,500 tonnes, the final result was 1,586 tonnes.

A white roof membrane is the best for the environment and the energy bill. Thanks to the bulk pigmentation, white reflects up to 90% of the solar radiation. The heat that would otherwise penetrate a building via the roof is thus shut out to the optimum. This ensures that buildings need less cooling in the summer.

In order to counteract fouling and the reduction of reflections, a protective coating can be applied.

A white base under crystalline photovoltaic panels is the best. On the one hand the sunlight reflected by the white background increases the efficiency of the solar panels. On the other hand, due to the reflection of the sunlight, the temperature of the white roof covering remains low and avoids an output loss. Every one degree temperature increase of the cells means a 0.5% loss of output.
Application of plastics: PVC sealing on which solar cell modules are bonded.

Since 1933, the Antwerp Sportpaleis (Sports Hall) with its enormous roof has been a striking landmark on the Antwerp ring road. Between April and August 2010 the green roofing was replaced with PVC roof membranes in five shades of blue and grey. Despite the new blue colour, the roof of Belgium’s most popular events hall is still also ‘green’. Thanks to the 2,000 m² integrated solar cells, good for an estimated production of 45,000 kWh per year, the new roof is a textbook example of an energy roof.

The roof of the Antwerp Sportpaleis (Sports Hall) has a total area of 10,000 m². Originally it was built as a steel structure with corrugated panels. Later it was given a bituminous covering and in 1988 it was covered with a PVC roof. The green PVC membranes were still in a good condition and the sports hall could remain waterproof for many years. But the owners chose to give the roof additional thermal and acoustic insulation, by covering it with a new PVC seal in various shades of blue and light grey, and by providing the southern side with solar cells.

The existing PVC covering was repaired and now acts as a vapour barrier. In addition, a layer of insulation was applied, and then a new 1.5 mm thick seal, with polyester-reinforced PVC membranes whose dimensions were specially developed for this project. In order to perfectly correspond with the colour design, the new seal could be a maximum of 81 cm wide.

On the request of Antwerp province, the PVC membranes were made in four different shades of blue. As the icing on the cake, the logo of Antwerp province was introduced, in a shade of grey extending across the various roof surfaces so that it is clearly visible from the air and on ‘google Earth’.

In order to increase the UV resistance, to slow down the fouling and to guarantee the colour stability, the roof membrane was finished with a ‘clearcoat’ coating. This protective layer also ensures that the roof can be easily cleaned with water.

The existing PVC covering was applied, and then a new 1.5 mm thick seal, with polyester-reinforced PVC membranes whose dimensions were specially developed for this project.
The following table shows the advantages and disadvantages of different insulation materials:

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<tr>
<th>Insulation</th>
<th>Advantages</th>
<th>Disadvantages</th>
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<td>PVC</td>
<td>- durable usage</td>
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<td>- easy to handle</td>
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<td>- low temperature range up to 70°C</td>
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<td>XLPE</td>
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<td>EPR</td>
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<td>- wide temperature range</td>
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<td></td>
<td>- low tensile strength</td>
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</table>

A similar classification applies to the insulating layers:

Thermoplastics (not cross-linked):
- PVC
- PE
- PUR

Elastomers:
- EPR

The properties and qualities that the materials used for the insulation and outer sheath must satisfy (electrical and mechanical properties, environmental impact, lifetime and reaction to fire) are set out in international standards.

The commonest insulation materials are:
- Thermoplastics without cross-linking, such as PVC and PE
- Thermoplastics with cross-linking, such as XLPE and VPE
- Elastomers, e.g. EPR

* XLPE stands for cross-linked polyethylene.
* VPE stands for cross-linked polyethylene ("vernet polyethyleen").
* EPR stands for ethylene propylene rubber.
A sustainable floor covering is a covering with a long lifetime and minimum maintenance requirements. These are two great advantages of plastic floor finishes such as epoxy or polyurethane cast floors and vinyl floors.

Cast floors are completely flat floors that consist of a cast two-component epoxy resin or polyurethane. Because of their long lifetime and resistance, they are often used for industrial applications, but on account of their maintenance friendliness and their fine appearance, they are gaining ground in shops, showrooms, and offices. In homes, cast floors are extremely suitable for bedrooms, the kitchen, and living room. Moreover, they can be perfectly combined with floor heating.

Vinyl floors also have specific advantages. They form a resilient plastic floor covering made up of a number of layers, and they can be installed as readily and as easily as carpet.
03/ SUSTAINABLE SOCIETY
Today we are facing the greatest challenges ever. An increase in our population and life expectancy, and increasing demand for food, energy and accommodation are increasingly at odds with the reduction of the available raw materials and the saturated level of pollution of our planet. These challenges are initiating great changes on a social, industrial and political level. Sustainable development is the driving force towards more responsible behaviour. The aim here is to find solutions to decrease the pressure on our raw materials, without reducing living comfort and while preserving a viable economy. Sustainable industrial development is only possible when a solution is environmentally justified, aimed at economic growth, and offers social progress.

In the early 20th century plastics were primarily produced from coal. Today they are made from hydrocarbons. They primarily come from petroleum and natural gas, as they are still the most economic raw materials for this purpose. Plastics use petroleum but do not exhaust them. Barely 4% of all petroleum is used as a raw material for plastics. 87% of the available petroleum is burned for transport (45%), energy generation or heating buildings (42%), or is a raw material in the chemical industry or other applications such as pharmaceuticals.

Due to the increasing traffic and housing stock, and the accompanying energy consumption, the combustion of petroleum is difficult to reduce. Hence the plastics sector has already been developing alternatives for a long time. More and more hydrocarbons are today being extracted from natural gas and biomass. Other alternative renewable raw materials for plastics are starch, cellulose, sugars, lactic acid, organic waste, vegetable oils, microorganisms and algae. With its BioBase Europe cluster, Belgium is a world leader in the diversification of raw materials for plastics.
**IS THE REPLACEMENT OF PLASTICS BY OTHER RAW MATERIALS NOT THE SOLUTION?**

Not according to the 2010 Denkstatt report. This report calculated what the substitution of plastics by a replacement product would mean. In order to be representative it did the calculations for 123 plastics in as many applications, and this in the 27 European member states. The result: almost four times the total mass, an increase in energy consumption of 57%, an increase of greenhouse gas emissions by 61%. This corresponds to 39% of the EU15 Kyoto objective.

The study also shows that the greatest potential for reducing CO2 lies with plastics. Today the carbon balance is around 4 to 8. In other words for every tonne of CO2 that is produced, on average plastics save 5 to 9 tonnes of CO2 during their usage and end-of-life phase. Potentially, this figure can be improved to 9 to 15, which is a gigantic leap towards greater sustainability. In many applications plastics make an active contribution to burning less petroleum.

In the transport sector in Western Europe, around 1.7 million tonnes of plastics are used each year. Their production requires around 3.25 million tonnes of oil. Their usage results in such a substantial weight reduction that plastics generate a saving of 12 million tonnes of oil. This is four times the quantity of energy needed to produce them. This energy-saving results in a reduction of CO2 emissions of as much as 30 million tonnes per year.

During their usage, plastics do not really consume 3.25 million tonnes of oil. If at the end of their lifetime they are not further recycled, plastics can release the energy that they have stored by ‘energy recovery’ or incineration under controlled conditions. As a result, energy equivalent to 1.9 million tonnes of oil is released.

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2. In the framework of the Kyoto protocol, the 15 states that made up the EU at that time set a particularly ambitious objective to jointly reduce their greenhouse gas emissions by 2021 by 8% compared to 1990. This joint obligation resulted in an individual, legally binding obligation for each member state, based on its capacity to limit emissions. For example, committed to a reduction of 7.5% by 1990-existing plastics, this reduction effort of the EU20 would be increased from 6% to more than 11%. For figures apply to Western Europe.
3. The vision of plastics processors is available on www.youtube.com/watch?v=82-Yz8MbxAo

The next time you get in your car, just remember that your plastic bumper not only increases the safety of vulnerable road users, but also saves 4 times more energy than needed to produce it. Purely because of the weight saving.

Or if you fly in an Airbus 380, remember that 22% of the aircraft consists of plastic carbon fibre composites, and thus saves 15% fuel. A figure that can be even better. For example the Boeing 787 Dreamliner is 50% plastic carbon fibre composite.

Plastic packaging is literally everywhere, and for good reasons. Plastics form 2% of European waste, but they save 2 times the energy needed to produce them by extending the shelf-life of the food. As a result European food waste has fallen to 2%.

In developing countries this is 50%. The energy savings and reduced environmental pressure as a result of plastic packaging are enormous.

Plastics are also essential for generating energy (the blades of wind turbines, solar panels, batteries and fuel cells for renewable energy; breeder reactors for oil extraction from algae, etc). Plastics prevent the premature exhaustion of oil reserves.
The total consumption of primary energy essentially lies in three sectors: construction, road transport, and industry. The greatest energy savings can be made in the construction sector. This applies to our country in particular, which is well behind regarding the energy-efficiency of residential buildings compared to the rest of Europe.

Stricter European directives will ensure that by 2020 new buildings must be nearly zero energy. This is an enormous challenge for the building sector and will be a fundamental about turn in the way in which building is done in the coming years. New techniques and new materials will play a key role here.

The greater the choice of (raw) materials, the more opportunities there are to achieve the most sustainable solutions. Nowadays good results are already being obtained with plastics, but future developments in the plastics industry will enable even more improvements.

The properties of plastics make them extremely suitable for construction: they are strong, light, easy to use, weather resistant, mouldable and have a high insulation value. The number of applications of plastics in building is spectacular: from thermally insulated pipes, to insulating foam for cavity walls and super-insulating roof panels.

It is important to examine the production and recycling of these materials. This is a very important factor in the way in which we will deal with raw materials in the future. Better recycling should reduce the environmental burden due to air emissions from raw materials.

Not only are the materials important, but also the people who can correctly install the materials. In a fast developing sector, it is important to stay abreast and to master the very latest techniques.

The attention on new materials and techniques in the various building training courses is thus considerable. The building sector is facing an enormous challenge in finding suitable staff who can work with all the latest technologies and new materials.

ROBERT DE MUILENBERG – chief executive officer Confederatie Bouw (Building Confederation)
**RECYCLING OF PLASTICS - URBAN MINING**

The plastics sector is also working closely with OVAM on closing our plastics circuit. Today 30% of plastic waste in Belgium is recycled. Thus Belgium is the leader in Europe. The Belgian plastics sector is also closely participating in initiatives such as the Clean Site System, FastPlus, Val-I-Pac, Kuro, Febeauto, Recupel, Recovinyl.

Unfortunately, because of their calorific value, plastics are also often readily put into energy recovery processes. Thus 69% of all plastics are incinerated prematurely. The sector is aiming to further increase the share of recycled plastic.

The objective is simple: recycled plastic must become a raw material again. Together with plastics extracted from biochemistry, this method can further reduce the proportion needed from petrochemistry. In the future we will use plastics in which a part is of a petrochemical origin, a part of a biochemical origin, and a part of a recycled origin. Or even better: a mixed closed circuit model.

A feverish search for biofuels is now on. But biofuels will never be able to meet the demand for fuels. Too much land would be needed that would jeopardise the food chain.

Prof. Martin Patel of the University of Utrecht stated in 2008 that the energy savings from bioethanol when substituting biofuels is around 9.5 GJ/tonne. If we replace petrochemical ethanol with the same quantity of bioethanol, or use it for plastic production, we gain around 37.5 GJ/tonne.

His conclusion: “In a world of scarce agricultural land and forest resources, it is more effective to use biomass for production of chemicals compared to the use for biofuels.”

This consideration is crucial. After all by 2020 the European Union aims to reach a 10% share of biofuels. This is more than the total raw material requirement of the entire European plastics industry.

Even if fewer plastics are taken out of our circuit (due to energy recovery) than must be added today, mostly of a petrochemical origin) to keep the circuit filled, then a balanced, mixed and separated system circuit arises.

Once we have achieved this in practice, the road is open for plastics to be called a fully-fledged cradle-to-cradle product.

Plastics are thus a lot greener than we think.

**PLASTICS PRODUCERS CALL FOR THE STOPPAG E OF SEA POLLUTION**

Plastics are often blamed for forming the basis of litter in the sea. Drifting plastic waste in the sea constitutes a serious environmental problem and requires an international approach. Plastics make this problem visible. But in themselves they are not the cause.

Indeed, in Belgium 95% of plastic waste has a useful application: 30% is recycled into new products and 69% is incinerated with energy recovery. The other 7% is dumped under controlled conditions.

This figure must improve. Every day the plastics sector is working hard to recycle even more plastic waste. In 2010, Federplast be asked OVAM to form a working group together with the recycling sector in order to research the possibilities of additional plastics recycling.

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1. This refers to the share of postconsumer waste. This is the proportion of waste collected through recycling systems. During production processes the industrial waste is already 100% recycled. However, this belongs to the share preconsumer or industrial waste.

2. The calorific value is the energy content of the material. Waste incinerators generate energy. They derive this energy from the heat released during the incineration process. Not all wastes burn so well, however. Sometimes a great deal of energy has to be supplied in order to keep the balance positive. Separated waste with a high-combustion value, such as plastics, are often added. This is done too often.
In the UNEP study of April 2009, GESAMP (United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution) demonstrated that 80% of litter at sea comes from the land. The other 20% comes from ships that dump their waste illegally. Of all floating waste at sea, 90% is plastic, of which 18% are bottles and bags. On the coast plastics cause 58% of waste, of which 14% comes from fishing. No less than 38% of the waste found at sea originates from beach visitors.

More info on www.unep.org

Unfortunately the cause of pollution of the world’s seas are primarily to be found outside Belgium international shipping - and even more importantly - countries that do not have a sound system for collecting and processing their waste, form the greatest source of litter.

Plastics generally get into the sea from the land. Plastics producers are working on the basis of the UNEP study to create broad awareness among beach visitors in coastal regions. They are also supporting the initiative of state secretary Schouppe, responsible for the North Sea, to pay Belgian fishermen for bringing waste to land that they haul in as a ‘side catch’.

The plastics industry is also making its expertise available in the framework of international cooperation in order to find solutions. Thus, together with Prof. Colin Janssen (University of Ghent), the sector is researching the presence of microplastics in marine organisms.

There are also no reasons why plastic packaging should cause health risks, but the sector is leaving nothing to chance. The study of Prof. Janssen will provide a firm answer.

As Belgium processes the most plastics per capita in the world - the majority of which are exported - the Belgian plastics industry has a moral duty to the rest of the world to set an example with regard to the sustainable use of plastics.

Because propellants were already in the ozone layer, it was expected that the ozone hole would not immediately get smaller. The life expectancy of these propellant gases is more than 50 years. Up until 2006 this was indeed the case. Since then there has been a remarkable recovery. Today it is expected that the ozone hole will be closed in around 2050. This is a good example of how science and industry together can build a sustainable world. Thanks to the recognition of the problem and the accelerated implementation of the Montréal Protocol the ozone hole is getting smaller year by year.

An accentuated Montréal Protocol also stipulates the accelerated reduction of HCFC’s. The first replacements for CFC’s must be completely replaced by 2020. Europe has practically fully realised this objective already.

Today, no plastics are manufactured in Europe that contain CFC’s or HCFC’s.

The systematic depletion of the ozone layer was first observed in the 1970’s by Paul Crutzen and Frank Sherwood Rowland. They made the link between the use of CFC’s and the damage to the ozone layer. On account of this groundbreaking discovery, both were awarded the Nobel Prize for chemistry in 1995. However, it was not until 1 January 1989 that a stop to the damage to the ozone layer was called for with the Montréal Protocol. This Protocol is one of the most successful international environmental treaties ever, thanks to the expertise with which propellant gases are dealt with.

An accentuated Montréal Protocol also stipulates the accelerated reduction of HCFC’s. The first replacements for CFC’s must be completely replaced by 2020. Europe has practically fully realised this objective already.

Today, no plastics are manufactured in Europe that contain CFC’s or HCFC’s.
Since their first large scale use as a replacement product for shellac - a former electrical insulator - or as a replacement product for wooden windows and doors during the reconstruction of Europe after World War II, plastics have been used to save other raw materials. For example they help prevent the premature exhaustion of raw materials, and also keep innovative applications affordable.

Thanks to the formation of knowledge centres our understanding of building physics has increased. As a result, the application requirements in construction became increasingly strict. Because of this, the aim was to use the building materials best fit for the intended purpose. The stricter these requirements became, the better plastic performed. The properties of natural products such as wood, sand or reed have changed little, if at all, over the years. In plastic processing on the other hand, intensive research has led to greater numbers of raw materials that meet the increasingly strict technical requirements for building products. As a result more has become possible with less plastic.

Buildings, cold chains and industrial installations are currently thermally insulated with plastics with exceptionally low thermal conductivities (λ-values). As a result in one year a modern house reduces CO₂ emissions by 2 to 5 times the amount needed to produce the insulation. Over 30 years this is a good 60 times the energy needed to produce the insulation.

The weight of plastic also has an important effect on structures. Increasingly strict building regulations (safety, sustainability, energy consumption, etc.) are making it more difficult for existing constructions to satisfy them. For renovations, buildings are often demolished because the structure cannot bear the additional load needed to meet the building requirements with traditional building materials. As a result valuable heritage is being lost. Plastics can play an important role here. For example, the great hall in Antwerp Central Station.

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1 The thermal conductivity of plastics is 1/1000 that of stone.
2 The current E-level of houses is E80. The savings can be increased if the E-level is made stricter.
'The current development towards more attention on the environment and reducing energy consumption has important ecological and social implications, but also offers many prospects on an economic level.'

As a result a strong growth market is developing, which is creating a lot of extra employment. Small and medium-sized building companies are also particularly well placed to meet the rising demand for sustainable houses and energy-saving conversions. At least if they have the necessary training, experience and specialisation, as sustainable building requires a great deal of professional knowledge. Here the skilled worker can differentiate himself from the moonlighter and do-it-yourselfer.

If you want to save energy efficiently in your home, it is best done in the most logical order from a financial and technical point of view. First and foremost it must be ensured that as little energy as possible is lost. This means: insulation and airtight buildings. For this work there is an enormous offering of (raw) materials. It comes down to every material being used in the right way for the right purposes. For example, insulation materials lose their thermal properties when they become wet. Hence for certain specific applications it is best to use plastic foam panels whose moisture absorption is very limited.

Injected PUR is often used on account of its fast and seamless implementation. Plastic foam panels are sturdy but very light, such that they can easily be installed. Generally plastic-based insulation materials have excellent thermal properties, resulting in a clear energy saving. What is gradually entering the building world is airtight building by using films and tapes. But these materials and methods often meet scepticism and questions about their correct implementation. A lot of training and awareness creation is still required in this field.

In addition to insulation and airtight buildings, rubbers and plastics are also gaining importance in other building applications. Just think of the joinery, the heating system, ventilation systems, (green) roofs, etc. In general the great advantage of these materials is their light weight, which ensures lower transport costs, easier installation and lighter building structures.

In the meantime building materials have also become available that are made of recyclable plastics. Large and accessible initiatives to collect them could mean considerable added value. But the awareness is now there.

LEGISLATIVE INITIATIVES MEAN THAT CONSTRUCTION AND RENOVATION ARE NOW INSEPARABLE FROM THE ENVIRONMENT AND ENERGY. ALL THE FINANCIAL INCENTIVES NOT ONLY ENCOURAGE THE EXISTING GROUP OF POTENTIAL BUILDERS AND RENOVATORS TO MAKE CERTAIN INVESTMENTS IN ENERGY SAVINGS, BUT ALSO THE TENANTS AND OWNERS OF HOUSES.

HILDE MASSCHELEN – Chief executive of the Bouwunie (Building Union)
Application of plastics:
PVC membranes for roofing.

When in 1975 a German retailer suddenly cancelled an important order, out of pure necessity Amancio Ortega opened a shop to sell his products and he called this shop Zara. Now there are more than 650 Zara shops in 50 countries, and Ortega is perhaps the richest man in Spain. This is mainly because of his unique supply chain. The development, production and distribution of new products can take place within 15 days. This is extremely fast for the fashion industry.

In 2008, Zara opened up a new distribution centre in Zaragoza at a price of 100 million euros. Every week around 2.5 million items are handled there. Around 800 permanent employees work there 8 hours per day. At peak times, this capacity is expanded by around 50%.

Originally the architect wanted to seal the 114,000 m² roof with bitumen, but then it turned out that bitumen would load the roof by an extra 840 tonnes. PVC membranes were chosen. They weigh up to five times less than the traditional multilayered sealing systems.

The PVC roof membranes used for the new Zara distribution centre in Zaragoza weigh only 1.56 kg/m². Two-layer bitumen of 8 mm weighs around 8 kg/m².

More than 800 tonne difference results in a substantially lighter roof structure and a considerable energy-saving in the transport costs of all materials. The plastic membrane of monomer PVC also means a saving in the implementation: for one roll of 36 m², 6 rolls of a two-layer bitumen system are needed.

Savings can also be made in the maintenance. Contrary to the traditional sealing systems, the maintenance of the plastic sheeting is generally limited to a visual inspection.

If the roof had been insulated with PUR instead of with mineral wool, the designers could have saved even more weight.

Plastics are helping to save our most valuable raw materials. For example plastic windows and doors reduce tropical deforestation, and synthetic elastomers and rubbers reduce the exploitation of natural rubber plantations.
Belgium is the European leader in recycling plastics

At the end of their life, plastics still make an important contribution to sustainable development. Thanks to the constantly smaller and lighter plastic products, the waste is reduced. New technologies enable an ever increasing proportion of this waste to be recovered.

In sectors such as distribution, packaging and building materials, plastic products are already almost entirely reused. In the building sector, for example, in Belgium the demand for PVC waste is currently greater than the supply. The waste is ground and reworked into pipes, frame profiles, wall panels and sound-proofing screens.

In Belgium 93% of all plastic waste is usefully used: 30% is reused in new products. This means our country is a world leader. 61% is incinerated with heat recuperation on account of its high calorific value. The remaining 7% is landfilled under controlled conditions.

The contribution of every one of us is important here. The correct collection of materials enables more recovery, such that more recycling is possible.

Of the 2.3 million tonnes of plastics that we process in Belgium, around 0.5 million tonnes are currently recyclable. This proportion must increase. This can be done by taking plastic materials to the container park, but also by asking the installer to take back the residual materials.

For many plastic building products there is already a closed circuit:

- Plastic frames, doors and facades, plastic sawdust, profiles and old frames are taken back, dismantled, broken, micronised and used again in new windows, doors, facades, windowsills, etc.
- Plastic drains, sewers and water pipes are returned and collected at 20 points spread across Belgium. These pipes are also ground, micronised and used again in new pipes.
- Sheaths for new cables are made from plastic cables (for electricity, telephones, etc).
- Plastic roof coverings are collected and reprocessed into new products.

Projects such as EKOL convert plastic waste (without a sufficiently high level of separation) into products with a second lifecycle such as acoustic barriers and benches. In this way the waste from 750,000 residents is converted each year into 69,000 tonnes of new products.

In Europe 260,000 tonnes of PVC have been recycled each year on a voluntary basis since 2010. If we loaded this onto 20 tonne lorries, it would correspond to a line of lorries from Antwerp to Liege and back again.

Plastics are recycled in many applications and many materials:

* According to application: roofs, windows, doors, facades, profiles, insulation products, cables, pipes, packaging of building products
* According to material: PP, PE, HDPE, LDPE, PVC, EPS and XPS

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1 The recycling code ensures that materials in waste processing are sorted and recycled in the right way. It is indicated by the Möbius strip symbol (3 arrows) with a number in the middle to indicate the material: PET = 01, HDPE = 02, PVC = 03, LDPE = 04, PP = 05, PS = 06, and other plastics come under 07.

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1 The packaging of building materials is recycled via the Clean Site system. More info in Chapter 6.
'Waste materials should no longer be regarded as a problem, but as valuable raw materials.'

So far this policy has been very successful, but we must take a step further. Waste materials should no longer be regarded as a problem, but as a valuable raw material. Raw materials for our economy, raw materials for new products. For us it is important to broaden this waste material policy into a sustainable material policy. This means that we must examine the environmental impact of materials over their entire lifecycle. Thus not only the environmental impact of the waste, but also the raw materials that are used, the production process, the collection and recycling opportunities, etc. This applies to all sectors, thus also to the building sector and to plastics in the building sector.

It is estimated that worldwide the building sector is responsible for around 40% of the consumption of energy supplies and around one third of the emissions of greenhouse gases. Looking at Flanders, building and demolition waste is one of the largest fractions of both household and company waste. Fortunately the recycling percentages of this waste flow are very high: up to 90%.

Plastics in themselves represent only a small fraction in Western Europe - barely 1% - of all materials used in the building sector. They are primarily PVC for frame profiles, floor coverings, cabling and pipes, as well as PUR and EPS for insulation or pipes. Today more plastic building materials are coming on the market than are collected and recycled. This is partly explained by the fact that recycling could be better, but also partly because of the long lifetime of plastic products that are in buildings. There is thus an enormous stock of plastics in buildings that may be released as waste in the coming decades. It is important that the building and waste flow from this can be collected and recycled better in the future.

In 2011, together with all players in the building sector - thus also the players in plastic building materials - we started a study in order to understand the environmental impact of the use of materials in buildings and to limit it where necessary.

This is done using quantified methodologies based on existing LCA databases, but also on the basis of environmental product declarations for building materials. In the past there have been many initiatives to selectively collect and recycle plastics in building and demolition waste. Recovinyl for the recovery of PVC. KURIO, an initiative of Federplast, to recycle plastic pipes. Or the clean site system, a project that was developed to collect plastic packaging on building sites. The aim is to examine, together with the organisers of these projects, how all these projects are proceeding and what the difficulties have been.

Thus we hope to be able to monitor the entire material circuit, and where possible to close it. This has already been done successfully for the plaster sector. Over the last few years we brought together all players in the entire plaster chain, from producers to companies active in demolition and the collection of demolition waste, up to the recyclers, in order to examine who could play what role to ensure that plaster waste gets into a closed circuit so that it can become new material.

JAN VERHEYEN - OVAM spokesperson
Why should water be a problem in Belgium where it rains so frequently? Much of the rainwater in Belgium is polluted by pesticides, nitrates, households and industry. In addition to water pollution there is also sometimes a problem with the quantity of water. Some places suffer flooding, while others have water shortages.

Drinking water is often extracted from layers that are not replenished quickly enough, while the increasing paving of surfaces (streets, drives, terraces, etc) impedes the infiltration of water, which overloads the sewers and leads to flooding when there is heavy rainfall.

Drinking water must be taken from a source (canal, river, catchment basin) to the treatment plant, and from there to the taps in homes.

For a long time this transport, both outside and inside a house, was the sole preserve of concrete, fibre cement and metals such as zinc, copper, stainless steel and lead.

Nowadays, high-quality plastics (such as PVC, polyethylene or polypropylene) are proving their important positive qualities. They provide rust-free pipes that are light, impact resistant and above all water neutral. Plastics do not affect the water and are excellent insulators. Because they weigh a little less than conventional materials, they are much easier, economical and environmentally-friendly to transport.

In our own housekeeping we can take many steps to prevent pollution and to use the right water in the right place. Flushing toilets, laundry, cleaning, can all be done perfectly with rainwater. The installation of a rainwater tank is the first step here. Low-flow showerheads are made almost entirely of plastic, whereby they consume less but still provide the same comfort. Modern cisterns are generally made of porcelain, but the half/full flush select button is almost exclusively controlled by a plastic mechanism.

By having water appliances operate more efficiently, we can do the environment a great service.

In Belgium plastics go even further, by providing solutions for integral water management. They vary from separate sewage systems that prevent flooding in the event of heavy rainfall, to membranes for desalinating seawater and encasing dumps and polluted sites.

Further from home, in the Arizona desert (US) for example, plastic drip pipes contribute to the more efficient use of water in crop cultivation. These drip pipes are buried 20 to 25 cm in the soil. Due to less evaporation from the soil surface, the efficient use of water for crops increases from 6% to 95%. Thus less water is pumped up from the ground, which saves 90% energy. The yields of crops are 90% higher as a result. Moreover, regions where this was scarcely possible now have the opportunity to grow crops.

The UN granted a ‘Best Practice Award’ to a similar system in Mongolia and Gansu during their ‘Development Programme on World Desertification and Drought Prevention Day’. By laying a sheet 20 cm deep, 60% to 80% water can be saved and a substantial increase in the crop yields are realised.

Plastics also help Water Aid in its fight against deaths due to polluted water. Today a child dies every 20 seconds somewhere in the world from drinking unclean water.

Worldwide 35% of all deaths are the result of polluted water.

Of the 6.7 billion people on earth more than 2 billion people have no access to water. Water Aid has given 5.5 million people in Nepal access to clean and pure water through transportable, light plastic pipes that are easy to handle.

The average water consumption in Flanders is 110 litres per day per person.
'In Flanders our water availability is on the verge of what is internationally considered to be a hazardous situation leading to water shortages.'

Secondly there is the fact that around half of the water we use is groundwater and half is surface water. Over the last few years the groundwater reserves have decreased in many places in Flanders. On the one hand this is due to the relatively large consumption, not only for drinking water but also for agriculture and industry, and on the other because groundwater is replenished very slowly. In some places the deep water layers are tens of metres lower than 50 years ago, for example. Even if something should change to the licensing policy, it will be years before the situation recovers. In addition, all studies on the impact of the possible expected climate change indicate that in winter we will have a little more precipitation and in summer a little less. And if it rains in summer, then the rain will be concentrated in a smaller number of much heavier rainfalls. As it is summer, the rain will evaporate more quickly and because the rain falls over a shorter period and has much less time to infiltrate, we must fear that the groundwater reserves will be jeopardised in the future. Hence it is of great importance to do everything possible to counteract this development.

One of the actions we can take is to ensure that the rainwater that we receive throughout the year does not flow as quickly to the rivers and the sea via the streets, channels and sewers, and to keep it where it falls and give it the opportunity to replenish our groundwater reserves in this way. In the first instance this will be the shallow groundwater layers. Only over time will the deep groundwater also benefit from this.

In addition to the possibilities to aid infiltration, rainwater tanks also play an important role. When we collect rainwater and reuse it in our home, we will use less drinking water and this way save our reserves.
The average energy consumption per person in the world is around 210 MJ per day. In prosperous countries the energy consumption is substantially higher. An average resident in the United States consumes around 900 MJ/day or four times more than the world average. In Europe this figure is approx. 400 MJ/day.

The energy demand in Europe is mainly generated by transport (32.6% travel by car, train, aircraft, etc), industry (27.9%) and households (24.6%). Together they form the main share of the energy requirement of prosperous European member states.

In European member states, energy is primarily obtained from oil and natural gas. The bulk of electricity is currently generated from burning fossil fuels. Not only does this lead to increased CO2 emissions, which contributes to the greenhouse effect, but it also constitutes the weakness of our European prosperity. Europe expects that almost 50% of its energy will have to be imported by 2030, unless it can reduce its energy demand. Otherwise Europe increasingly risks becoming more energy dependent on politically unstable regions.

European research has shown that construction in Europe constitutes 40% of total European energy consumption. Construction produces 40% of total European CO2 emissions and consumes half of all raw materials extracted in Europe. Together with the transport sector construction also forms the pre-eminent field of play where Europe can make its energy reductions.

In order to reduce their energy dependency, in March 2007 the EU countries signed up to the ‘20-20-20’ objectives. The European member states thereby undertook to be 20% more energy efficient and emit 20% less CO2 with respect to the reference year 1990, and to derive 20% of its energy consumption from renewable sources such as wind and water by the end of 2020.

* In Europe energy consumption increased by a total of 10% between 1980 and 1995. The transport sector in this period rose by 46%, while industry fell by 4%. Other sectors presented a rise of 7%.
In 1985, 12 years before the Kyoto protocol, the global plastics industry started a voluntary initiative: Responsible Care®1 to safeguard the environment as much as possible. This prolonged and discrete effort is now bearing fruit.

One of the most obvious options was energy recovery. Since 1970, in Belgium the total production of the chemical industry has increased fourfold. In that period the energy consumption only doubled. Products are now produced twice as energy efficiently as in 1970. This means an energy saving of 50%.

The chemical sector has doubled its energy consumption since 1970, but in the same period its production has increased fourfold. Today it thus uses only 50% of the quantity of energy per product that it needed in 1970. In other words, its energy efficiency has increased by a factor of two.

Over the last 20 years, during the production increase thus, the chemical sector reduced its greenhouse gas emissions by 60%.

Almost 95% of all petroleum is used in the Belgian chemical industry as feedstock3. In order to generate its energy, the chemical industry only burns 2% of it. For the rest it uses electricity (61%) and natural gas (30%) with CHP. Today these CHP investments yield an extra 813 MWe power. The remaining fraction is steam.

The Doel nuclear power station on the 80 ha site generates around 2,912 MW.

Doel 1: 433 MW - Doel 2: 433 MW - Doel 3: 1,006 MW - Doel 4: 1,040 MW

Combined heat and power in the chemical industry is thus equal to almost the power supplied by Doel 1 and Doel 2 together.

In order to save energy the rule of the Energy Triangle is applied.

The order of this is:
+ Limit your energy consumption. The most sustainable energy is the energy you do not consume.
+ If you consume energy, then consume sustainable (renewable) energy.
+ If sustainable energy is insufficient, then use fossil fuels economically.

Because they only consume few fossil raw materials, plastics are not the cause of our energy problems. On the contrary, they constitute an important part of the solution. Plastics are one of the few applications of petroleum that enable energy consumption to be reduced, and this scarce raw material to be used sustainably.

Often plastics even form the only viable solution for reducing the use of oil, natural gas and coal.

Thanks to their light weight, considerable freedom of design and insulating properties, plastics contribute to the more economical use of raw materials and energy.

+ Thanks to the low melting temperature, energy is saved when forming the products.
+ Many thermal insulation materials are manufactured from plastics:
  - For buildings: insulation foams, sandwich panels, insulating window profiles, multi-walled panels, etc.
  - In the cold chain: refrigerating installations, refrigerated transport and packaging.
  - In thermal production processes and with the recovery of heat.
+ Thanks to the weight reduction, vehicles (cars, electric vehicles, TGV, aircraft and transport containers) use less energy.
+ Lighter packaging, lighter cases, etc. Weight reduction in transport results in less fuel consumption.
+ Less maintenance and longer lifetime of building materials, car components and household articles.

Plastics do not need much energy for their production, while they still deliver a high performance and yield only a minimum of waste.

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1 Responsible Care originally related to health, safety and protection of the environment and properties. Later it was extended to users and end products.

2 More info on www.triasenergetica.com

3 How plastics contribute to less energy consumption can be seen on www.youtube.com/watch?v=82-Yz8MbxAo.
Carbon dioxide or CO\(_2\) seems to be the number one enemy of the 21st century. However, CO\(_2\) reduction really means the reduction of greenhouse gases. These are gases in the atmosphere that increase the greenhouse effect. Without greenhouse gases the average temperature on earth would be a few tens of degrees Celsius below zero. Thus not habitable. Too many greenhouse gases can raise the temperature on earth such that the climate becomes too hot for man. It is thus a question of preserving a balance. This is why the proportions of greenhouse gases in the atmosphere are calculated.

In addition to man, nature also produces greenhouse gases. Biologists and chemists are attempting to chart their share, but this is a complex matter because there are many types of greenhouse gases, and polyatomic gases contribute more to the greenhouse effect than monatomic gases. In order to make everything comparable, the contribution is expressed in CO\(_2\) equivalents. Thus, by definition carbon dioxide (CO\(_2\)) has a CO\(_2\) equivalent of 1. Gases such as argon (Ar) and nitrogen (N\(_2\)) cannot absorb heat radiation from the sun and thus do not contribute to the greenhouse effect. Water vapour (H\(_2\)O) and ozone (O\(_3\)) do indeed. Methane (CH\(_4\)) consists of even more atoms than CO\(_2\) and thus contributes more strongly than CO\(_2\) for example. Methane has a CO\(_2\) equivalent of 23 and thus contributes to the greenhouse effect 23 times more than the CO\(_2\).

Despite Kyoto the emissions of greenhouse gases are evolving in the wrong direction. Only in 2005 did we see a fall in Belgium of 2% compared to 1990\(^{3}\), while by 2012 our country is aiming for a reduction of 7.5%. We are thus far from the right Kyoto track. This is primarily because the increased CO\(_2\) emissions are only partially offset by a drastic reduction of other greenhouse gases.

Certain sectors, industry at the front, have scaled back their CO\(_2\) emissions in Belgium. Others such as transport, and also the residential sector and services, in fact emit more CO\(_2\). Today they form the basis of the ‘Kyoto gap’.

For example, the production of raw materials since 2007 the western chemical industry has emitted 60% fewer greenhouse gases per tonne of material produced than in 1970.

The well-known McKinsey\(^1\) consultancy did a study that was checked by the German Oko Institute\(^3\). McKinsey calculated the contribution of the chemical industry to the possible savings in emissions, as recommended by the IPPC\(^4\). The study shows the strategic role that insulation products play in combating CO\(_2\) emissions. They are followed by crop protection products, lighting applications and plastics in packaging and pipes.

Plastics save hundreds of times more CO\(_2\) than is needed to produce them. In order to keep the heat generated inside and thus to reduce CO\(_2\) emissions, the use of plastics can make an enormous difference. For every tonne of carbon dioxide emitted in the production of plastic insulation materials, over the entire lifecycle of insulation materials a good 233 tonnes of carbon dioxide are saved.

In total, according to McKinsey, for every tonne of CO\(_2\) that plastics emit during their production, 2.6 tonnes of CO\(_2\) are saved during their lifetime. This figure can increase to 4.5 tonnes of CO\(_2\) if investments are made in further plastics innovation.

For buildings, CO\(_2\) emissions are inextricably linked to the heating of them. The only solution is to reduce the heating.

Insulation products play a strategic role in combating CO\(_2\) emissions.

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1. Carbon dioxide is a colourless and odourless gas that occurs in the atmosphere.
2. The share of greenhouse gases in the atmosphere is today estimated to be 0.04% in the troposphere.
3. In 2008 the chemical sector invested 27% of the total investments made by the Belgian processing industries. Chemistry sets aside 4% of its turnover for investments in Belgium the average for this is 2.6%.
5. More info on www.oko.de
6. The IPPC, the Intergovernmental Panel on Climate Change, works with the United Nations Framework Convention on Climate Change (UNFCCC).
Today some subsidies are allocated on the basis of the material type. As a result, the one building material is given a subsidy and the other not. However, building materials only make a small contribution to the 20/20/20 objectives.

The plastics sector shares the view of Europe. They argue for subsidies not to be granted on the basis of sustainability on a material level, but on a building level. A sustainable building is not only based on the energy savings that can be realised during the production of the building materials, but also during the usage phase and the end-of-life phase of the materials. At the same time a sustainable building takes account of the scarcity and transport costs of materials, aims for a compact design and an ideal orientation, and targets the most efficient possible energy consumption by its occupiers, is sufficiently flexible to change its function over its long lifetime, and ensures sustainable accessibility via public transport.

Instead of replacing windows and doors with wooden windows and doors and granting subsidies for this new joinery, it would be better to grant subsidies for the window profiles + glass. By switching from double glazing to high-efficiency glass, the energy saving realised is as much as 17 times greater than the energy saving from the substitution of the material type of the joinery. As a result, property developers and the environment get a lasting economic and ecological benefit.

The transport sector also benefits from more plastics. Today transport causes 20% of all greenhouse gases and 25% of CO2 emissions in Belgium. Plastics make vehicles lighter such that aircraft, for example, consume up to 20% less fuel, and cars emit 120 million tonnes less CO2 per year.

But the principle of the Energy Triangle also applies here. The most sustainable journey is the one that you do not take. If you nevertheless have to, then use a sustainable means of transport. And for that use renewable energy as much as possible.

Plastic bottles are many times lighter than glass bottles, and require much less energy for their transport. Light but strong plastics ensure that cars use up to one tenth less fuel and emit less CO2. The most innovative vehicles are using more and more plastic. Thus plastics are making an enormous contribution to reducing CO2 emissions.

The Solar Impulse is often considered as a futuristic aircraft, but it is much more than that. After Bertrand Piccard and Brian Jones flew around the world in their Breitling Orbiter balloon in 1999, 40 kg of liquid propane was left over from the 3.7 tonnes that they took with them.

Bertrand Piccard undertook to go around the world again, but this time without using any fuel. ‘Impossible’, everyone said. However, Bertrand Piccard comes from a family of inventors. His reply: ‘All that is impossible, remains to be achieved’, thus quoting Jules Verne.

Together with his team he devised the Solar Impulse, a technological marvel powered entirely by solar energy thanks to the 12,000 solar cells - based on polymer technology - secured to the wings. This single-seater aircraft has a wingspan of 63.4 metres, comparable to an Airbus 340. By predominantly using composite materials, the Solar Impulse weighed a mere 3,600 kg, similar to a small car. The four motors consume only 8 kilowatts (10.88 hp).

On 6 July 2010 Solar Impulse proved that it was possible to continue flying above the clouds day and night using only solar power, and without having to refuel. The solar energy absorbed during the day is partly stored in batteries to power the aircraft at night.

The Solar Impulse is an example of how an open spirit can show the way to greater sustainability.

More info on www.solarimpulse.com
The share of renewable energy must increase to 20%. This can be done by making more use of renewable energy sources, such as photovoltaic cells, biomass, combined heat and power (CHP) and wind power.

Plastics are used on a large scale in environmentally-friendly technologies such as:

+ Wind turbines (blades of composite materials)
+ Photovoltaic panels (films, transparent panels, frames)
+ Flexible organic solar cells on a film base
+ Batteries and fuel cells for the storage and utilisation of renewable energy
+ Breeder reactors for oil from algae
+ Barrier films for recovering gas from dumps and fermentation installations

In this way plastics help to save fossil fuels.
In western Europe the plastics industry represents 1.1 million employees who work in 30,000 companies. Together these companies invest 700 million euros per year in R&D. They make an important contribution to our knowledge society, our prosperity and employment. Their total production fluctuates around 65 million tonnes of plastic per year.

In Belgium the plastics industry comprises 306 companies and around 34,000 employees. Together they realise a turnover of 16 billion euros. In 2009 their export share exceeded 8 billion euros. As a result the Belgian plastics industry makes the most important contribution to the balance of trade of our country.

Belgium processes the most plastic per capita in the whole of Europe: 180 kg per capita per year. This does not mean that Belgium is also the largest consumer of plastics. The bulk of the processed plastic products are exported. Precisely because of that, plastics feed the coffers of our government.

Each year around 47 million tonnes of plastics are processed in Europe. In absolute figures Germany is the pre-eminent plastics country, followed by Italy, France, Spain and the United Kingdom. The Netherlands too are also ahead of Belgium. Thus Belgium is lagging behind the example set by the most ecological countries in Europe.

In order to safeguard the growth of the plastics industry in Belgium, the sector is working with the government to make more efforts in training and innovation.

Moreover, the plastics industry offers many opportunities to make an important contribution to a more sustainable economy by saving raw materials and energy.

* According to estimates, worldwide 300 million tonnes of plastics are produced per year.
Plastics are an important component of construction in Belgium. Moreover, their share is increasing every year. In 2006, Belgian plastics in construction were good for a turnover of 2 billion euros. This turnover was realised by more than 5,000 employees.

The increasing proportion of plastics in construction is a result of stricter European legislation. As of 2020, Europe will require Nearly Zero Energy Constructions. We cannot achieve this with the current building methods.

Up until now, a tightening of the E-level has been achievable by careful implementation. We can only meet the future European requirements through new building methods, technologies and building materials.

That is why the plastics sector stresses the great importance of continuing to stimulate product and process innovation.

The sector is already taking initiatives to bring various companies together so that building materials are better harmonised to one another, and even more energy-friendly building components can be produced.

The plastics federation organises various training courses together with its members, and also distributes up-to-date reliable information to architects, policymakers and property developers. In a highly innovative sector, the information is continually changing.

Unfortunately, all too often plastics are assessed on the basis of obsolete data. As new plastics are being produced every day, in order to continue satisfying the needs of our society, there is no point in using data older than 10 years for plastics. Alas, search engines such as Google also contain old and obsolete data alongside correct information.

The properties of many building materials have barely changed, if at all, over the last decades. Plastics are an exception to this.

In the meantime, new plastic clusters have been started in Europe in anticipation of the innovation wave. For example, in Poland there is the new cluster in Tarnow, in Spain the one in San Rogue, and in Germany the new ValuePark in Böhlen. All these European member states are investing in the markets of tomorrow. If Belgium wants to guarantee its employment in the industry, our country must act quickly.
An important part of assessing sustainability is the impact on society.

Worldwide we are facing a population explosion that is coupled with demographic changes. In 2030 how can around 9 billion people — whose life expectancy in developed countries is continually rising — be fed and supplied with drinking water and energy?

In the course of our history our society has built up a certain prosperity. Maintaining this prosperity not only requires the use of materials in the most sustainable way, but also the most sustainable techniques. The generation after us will not have the same quantity of available energy that we had in our youth. The energy needs will thus have to be satisfied in a different way. Plastics play a crucial role in making technologies available to a large number of people. Just think of electricity, water, mobile phones, computers (mainframes and laptops), and also insulation materials, solar panels, wind turbines, etc.

For developing countries it primarily comes down to building up prosperity as quickly as possible, without having to go through the entire learning process of western countries. They must make use of the most sustainable techniques available in their region as quickly as possible. Every industrialisation process also has an impact on the climate beyond national borders. Working on a smooth transition outside our national borders will be the challenge of the coming decades. Hence innovation within our own region must be encouraged more strongly.

1 Because cars are lighter and more advanced nowadays, they can cover the same distance with less energy. This is by no means an impoverishment with respect to the past.
03.3.1 / PLASTICS IN GENERAL

**FOOD**

We do not often consider that plastic packaging substantially extends the lifetime of foodstuffs. Due to a lack of suitable packaging in developing countries, up to half of the foodstuffs produced are wasted. In developing countries, this percentage has been reduced to 2%.

Also crop protection products and herbicides, more efficient water management and irrigation systems, the ensilage of fodder crops with agricultural sheeting and the storage of food crops are examples of the contribution that plastics can make to greater prosperity and comfort.

**EMERGENCY SERVICES**

Medical services, civil defence, the fire brigade or police intervention, are possible today thanks to the multiple use of plastics. Material, personal equipment and pesticides are generally made of plastic. As a result, plastics have saved many human lives.

**HEALTHCARE**

Children are sometimes saved at a young age by the healing effects of medicines, an injection, etc. Also catheters, infusion bags, lenses, artificial limbs and artificial hearts mean the difference between life and death for many.

Thanks to biocompatible polymers it is possible to conduct a regenerative operation on bones and tendons, or microprobes can be inserted in the body— with only a small risk of rejection symptoms afterwards.

**TRANSPORT**

The crumple zones of cars, airbags, car seats for children, crash helmets for bicycle, moped and motorbike riders, protective clothing for sportsmen and road users, etc., increase our safety. Public transport also increasingly consists of plastic.
03.3.2 / PLASTICS IN CONSTRUCTION

The plastics sector is the pre-eminent sector that has made the most changes and innovations over the past decades. They go from floor heating and separate sewer systems to energy-saving insulating layers, structural glazing, underroof membranes, vapour barriers, airtight construction sheets, green roofs, photovoltaic cells, heat pumps, concrete core activation, and non-piercing fastening techniques.

In the light of the European 20/20/20 objectives, plastics producers are now advocating innovative building technologies and building materials. The sector is asking policymakers to help stimulate innovation. Only in this way can the plastics sector succeed in developing suitable solutions for the challenges.

The plastics sector also argues that subsidies should not be material dependent, but performance dependent on a building level.

The use of more insulation products1 (in the roof, wall and floor) in combination with an airtight building shell and well dimensioned ventilation will make houses affordable for everyone tomorrow. Due to increasing energy prices, the number of households that are facing energy poverty is increasing. Plastic joinery combines excellent insulation with a sustainable material and an affordable price. It is thus possible for many households to have their current joinery replaced by insulating joinery.

Plastic roof membranes have completely changed the functions of roofs. From waterproofing, roofs have developed at high speed into a fifth facade that produces energy, buffers water and removes fine dust from the air. This places new requirements on roofs, and ensures that owners can be increasingly energy independent. This aim for energy independence will only increase in the future. Roof membranes are already meeting this expectation by studying leasing concepts whereby property developers do not have to pay the entire sum immediately, but can enjoy the benefits via a leasing concept.

Adhesives and sealants are often considered as not very sustainable solutions. Thanks to new bonding/debonding technologies they have become recyclable. As a result the technology is not only gaining in sustainability, but in time they will be increasingly accepted by property developers, such that they will be used more.

Non-piercing fixings form a technology of the future. Today more than half of the fixings are piercing. The concept of the near zero energy house in 2020 is based on an absolutely airtight building shell. An opening the size of a hand is enough to fall short of the set 0 level. However, many hundreds of holes must either be integrated in a new building concept (cable cavity) or sealed on site (difficult and intensive work), or be replaced by non-piercing fixings. These last mentioned have proven their soundness for more than 40 years.

Finally in construction we must ensure that the proportion of building materials from our own region does not fall any further. Traditionally 80% of building materials came from our own country and 20% were imported.

Since the introduction of the concept of ‘sustainability’ the proportion of building materials from our own region has fallen to 70%. Thus 10% more building materials are imported. Because the transport distance is not always taken into account, this results in a competitive disadvantage for our Belgian industry, such that in time jobs could be lost. After all, our industry must satisfy the legislation of the regions - which is one of the strictest in Europe - while imported products are allowed in under European legislation. This difference makes it impossible for the plastics industry to make its efforts in the area of sustainability demonstrable. We also endeavour to illuminate this fact with this book.

1 The current trend is increasingly clearly in the direction of high-efficiency glazing. The U value of triple glazing is between 0.4 and 0.6 W/m²K. For near zero energy houses, the target for 2020 is a U value for walls of around 0.15 W/m²K.

1 Sustainability in the narrow sense, in other words only looking at a material level and also sometimes limited to the production phase.
04/

BIOPLASTICS
‘Plastics are not bound to raw materials. Previously they were based on coal, then petrochemicals. Will it soon be biopolymers?’

‘Bio-based’ refers to the natural raw materials from which a plastic is made.

‘Biodegradable’ on the other hand refers to a property of the polymer itself, i.e. that after use it can be broken down as a result of hydrolysis processes for example.

Some biodegradable polymers are bio-based and vice versa, but there are many more examples where there is no link between the two. Polyethylene for example, one of the most used plastics in the world, is not biodegradable but can be made from bio-based raw materials. Polyethylene is manufactured from ethylene, a petroleum derivative. Now there are also processes on the market that extract ethylene from ethanol, a glucose derivative.

Biodegradable polymers are frequently defined as industrial products which, when disposed of, are broken down by bacteria or other biological agents. This is insufficient as a definition. The time needed for it to break down, as well as the place of break down and the total environmental impact all have to be taken into account.

At the end of the lifecycle of a biodegradable polymer there are two possibilities, depending on the class to which the polymer belongs. There are polymers of a natural origin, polymers made by microorganisms, a third type manufactured from biotechnological processes, and polymers based on petrochemical products. For certain classes there is a compostable route so as to recuperate energy. The CO2 formed can then be converted back into raw materials by photosynthesis.

Currently the most successful bio-based plastic of a natural origin is polylactic acid. Polylactic acid, although biodegradable, lacks other physical properties. Hence the petrochemical sector also makes plastics that are biodegradable, such as polypropylene, polyethylene, and polyethylene terephthalate.

Are biopolymers the future?

In the next few years an increase is expected, but worldwide the production capacity is currently flattening out, partly as a result of the low availability of the raw materials. Currently the production capacity is around 0.5% of all plastics. Over the next few years this will develop to around 1.5% but it will certainly not be the case that the bulk of plastics are replaced by biopolymers. In any case the question is whether it is so pressing, as all in all the fraction of petroleum needed to produce plastics is relatively modest. Of all the petroleum, only 4% goes into the 300 million tonnes of plastics produced annually. If you want to do something to reduce the quantity of petroleum, in the first place savings must be made in the heating and transport sectors.”

PROF. FILIP DU PREZ – Polymer Chemistry Research Group, University of Ghent.
Over the last few decades biochemistry has been responsible for an increasing share of the production of plastics. In view of the future scarcity of petroleum there are increasing numbers of projects to study how biochemistry can help preserve our prosperity.

In Tessenderlo there is the second-largest installation in the world that produces new bio-oil products from biomass. This is done by a pyrolysis process. Every year around 20,000 tonnes are processed here.

In Ghent/Terneuzen there is Europe’s largest cluster of biofuels that start with renewable vegetable raw materials such as sugar, potatoes and sweet corn. With a capacity of 1200 ktonnes this cluster is larger than similar clusters in Rotterdam or Hamburg. The glycerol produced here lies at the basis of the manufacture of some bio-plastics. Labs from the University of Ghent and the Catholic University of Leuven are working hard on optimising these processes.

Bio-based plastics are thus emerging in abundance. Examples of known plastics that can be made entirely or partially from renewable raw materials are certain types of polyethylene (PE), polypropylene (PP), PVC, nylons, polyesters and meltable rubbers.

What are biodegradable polymers?

Biodegradable polymers are products based on a polymer material that:

+ Maintain the same performance during their usage as ordinary plastics
+ After use break down into low molecular weight components through the action of biological and/or chemical/physical stimuli (light, water, oxygen) in the environment.
+ Finally break down into CO2 and/or CH4, H2O and biomass at similar speeds and conversions as other degradable materials, and which do not leave behind any toxic or permanent residues.

AIM Magazine, Vol. 55, suppl. 1, 2003, p. 66-711

The industry is working hard to first make the bio-component equivalent to the fractions of materials currently withdrawn. Thus a balance can be struck between the production of new plastics and the removal of them through energy recovery. Thanks to an increasing recycling percentage this equilibrium is becoming increasingly feasible.

However, the incineration of plastics with energy recovery must be further reduced in the favour of recycling. Belgium, which is often called the leading country in plastics recycling, is currently innovating hard to recycle plastics into fully-fledged raw materials.

This requires the further development of separation techniques for mixed closed circuits.

Other techniques are also being examined, such as self-healing polymers. Such polymers can repair their own chemical bonds, so that the lifetime and area of application can be substantially increased.

It will be a combination of innovation and hard work that will transform the plastics sector into a cradle-to-cradle building material. As to when this will be achieved will largely depend on the user and policymaker.

As always in Belgium, a consensus forms the basis for this.
In general the awareness is growing that sustainability in construction must be evaluated on a building level. To this end the social, ecological and economic impact of a building must be taken into account. At the same time every material (regrowable, recyclable, etc) must meet the same strict technical requirements and be able to present the necessary guarantees for this.

Plastics distinguish themselves with regard to sustainability in many respects:

- Plastics use petroleum but they do not exhaust it. Barely 4% of all petroleum today is used as a long-term raw material for plastics.

- Plastics are not necessarily made from petroleum. Hydrocarbons are being increasingly extracted from natural gas and biomass. Other alternative raw materials for plastics are starch, cellulose, sugars, lactic acid, organic waste, vegetable oils, microorganisms and algae.

- Plastics make integral water management possible. From infiltration systems to drainpipes and rainwater tanks, plastics offer all possible systems for a sustainable water policy.

- Plastics are increasingly being reused as plastics. In 2011 36% of postconsumer plastic waste was recycled in Belgium. Belgium is the European leader in this respect.

- Thanks to the optimisation of their unique properties (barrier function, design freedom, insulation and acoustic properties, recyclability, etc) plastics help save natural raw materials and consume less energy.

- Plastics have a long lifetime. Plastic pipes for water pipes have a lifetime of at least 100 years, plastic joinery lasts at least 50 years. Over the last 15 years the lifetime of PVC roof coverings has increased by 50%.

- Plastics offer lightweight solutions for structures. With renovations, buildings are often demolished because the structure cannot handle the additional load needed to meet the current insulation requirements, for example. As a result valuable heritage is being lost. Plastics can play an important role in this respect.

- Plastics lie at the basis of renewable energy. Plastics are essential for the blades of wind turbines, solar panels, fuel cells, breeder reactors for oil extraction from algae, etc.

- Plastics are increasingly using fewer materials. Thanks to plastics, applications can be ‘miniaturnised’. Just think of computers, cooling installations, communications equipment and the thermal breaks in metal and wooden profiles.

- Plastics form the basis for optimised building components. The sector is encouraging plastics producers to get together with other companies, in order to optimally harmonise the materials for a building element. Successful initiatives are the ‘massively passive’ house and Isofinish, for example.

- Replacing plastics is undesirable. According to the Denkstatt report (2010) plastics have the greatest potential for reducing CO2. For every tonne of CO2 produced, over their usage and end-of-life phase plastics save on average 4 to 8 tonnes of CO2. This figure can be further improved to 9 to 15 tonnes.

- Plastics save nature. Plastics manufactured in our country today do not contain any CFCs or HCFCs and are also free of heavy metals such as cadmium or lead.

If the Earth is the building in which we all have to live, if we want to leave a truly sustainable Earth for our children, the challenge is not only to implement Brundtland’s sustainability in our society, but also to transfer its technological foundations beyond our national borders.

This requires a complete change of attitude, including the use of biopolymers for plastics instead of for fuels. In this way oil reserves will last longer and we can anticipate the challenges of tomorrow.

Technologically supporting such changes of attitude will enable us to provide a general answer to questions of sustainability.

Sustainable building with plastics? Naturally!
USEFUL LINKS

- Agoria, vector federation for the technological industry in Belgium (http://www.agoria.be)
- BREAG (United Kingdom) (http://www.breag.org)
- BWA: Bitumen Waterproofing Association (http://www.bwa-europe.com)
- CEN TC 350 Sustainability of Construction Works (http://www.cen.eu/cen/Sectors/TechnicalCommitteesWorkshops/CENTechnicalCommittees/Pages/PdfDisplay.aspx)
- Clean Site System: recycling of building material packaging on site (http://www.cleansitesystem.be)
- Denkilli study: substitution of plastics by other materials (http://www.federplast.be/downloads/)
- DETIC: Belgian-Luxembourg association of producers and distributors of cosmetics, detergents, maintenance products, adhesives and mastics, brodies, related products and products packaged in spray cans (http://www.detic.be)
- DGNB (Deutshe Gesellschaft für Nachhaltiges Bauen) (www.dgnb.de)
- EPPA: European PVC Window Profile and related Building Products Association (http://www.eppa-profiles.org)
- Essencia, Belgian Federation of the Chemical Industry and Life Sciences (http://www.essencia.be)
- ESIWA: European Single Ply Waterproofing Association (http://www.esiwa.be)
- EUWIPS: European Manufacturers of EPS (http://www.euwips.org)
- EuPC: European Plastics Converters (http://www.plasticsconverters.eu)
- Exiba: European XPS associations (http://www.exiba.org)
- Febelauto: processing car wrecks (http://www.febelauto.be)
- Federplast.be, association of producers of plastic and rubber articles (http://www.federplast.be)
- FEICA: Association of European Adhesives and Sealants (http://www.feica.org)
- FootPlus: recycling of household packaging waste (http://www.footplus.be)
- HQE (Association pour la Haute Qualité Environnementale des Bâtiments - France) (http://www.asshehp.org)
- ISO organisation (international organization for standardisation) (http://www.iso.org/iso/home.html)
- Kort / Emio: Belgian manufacturers of plastic piping systems (http://www.kort.be)
- LEED Leadership in Energy and Environmental Design - United States of America (http://www.usgbc.org/leed)
- LCA analyses of PVC (http://www.pvc.org)
- Our common future, 1987 (LEED report issued under the chairwomanship of Gro Harlem Brundtland) (http://www.un-documents.net/weod-of.htm)
- Plastics are too valuable to throw away (http://www.youtube.com/watch?v=1-zP3lMxW4k)
- Plastics help to protect the planet (http://www.youtube.com/watch?v=QV1k4uItmJ&feature=related)
- Plastics Europe: West European Plastic Manufacturing Industry (http://www.plastics-europe.org)
- PU-Europe: European PUR insulation industry (http://www.pu-europe.eu)
- Recycling: collection of PVC waste from the construction and demolition sector (http://www.recoupl.com)
- Recycling: producers and importers of electrical and electronic equipment (http://www.recupe.be)
- Responsible Care, voluntary worldwide initiative of the chemical industry for the continual improvement of performance with regard to health, safety and the environment (http://www.rac.org/research/ResponsibleCare)
- Solar Impulse: flying without fossil fuels (http://www.solarimpulse.com)
- Stylabel: Belgian association of manufacturers of expanded poly styrene (http://www.stylabel.be)
- TEPFPA: European Plastic Pipes and Fittings Association (http://www.tepfpa.org)
- Val-I-Pac: business packaging waste (http://www.valipac.be)
- Vinyl 2020: voluntary undertaking to increase the sustainability of PVC production (http://www.vinyl2020.org) now continued as Vinyl Plus.
SOURCE ACKNOWLEDGEMENTS

Page 5
- The World in 2030 (Ray Hammond)
- Our common future (Gro Harlem Brundtland)

Page 13
- CEN TC 150, sustainability of construction works
- ISO organisation

Page 15
- EC DG Enterprise Taskforce

Page 22 - 28
- Plastics Europe
- Federplast be
- Essenscia

Page 31 - 74 (Chapter 2.4)
- Building Sector Commission

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- Plastics Europe
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- Building Sector Commission

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