



PVCu Products
Investing for the future



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Anglian Building Products Environmental & Recycled Initiatives PVCu Products





Recycling and careful waste management will help reduce CO₂ emissions which are a major cause of acid rain.

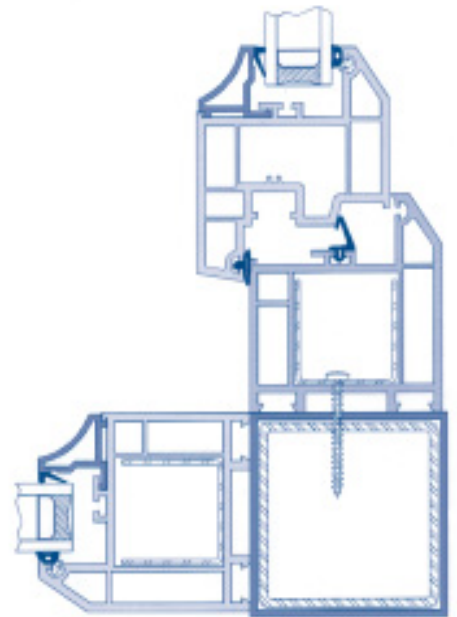
Anglian Building Products

Anglian Building Products, a division of Anglian Windows, Britain's largest manufacturers and installers of PVCu windows, doors and conservatories, are successfully delivering new standards of service and product performance in both public and private sectors.

With over 25 years' experience, Anglian's prominence reflects a unique ability to meet the diverse challenges of major refurbishment projects and new build developments.

Anglian Windows Ltd is vertically integrated, enabling total quality control of all processes; from initial contact through estimating, design, extrusion manufacture, fabrication, glazing, installation, technical support and recycling, and as a consequence occupies a unique position in the market place.

Anglian's extensive, fully accredited products are the unequalled brand leader in UK markets. Over 31 million metres of PVCu section are extruded each year together with more than one and a half million glass sealed units produced, this equates to three quarters of a million doors and windows fabricated and supplied every year. Anglian's manufacturing facilities have the largest capacity in the UK with the most modern glass toughening facility in Europe.



Why Select PVCu?

The PVCu used by Anglian is a high performance material specially formulated to meet the stringent requirements necessary to deliver long-lasting performance. Anglian believes that real environmental, technical and economic benefits arise from the use of PVCu compared to other materials.

Anglian chooses to use PVCu because after many years of experience, including experience of alternatives such as timber or aluminium composites, it believes that PVCu has the best combination of properties for cost effective glazing framing in the U.K.

PVCu is extremely tough, it possesses good inherent fire resistance, with excellent durability, low thermal conductivity, exceptional design flexibility, it is easy to recycle, and enables reliable, high quality windows to be fabricated.

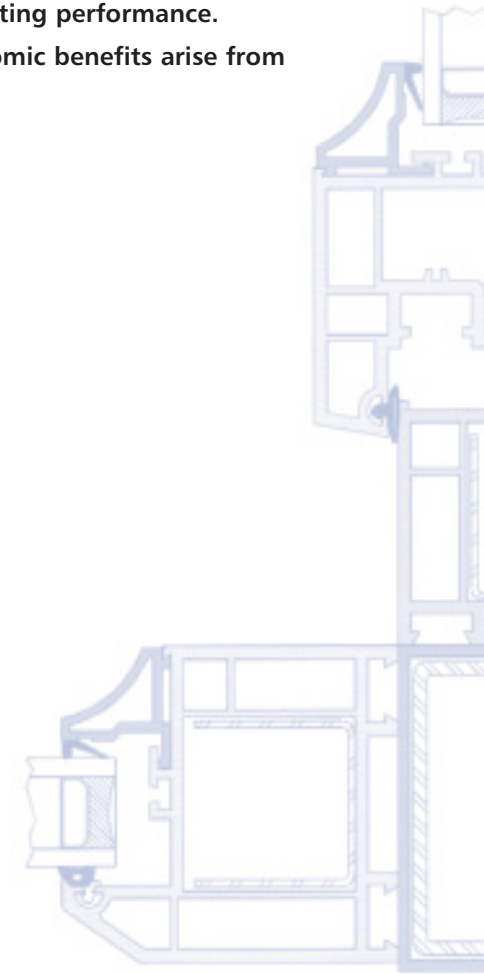
With any material comparisons there will always be a need to take a balanced view of all the properties and environmental characteristics. A summary of these relative benefits is presented in appendix 1.

It is the opinion of the Anglian organisation that windows and

doors manufactured from PVCu represent the best balance of these properties. This view is supported by recent research that looks at both the economic and environmental issues *together*.¹

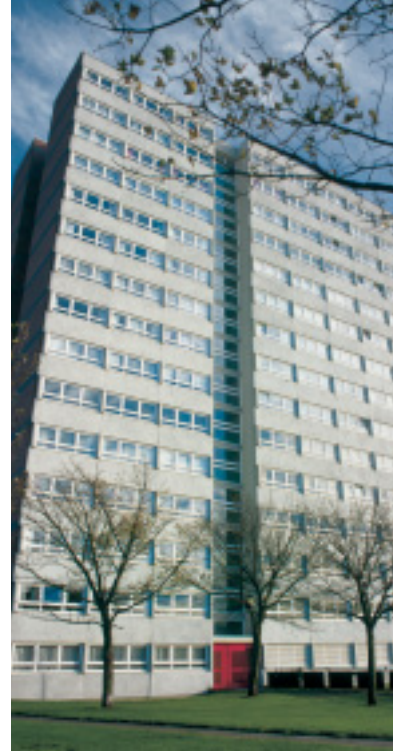
Furthermore when the PVCu life cycle is managed in an responsible manner and end life products are recycled, ecological burdens are comparable with any alternative joinery system.^{2,3}

Anglian Building Products recommendation of PVCu represents a commitment to a consistent, quality framing material which has been continually developed to meet modern performance requirements embodied in British Standards, BS 7412⁴, and BS 7413.⁵ These PVCu standards together with security requirements defined in BS 7950⁶ and PAS 24⁷ attest to the highest level of performance possible with modern PVCu products.



Amphibious creatures are particularly vulnerable to the earth's pollution levels and the toxicity of the land. Anglian have led the way in the elimination of process waste landfill.





- ¹ E.J. Spindler, "Combined assessment of ecological and economical properties a step towards measuring sustainability", PVC 2002 Towards a Sustainable Future, conference papers, IOM, London, 2002, pp 353-360.
- ² L. Flanagan, "Identification & Reduction of the Environmental Impacts associated with the Life Cycle assessment of PVCu Extrusions", PVC 2002 Towards a Sustainable Future, conference papers, IOM, London, 2002, pp. 365-372.
- ³ H. Krahling, "Life cycle assessments of PVCu products: Green guides to ecological sustainability". LCA Documents. Vol. 6 1999. Eco-Informa Press, Bayreuth, Germany. ISBN 3-928379-58-5.
- ⁴ BSI, "BS 7412:2002 Plastics windows made from unplasticized polyvinyl chloride (PVC-U) extruded hollow profiles-specification", 2002.
- ⁵ BSI, "BS7413:2002 Unplasticized polyvinyl chloride (PVC-U) profiles for windows and doors-specification", 2002.
- ⁶ BSI, "BS7950:1997 Specification for enhanced security performance of casements, tilt/turn windows for domestic applications", 1997.
- ⁷ BSI, "BS PAS 24-1:1999 Enhanced security performance requirements for door assemblies", 1999.

PVCu – A Controversial Material

Environmental campaigners since the 1970s have tried to suggest that PVCu is an environmentally damaging material. Some of these criticisms were valid, and in the early 1980s this was recognised.

The response of the PVC industry was to set out a series of Voluntary Commitments that seek to tackle the key environmental issues. These commitments are now externally verified and embodied in a legal structure, "Vinyl 2010".⁸

Some of the key points include

- A charter for the production of PVC & Vinyl Chloride Monomer in order to reduce or prevent emissions in the air, water and land.

- A timetable for the phase out of heavy metals for use as stabilisers in PVCu.
- A timetable for the setting up of Post Consumer Window recycling across Europe.
- Substantial investment in mixed PVC waste using feed stock recovery and dissolution precipitation recovery process.

Anglian fully supports "Vinyl 2010" and is actively committed to improving the sustainability of

PVCu materials. A second report detailing progress towards the commitments has been issued in March 2002, entitled, "A Progress Report 2002"⁹

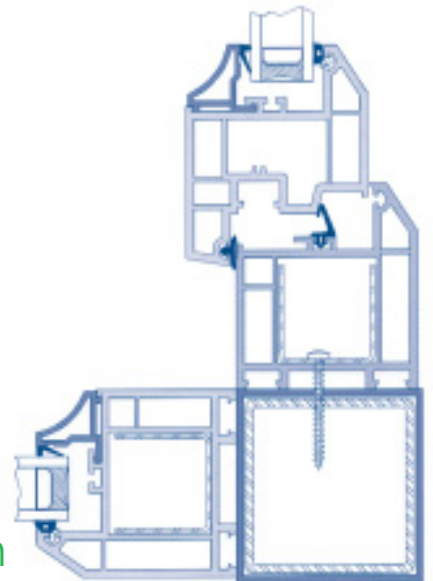
This document is aimed at providing clear and concise facts about PVCu and its use in windows and doors, instead of conjecture and hear-say. To address some of the common misconceptions regarding PVC a summary of environmental facts regarding PVC and Anglian is presented in appendix 2.



⁸ Vinyl 2010, "The Voluntary Commitment of the PVC Industry", <http://www.ecvm.org/hp.cfm>, 25 Oct 2001.

⁹ Vinyl 2010, "A Progress Report 2002", <http://www.ecvm.org/hp.cfm>, March 2002.

PVCu – Life Cycle Stewardship with Anglian



All material usage will have some impact on the environment and it is just as significant to consider how materials are managed through their life cycle as it is in deciding which materials should be used. This concept is explained more fully in the publication of the Natural Step, “PVC & Sustainability”.¹⁰ This publication was sponsored by the Environment Agency and seeks to create a vision of a sustainable future. It outlines a rigorous set of requirements in terms of four System Conditions. Each of these conditions requires closed loop recycling to improve the sustainability of PVCu.

Anglian believes that its vertical integration and control of the extrusion process through to installation enables efficient closed loop systems to be developed. Since October 2001 Anglian has been collecting post use PVCu products in order to develop effective closed loop recycling techniques. This Anglian “ECOLOOP” system is in the process of being extended to all Anglian installation centres.

The TNO Report,
“Recommendations for a
European Window Recycling

Structure”¹¹ recognises that Anglian’s vertical structure offers one of the most efficient recycling structures for post consumer window re-use.

The “ECOLOOP” system involves the return of post use PVCu products to Norwich where they are manually disassembled and the PVCu, glass and reinforcement are recovered for recycling.

The recovered PVCu materials have been reprocessed and a number of evaluation programmes started. These are intended to characterise

the recycle to ensure it meets the latest requirements of BS 7413 and to evaluate different reprocessing options. These trials are summarised in section 7.0, Recycling PVCu.

¹⁰ The Natural Step, “PVC & Sustainability”, 2020 Vision Series No.2, 24/10/00, http://www.naturalstep.org.uk/2020_top.html

¹¹ H. D. Groot, A. Tucker, TNO, “Study into the feasibility of a European collection & recycling scheme of post-consumer PVC windows”, EPPA seminar, Brussels, 16/11/2001, Slide 12.

PVCu – A Durable and Proven Material

As others have commented PVCu window products owe their market dominance to the delivery of product benefits to new markets. These benefits have been based upon their expected service life, which can typically be 40 years, low maintenance characteristics and design flexibility. These factors have delivered reduced window replacement and maintenance costs.

Anglian's PVCu formulation, which is routinely tested by the BSI, is formulated and processed to provide a durable long life material. This material is designed to cope with extreme weather and climatic conditions, it will not warp, rot, peel or flake. Anglian's own test data indicates that the impact performance of PVCu products still meets current UK standards after 10 years weathering in the UK and 7 years exposure, to date, in Bandol, Southern France. Recent extended accelerated weathering studies have also confirmed that Anglian's formulation has exceptional resistance to surface deterioration due to UV exposure.

The combination of this durability with design flexibility has allowed for the production of finely detailed extrusions. This has led directly to improved glazing systems, more versatile hardware,

better weather-tightness through the use of high performance seals, and ultimately more reliable window fabrication.

Correctly designed PVCu window and door products are consequently low maintenance, draft free, watertight and energy efficient with good acoustic properties.

Indications from post use windows, which have been collected by Anglian, suggest that where PVCu products appear to be replaced this was invariably due to a seal or hardware failure. Other reasons for replacement include: the need to improve aesthetics, glazing, or security performance, rather than the failure of the PVCu.

The operation of closed loop recycling schemes is leading to an improved understanding of the causes of PVCu replacement. This in turn is helping to specify window designs for the future so that real gains in sustainability can be achieved.







Whole Life Costs of Windows and Doors

Life Cycle Costs for windows manufactured from PVCu, timber, and aluminium windows have been calculated by Prognos AG Basel.¹² They concluded that PVCu windows offered much lower economic costs than comparable products made from either timber or aluminium. Furthermore, if high efficiency Low U value glazing systems were employed, the life cycle costs are still lower than specified timber or aluminium products.

The recently published government document, "The Life Cycle Assessment of Polyvinyl Chloride and Alternatives"¹³ by the DETR (DEFRA), assessed and compared the life cycles and economic performance of PVCu and timber windows. It concluded that, "wood is a socially more costly product than PVC for the manufacture of windows".

A recent independent report¹⁴ by Entec for Manchester City Council found that, "over a 30 year life cycle, the net present value for wood profiles is 22% greater than



that for PVCu profiles, whether replacing 500 or 5,000 standard units per year". This means that the cost of buying, installing and maintaining a timber window over a thirty year period is 22% more expensive than a PVCu window of a similar design over the same time period.

A report by the BRE, Constructing the Future¹⁵, gave a life expectancy to PVCu windows and doors of 40 years. This working life avoids the need for more regular replacement or maintenance in homes and offices which significantly reduces the ongoing need for processing,

manufacturing, transporting, installing and maintaining associated with other materials.

The general conclusion from all these reports is that PVCu doors and windows offer lower capital & maintenance costs compared to similar products made from alternative materials.



Reducing energy consumption is a vital part of lowering CO₂ emissions. PVCu windows require relatively little energy to manufacture, but deliver significant everyday savings through their high levels of energy efficiency and long life.



¹² Prognos-AG, Basel, Deutscher Institutverlag Koln, (ISBN-Nr. 3-602-14485-2), 1999

¹³ DETR(DEFRA), "Life Cycle assessment of PVC and Alternatives", September 2000, pp119 .

¹⁴ Entec for Manchester City Council Window & Door Materials Assessment. "The Environmental & Financial life cycle costs of UPVC & Wood Windows". Sept 2001

¹⁵ BRE, "Constructing the Future", Report 1998.

Recycling PVCu

Claims that PVCu cannot be recycled are simply not true. PVCu has been effectively recycled at Anglian since the early 1980s. Some of the PVCu recyclate streams have been recycled at levels of 100% into new building products for over 15 years.

Process PVCu recyclate tends to arise in the form of either machine start-up, bar length or fabrication material. Anglian currently recycles all these materials, they are all returned to long-life building applications.

Examples include: Sill reinforcement sections made from 100% foamed glazing bead waste, glazing beads from 100% fabrication offcuts, cavity closure sections manufactured from Anglian fabrication process waste.

Window profiles can also contain a fixed percentage of high-grade recyclate as permitted by British Standard BS 7413. Anglian and its recycling partners have recently made significant investments to improve recyclate quality and enable this material to be reprocessed into window profiles which fully comply with BS 7413.

Last year, (YE 2001) over 2300 tonnes of PVCu were collected

and over 1500 tonnes was recycled back into window products by Anglian. Of the remainder not processed by ourselves at least 95% was recycled into long life building applications, e.g. pipe or conduit. i.e. virtually all collected available PVCu waste was reprocessed into long life applications.

Currently there are a number of projects underway which should increase the level of internal recycling to greater than 90%. Ultimately it is believed that 100% re-use should be achievable.

In the past the PVCu window industry has been criticised for not doing enough to recycle profiles after use by the consumer. This was the case simply because there was not enough PVCu being removed.

Anglian has conducted its own research recently and found that in a sample of over 2500

installations there is still only 5% being removed. This agrees with other European studies, over 75% of the products being replaced by PVCu were timber. Again these figures demonstrate the exceptionally long service life of PVCu products.

However, consistent with Anglian's support of the Voluntary Commitment defined in "Vinyl 2010", several schemes to recycle post-use PVCu have been started.

Acid rain is a major problem for wildlife. Anglian is currently the only UK manufacturer to recycle PVCu products commercially.





Two schemes are in operation; one involves the collection and recycling of cellular foam installation off-cuts and the other the collection of post-use PVCu windows.

The post use window scheme was originally started as a pilot however it is now extended to all Anglian installation centres.

A number of successful trials have now been completed which have enabled the production of window framing profiles which meet the requirements of BS 7413. These profiles have made commercial windows that are in use today.

There is a need however to conduct further work to enable a thorough risk assessment of the use and performance of post consumer recyclate. Key issues that require more data include:

- The creation of a risk assessment for the safe use of post consumer recyclate that may contain heavy metals.
- A thorough understanding of the relationship between contamination level, recyclate concentration and mechanical properties.

Anglian will be tackling these issues in the years ahead however progress is being limited by the lack of post consumer material available at present.

The cellular foam off-cut scheme has been operating at selected locations since October 2001 and the collected waste recycled back into cellular foam products.



The Disposal of PVCu

Independent studies¹⁷ carried out in Sweden concluded that PVCu remains inert in landfill and there is no evidence to suggest that PVCu would be a source of any toxic substances under landfill conditions.

Small levels of process waste do currently arise at landfill. Anglian is working to reduce these to zero. Current quantities are estimated at less than 0.5%.

Post use/consumer PVCu window waste is tackled with the

collection of PVCu window and door products from Anglian installation centres nationwide.

Work is also ongoing to improve collection systems with respect to off-cuts and lower grade waste.

If PVCu is incinerated with domestic rubbish, investigations have shown that the presence of PVC does not increase dioxin formation. Furthermore, modern incinerator operation requires the scrubbing of flue gases, which will neutralise any hydrogen chloride that may be evolved during incineration.¹⁸



¹⁷ Mersiowsky, I., Rainer Stegman, I., Ejlertsson, J., Svensson, B., "The long term behaviour of PVC products under soil-buried and landfill conditions", 2nd Revised Edition July 1999.

¹⁸ EVC, "PVC the positive choice", pp33, July, 2000.

Toxicity and PVCu

PVCu formulations do require the use of advanced technology to increase the processing characteristics and durability of the material. This usually involves the addition of metal stabiliser compounds. Anglian has for the last ten years manufactured PVCu products using lead stabiliser technology. This has resulted in a proven material that has exceptional thermal stability and product durability. This is the only additive that is included in Anglian PVCu material which is regarded as toxic.

The major risk associated with the use of stabilisers comes in their manufacture and subsequent mixing of the raw PVCu materials. Once the compounds are blended they are significantly diluted and once extruded they are safely encapsulated in the PVC matrix at low concentration levels.

Suppliers using some of the most advanced and modern process plants in Europe produce lead compounds supplied to Anglian. They stringently monitor all personnel and local environments to ensure compliance with current legislation relating to lead exposure.

Anglian also monitors any employees who are likely to be exposed to lead hazards. Over the last 15 years this monitoring has not indicated any problems.

The Swedish Environmental Protection Agency in a recent press



statement confirmed that heavy metal stabilisers are, "firmly bonded into the PVCu material, and do not leach out". This conclusion was derived from an investigation into the stability of PVC in simulated landfill conditions.¹⁹

In line with Anglian's endorsement of the Vinyl 2010 Voluntary Commitment, Anglian are actively developing alternative lead free PVCu formulations utilising Calcium Zinc technology.

The presence of heavy metals in PVCu frame materials is not thought to present any significant additional short or medium term risk to human health in small or large scale fires.^{20, 21}

¹⁹ Mersiowsky, I., Rainer Stegman, I., Ejlertsson, J., Svensson, B., "The long term behaviour of PVC products under soil-buried and landfill conditions", 2nd Revised Edition July 1999.

²⁰ BSI, "Draft BS7982 Guidance on environmental impact of large scale fires involving plastics materials", pp 18-19, 3/11/00.

²¹ Hirsler, M. M., "Toxicity of the smoke from PVC materials: New concepts", Progress in Rubber & Plastics Technology, 10-2, 154-69, 1994.

Appendix 1

Table of Comparative Properties for Window & Door Framing Materials

<i>Material Property</i>	<i>PVCu</i>	<i>Timber</i>	<i>Aluminium/ Wood Composite</i>	<i>Wood Polymer Composite Extrusion</i>	<i>Other Plastic ABS + Capstock</i>
<i>Low Cost</i>	Excellent	Good	Moderate	No data	Poor
<i>Flexural strength</i>	Good	Good	Excellent	Moderate – poor	Good but needs reinforcement
<i>Weatherability Northern Europe</i>	Good but needs cleaning	Moderate requires correct and regular treatment	Moderate	Moderate dependant upon composition treatment & process	Excellent requires ASA capstock
<i>Low thermal conductivity</i>	Good	Good	Design dependant	Good	Good
<i>Colour matching</i>	Good but requires foil or co-extrusion	Good but requires regular treatment	Good but requires high volumes	Good but requires regular treatment	Moderate, capstock & design dependant
<i>Fire resistance</i>	Good – moderate with reinforcement	Moderate	Good	Moderate – poor	Moderate – poor
<i>Security</i>	Good	Moderate	Excellent	Moderate	No data
<i>Design flexibility & efficiency</i>	Excellent	Moderate	Good	Moderate	Moderate
<i>Dimensional stability with temperature</i>	Moderate	Moderate	Excellent	Moderate	Poor
<i>Dimensional stability with humidity</i>	Excellent	Poor	Excellent	Moderate	Excellent
<i>Ease of repair</i>	Moderate requires correct tools	Good	Poor	Moderate	Moderate
<i>Recyclability (Post Consumer)</i>	Good – moderate Post use/consumer recycling starting	No data on post use/consumer schemes	Good due to high value of aluminium	Good in theory	Moderate in theory

Appendix 2

Environmental Questions regarding PVCu Materials

Does PVCu contain phthalates (plasticizer)?	No
Do stabilisers in PVCu compounds represent a health hazard to the occupier?	No ²²
Do PVCu products in an incinerator contribute to greater levels of dioxins than timber products?	No ²³
Which window framing material produces the least quantity of dioxins over its life cycle?	PVC ²⁴
In a fire will the presence of PVCu products contribute to significantly greater risk to the occupier?	No ^{25, 26}
Do PVC products contribute to a special risk in fire situations in the opinion of insurance companies?	No ²⁷
Does the emission of HCL during a fire as a result of PVCu significantly increase risk to health?	No ²⁸
Which commodity plastic is least dependent on the consumption of oil?	PVC ²⁹
Which flexible material is the only one approved for the production of blood bags?	PVC ³⁰
Which framing material contributes to the lowest energy consumption in the use phase?	PVC ³¹
Did the recent DEFRA LCA study with respect to PVC windows consider the impact of post use recycling?	No
Does Anglian Windows collect & recycle post use windows?	Yes
Does Anglian Windows recycle all its PVCu waste internally?	No
Does Anglian Windows believe all its PVCu waste can be recycled?	Yes
How long has Anglian Windows been recycling PVCu materials?	Since 1985
Is there a theoretical limit to how many times PVCu materials can be recycled?	No
How many times has Anglian Windows successfully re-used the same PVCu material?	Four
Can PVCu containing heavy metal stabilisers be safely recycled?	Yes ³²

²² DETR (DEFRA), "Life Cycle assessment of PVC and Alternatives", September 2000, pp 126.

²³ APME, "Dioxin & Furan Emissions: Trials on a municipal solid waste incinerator, Wurzburg, Germany", 1994.

²⁴ Dr Ernst-Josef Spindler, Vinnolit, "Dioxin balance along life cycle of windows", March 2002.

²⁵ Fardell, Murrell and Rogowski, "The performance of UPVC and wood double glazed windows when installed in a life size compartment and exposed to wooden crib fires of varied growth rate and intensity", Fire Research Establishment & the BPE, 1984.

²⁶ Hirsler, M. M., "Toxicity of the smoke from PVC materials: New concepts", Progress in Rubber & Plastics Technology, 10-2, 154-69, 1994.

²⁷ EVC, "PVC the positive choice", pp17, July 2000.

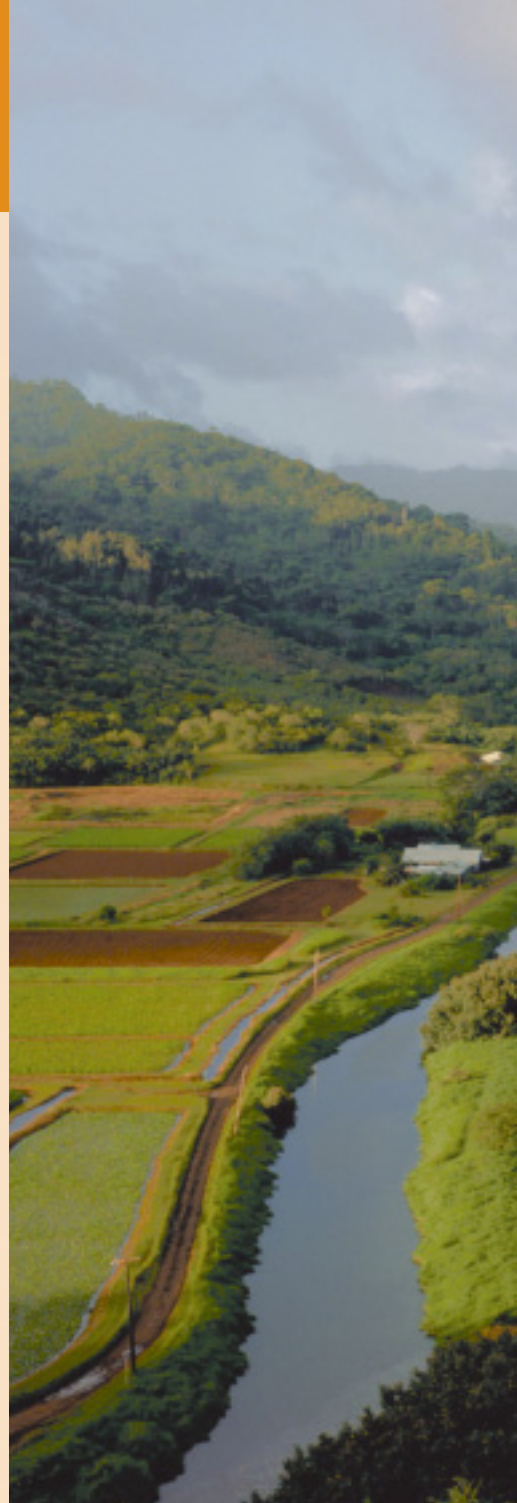
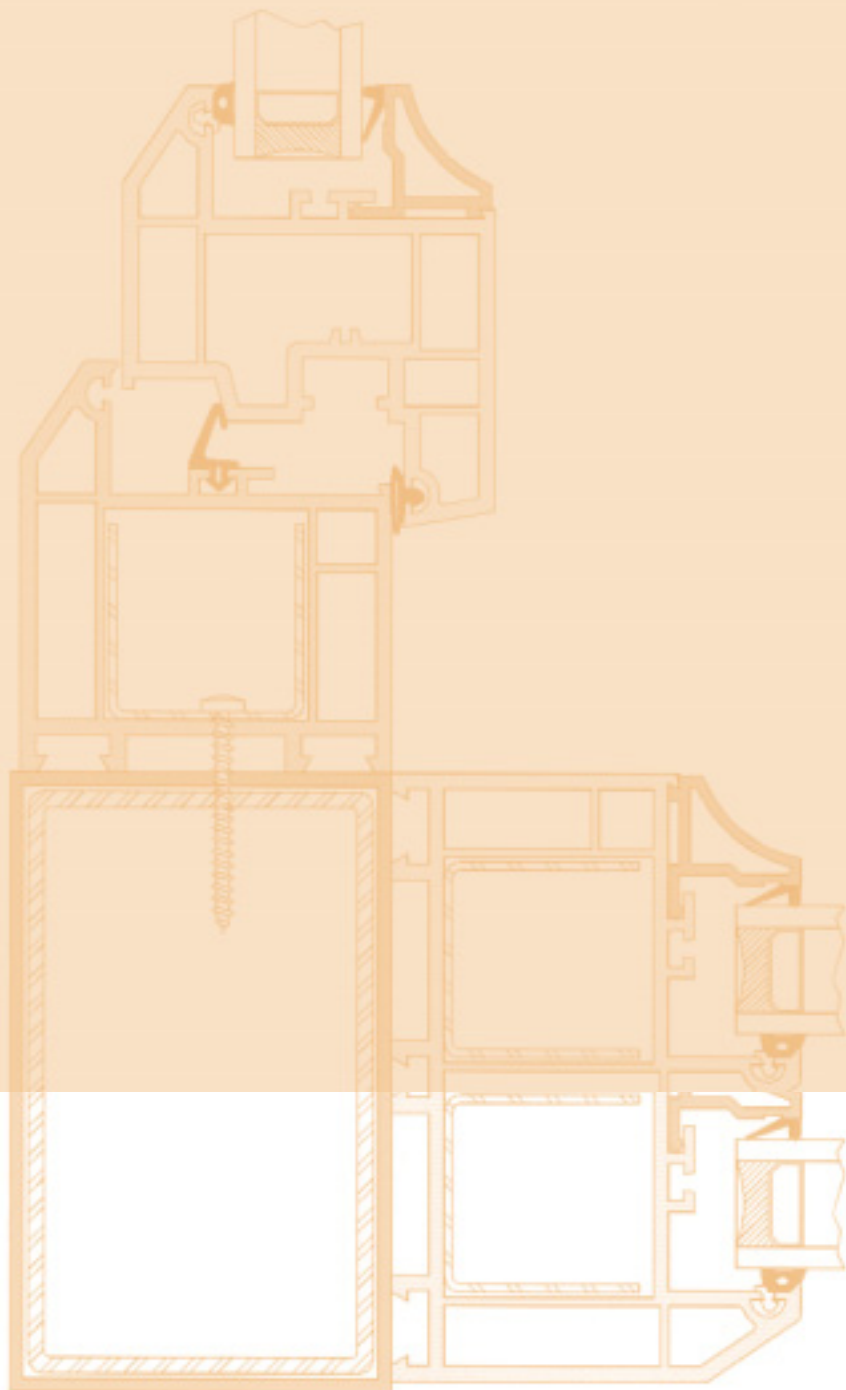
²⁸ BSI, "Draft BS7982 Guidance on environmental impact of large scale fires involving plastics materials", pp 20-21, 3/11/00.

²⁹ EVC, "PVC the positive choice", pp2, July 2000.

³⁰ EVC, "PVC the positive choice", pp13, July 2000.

³¹ DETR (DEFRA), "Life Cycle assessment of PVC and Alternatives", September 2000, pp 93

³² The Voluntary Commitment of the PVC Industry, "Progress Report 2002", pp 9, <http://www.ecvm.org/hp.cfm>, March 2002.



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