

Brighton & Hove City Council
For general release

Meeting: Housing Management Sub-Committee
Housing Committee

Date: 23 May 2006
15 June 2006

Report of: Director of Housing & City Support

Subject: Selection of Material for Use in Replacement of Window
Frames within the Housing Capital Repairs Programme.

Ward(s) affected: All

1. Purpose of the report

- 1.1. To inform the Committee and the Area Panels of the proposed selection of material for the manufacture of replacement windows to be used within the Housing Capital Repairs Programme.

2. Recommendations

- 2.1. That the Housing Management Sub-Committee recommend to Housing Committee the continued specification and use of replacement window frames manufactured from Unplasticised Polyvinyl Chloride subject to specific site requirements and that used PVC-U window frames are recycled.

3. Information/background

- 3.1. The annual budget for replacement windows to be fitted within the Housing Planned Maintenance Programme for the financial year (2006/07) is about £1. 416 million.
- 3.2. This figure may change for future years subject to approval by committees. The figure falls significantly short of need as described within the Housing Stock Condition Survey report.
- 3.3. First generation PVC-U windows are now becoming in need of replacement due the passage of time and failure of ironmongery and weatherproofing. Some early fabrications are also becoming

brittle and fracturing. In the medium term increasing numbers of PVC-U windows will require replacement.

- 3.4. Brighton & Hove City Council Sustainability Commission at its meeting of 10th March 2004 requested the Housing Management Sub-Committee give consideration to use of window frame materials other than PVC-U (Unplasticised Polyvinyl Chloride) on account of perceived environmental considerations.

(Minute 44.2 **RESOLVED** - That a report be prepared for the Housing Management Sub-Committee considering the ecological impact of the use of PVC-U window frames throughout the councils housing stock.)

- 3.5. This request was discussed and ratified by the Housing Committee and the Policy Resources Committee at their meetings of 25th and 31st March 2004.
- 3.6. The issues are that PVC-U is considered environmentally harmful, and that alternatives may provide equal or enhanced performance without the environmental levy attributed to the use of plastics.
- 3.7. Brighton & Hove City Council has been replacing windows with PVC-U framed units for many years. The use of PVC-U has not been exclusive over the years, but is becoming ever more predominant. Other frame materials have been used in particular circumstances, in particular, timber is used as required by planning within conservation areas.

4. Further information

- 4.1. A desk-top study of the environmental impact of window frame materials was carried out using information within the public domain. Various organisations have produced reports on the implications of the use of particular materials. Most of these reports are published to defend an organisation's particular stance or interest, and should therefore be treated with a degree of caution.
- 4.2. A report was commissioned from Dr. Les Flanagan of environmental consultants ESSA Europe Ltd. on the environmental impact of replacement windows in May 2004.
- 4.3. Following recent alterations to regulations controlling the end-use of materials, a further report to consider the implications of changes in legislation was commissioned. Dr. Les Flanagan now being with Vail Williams consultants, the revision report is from Vail Williams and is co-authored by Dr. Flanagan and Kevin Woudman.
- 4.4. The report below considers various aspects of PVC-U, Aluminium and Timber as materials for production of window frames.

- 4.5. PVC-U
Unplasticised Polyvinyl Chloride has become the material of choice for replacement windows. The surface is self finished, presenting a good gloss that is easily cleaned. Surfaces need little maintenance.
- 4.6. PVC-u is popular with residents. Its good appearance is popular, and marketing has enforced firm linkage between plastic windows and warmth. The fact that redecoration is not required, i.e. no painting of internal surfaces especially, is highly valued.
- 4.7. The reputation of PVC-U being "maintenance free" unfortunately is not deserved. Window frames manufactured from PVC-U rely on implanted metal sections for their rigidity. The functioning of the window assembly also is dependent upon ironmongery that is often mechanically complex. Unless carefully specified, and well maintained, these metal components are subject to wear and corrosion, leading to their relatively early failure, and potentially the failure of the entire window unit.
- 4.8. It should be noted that all manufacturers' guarantees of plastic windows are conditional upon regular maintenance. Frequently this maintenance requirement to validate the guarantee is stated as being twice or four times per year.
- 4.9. The plastic material itself, especially in earlier formulations, suffers surface degradation, principally due to the action of ultra-violet light. The surface finish discolours, and in some instances can erode. The material in earlier formulations can also become brittle, leading to fractures that are not readily repaired. The material is also soft, being readily scratched, and cosmetic repair is not usually practical.
- 4.10. There is considerable concern within interest groups over the harmful nature of the constituents of PVC materials. There are fears that some ingredients are carcinogenic, or act as artificial hormones that harm wildlife and humanity.
- 4.11. Polyvinyl Chloride is manufactured from Chlorine split from common salt, and Ethylene derived from fossil hydrocarbons, principally oil. The finished plastic also contains complex organo-chlorate plasticisers and filler materials. It is these ingredients that dictate the characteristics of the finished material, rendering it very soft and pliable, or dense and solid, give it colour, etc..
- 4.12. The plastic used in window frames is unplasticised, as its prime quality is to be rigid, thus many of the concerns which relate to the plasticisers in PVC are not relevant in respect of window frames.

- 4.13. Manufacture of PVC-U involves the use of relatively toxic components, and the potential release of portions of these into the environment. Of particular concern is the release of the intermediate monomer, which is highly carcinogenic, and of organic chlorine compounds many of which are known and very persistent insecticides and listed as actual or potential carcinogenic toxins. Members of the committee will recognise DDT and probably the (ex)garden insecticide Paraquat, both good examples.
- 4.14. Unfortunately environmental pollution attributable to PVC continues beyond manufacture. Disposal of PVC-U is considered difficult. Incineration of the material is considered to create and release dioxins, very toxic compounds. Waste recycling industries dispute this, claiming the full reclamation of released elemental chlorine into common salt. The alternative of disposal in landfill, although not particularly damaging, is bulky, and results in long term leaching of toxic plasticisers and some heavy metal (formerly cadmium, but now mostly lead) compounds used as stabilisers.
- 4.15. PVC-U is considered by many to be difficult and uneconomic to recycle. Until recently that was the case, but developments in the material recycling industry have provided specialist organisations the opportunity to recycle PVCs economically. Moves within the EU have motivated significant improvement in the recycling of PVC materials and there are now good facilities for the full recycling of post consumer PVC-U windows within the UK.
- 4.16. It is likely that current pressure on waste management will cause further improvement in plastics recycling. Presently recycling is predominantly of new material salvaged from the manufacture of products. Reclaimed used PVC is however capable of reuse for an estimated six generations of product. The Waste & Resources Action Programme (WRAP) has been active in this development and a specific purpose company has been set up to lead development of post consumer PVC-U window recycling in the UK. At least one major supplier of PVC-U windows in the Brighton area now provides full disassembly and recycling of all components from post-consumer PVC-U windows.
- 4.17. In considering the environmental impact of PVC-U windows, the recycling of the plastic and metal components is difficult to gauge, yet is the most significant variable to be considered. Development over the last 18 months has been considerable, to the extent that recycling is now not just viable, but locally operational. The further development of the recycling of PVC, to involve a greater number of companies, would reduce the environmental impact of the material

significantly, to the extent that alternative timber products would fail to compete.

- 4.18. PVC-U is frequently rejected as a material in conservation areas. Generally this is for pure conservation principles in that original materials must be matched. PVC-U windows however are generally of thicker sections than timber units, and therefore present a difference in appearance that would detract from original aesthetics.
- 4.19. Timber has in the past been poorly produced and timber windows produced in the 1960/70 period in particular were short lived.
- 4.20. Good quality timber, generally all heartwood and from slowly grown resources, is durable. Unfortunately the supply of such timber from sustainable resources is outstripped by demand and prices are consequently high.
- 4.21. Timber is a natural resource and has a downward influence on global free carbon dioxide. If obtained from properly managed resources use of timber is environmentally beneficial. For the purposes of this report timber is used to describe soft-wood, i.e. material derived from coniferous species. Hard-wood (deciduous tree timber) is considered more durable, but in terms of cost, fails to compete in the market being considered. Tropical hardwood derived from accredited and managed sources will remain the most durable and environmentally acceptable material for window production, but unfortunately the cost of the material renders the product unsuitable for the larger and lower cost market and accreditation presently is questionable.
- 4.22. Production of timber components however is not free of environmental impact. Machining of reduced timbers, transportation and manufacture are energy intensive.
- 4.23. Modern timber technology has produced a window manufacturing industry capable of providing softwood windows with a guaranteed life of 30 years. Timber is obtained from accredited sources, the components are carefully detailed and pressure treated with preservatives after manufacture.
- 4.24. The British Woodworking Federation has produced a good quality specification for timber windows that is available from a limited number of scrutinised manufacturers.
- 4.25. The guarantee of these window products is however subject to a requirement of regular maintenance by painting or staining. This is to prevent leaching of the preservative compounds applied and

prevent degradation by moisture and ultra-violet light. Fulfilling the conditions of guarantee will require a commitment to a rigorous redecoration routine.

- 4.26. The overall environmental impact of timber must include the frequently toxic preservatives and materials used in production of paints and preservative stains to be applied at intervals over the life of the component.
- 4.27. Modern timber windows are capable of long service life if properly maintained. The material is as good as PVC in respect of heat insulation, but presently available sections do not support the deeper double glazing usually used in PVC windows. The loss of insulation performance occasioned by this is normally overcome by the adoption of low emissivity glass or argon filled glazing units, which enhance the overall thermal performance.
- 4.28. Ironmongery used on standard timber windows is relatively simple, and in the event of failure, is readily replaced. Unfortunately where high performance timber windows are selected, or enhanced security is required, the functioning of the window assembly is dependent upon ironmongery that is often mechanically complex. These components are very similar to those used on PVC-U windows. Unless carefully specified, and well maintained, these metal components are similarly subject to wear and corrosion, leading to their relatively early failure, and potentially the failure of the entire window unit.
- 4.29. Draught-proofing is effected by the use of strips let into the frames and is readily replaced in the event of failure or accidental damage. Unless careful maintenance is carried out, draught strips are vulnerable to contamination by paint or stain applications and may become the site of localised component failure.
- 4.30. Maintenance of timber windows requires rigorous specification and workmanship. Redecoration using stains or paints requires attention to detail and must be carried out on a regular cycle, dependent upon the material initially specified. The maintenance cycle is on average 5 years. Whilst significantly less invasive than the six monthly cycle recommended for most plastic windows, the overall cost of redecoration is likely to remain a significant cost.
- 4.31. Decorative materials and post installation preservative treatments introduce additional environmental impact through their use of petroleum derivatives and the hazardous nature of their active ingredients. Recent introductions of less toxic preservatives provide protection against insect attack but this is seldom a significant risk to

window frames. There is little evidence to suggest that non-hazardous fungicidal ingredients are available, and the commonly used preparations are categorised as harmful.

- 4.32. An important consideration is that the majority of timber windows fail from decay originating from the internal surfaces or details where moisture can become contained. The use of timber window frames in housing properties will require that cyclical redecoration should include painting or staining of the internal services. This will substantially increase the lifetime costs. Commonly available post installation timber preservative treatments are not authorised for interior use, thus protection can only be provided through careful maintenance of intact paint films.
- 4.33. Recent changes to waste disposal regulations have made substantial difference to the relative environmental impact of timber for window frame use. Timbers that have been treated with paints, varnishes or stains and in particular, preservatives, are presently difficult to recycle or dispose of.
- 4.34. Of particular impact, the Landfill Directive requires substantial reduction in the disposal of bio-degradable substances in landfill in order to limit the release of methane gas. The implication of this is that timber products should be disposed of in some alternative form, generally by incineration or be recycled to form panel products.
- 4.35. Specific legislation has also been introduced to control wood treatments. Chromated Copper Arsenate (CCA) is the prime active ingredient in the Tanalith preservative treatment and is now banned for use in residential construction. The common alternative cyclodiene treatments, such as Aldrin are also persistent pesticides and similarly controlled. Alternative treatments are not yet fully time tested, and recommendations for use are based on extrapolated results of testing. There is however little information on the persistence of more recent fungicidal treatments or disposal recommendations in the public domain.
- 4.36. Timber containing more conventional preservative materials is listed as potentially hazardous under the Hazardous Waste Directive and reclaimed timbers should be tested to determine what residual substances are present and in what concentration. In consequence many recycling organisations will not accept timbers that have, or may have, been treated, and they are thus considered unsuitable for composting or conversion into wood particle products. This directive, in conjunction with the landfill directive, also makes timber reclaimed from window renewal difficult to consign to landfill and it must

therefore be disposed of by controlled incineration in order to prevent discharge of pollutants to atmosphere.

4.37. Aluminium

remains the most durable material. It is energy intensive in manufacture, but provides long service life, at the end of which the material can be recycled within an established market.

4.38. Modern section manufacture provides window frames that are self-finished, and incorporate insulation materials to reduce condensation of water on the internal surfaces of the frame. In order to comply with current standards, aluminium windows must be fitted with this "thermal break".

4.39. Maintenance is not as rigorous as required for either PVC-u or timber. There will be the need for occasional maintenance, but a simple clean and oiling of hinges at five-year intervals would normally suffice. Where complex ironmongery is used maintenance requirements would be more onerous as for other window types.

4.40. Repair of frames, when damaged, is difficult, and if the surface finish is damaged, further corrosion of the aluminium will result. Hinges and window latches are usually fixed with mechanical fastenings and can normally be replaced. Most windows however are fitted with plastic wedges to assist operation of the latches. These are prone to failure, and unless rapidly replaced, the window frame is likely to be irrevocably damaged. This vulnerability is significant and must be taken into account in assessing the suitability of aluminium in the social housing market.

4.41. Exposed aluminium is rapidly corroded in the presence of salt, and the build-up of corrosion products leads to further disruption of protective surface coatings, and therefore further corrosion. The relative reactive nature of aluminium, exacerbated in a marine environment, also leads to local corrosion around fixings fabricated from different metals. Care is therefore required in fabrication, and later maintenance replacement of components, to ensure that intimate contact of dissimilar metals is prevented.

4.42. Aluminium is seldom acceptable in conservation areas.

4.43. Glazing

is always the weak point in a double glazed system.

4.44. Glazing units consist of layers of glass, sealed with a rubber gasket at the perimeter, forming an air gap between the glass panes. Depending upon the size of the unit, and the intended use, glass of various types and thickness are used. The gap between the panes

can be filled with particular gasses to enhance performance, and the dimension of the gap can be varied to improve thermal or acoustic insulation properties.

- 4.45. Double glazed units are available in a range of thicknesses. Timber window frames are restricted to the thinner units, up to 24mm. (28mm is the usual thickness presently used in PVC-U frames). In practical terms, this is not a major consequence in respect of thermal performance, but where sound insulation is also a factor, the wider air gaps possible with plastic frames will provide better performance.
- 4.46. Double glazed units rely on the integrity of the rubber seal around the edge of the unit. When this seal breaks down, moisture will enter the air gap and will cause misting of the window.
- 4.47. Glazing units typically last for about ten years at which time it will be necessary to attend any installation. Replacement of units in PVC-U or aluminium frames requires removal of a clipped-in bead, which with reasonable care will be effected without any damage. Timber windows however will require redecoration after replacement of a glazing unit. This is because the glass will typically be secured with a timber bead secured with nails, removal of which will damage any paint or stained finish.
- 4.48. Industry reports indicate that glazing failure tends to occur prematurely, with timber frames in particular, due to moisture being held against the edge of the glazing unit. Such premature failure could be reduced by implementation of careful design and installation.

5. Comparative Impact

- 5.1. The table below is taken from a paper prepared by consultants before the introduction of the Vinyl 2010 commitment and accessible recycling of post-consumer PVC. The table also pre-dates recent changes in disposal regulations that impact upon timber products. The paper is noted as background to this report.

Environmental Impact Matrix (Low score = Low impact)						
System	Resource use	Process impact	Durability	Service life	End-use impact	Total
PVC-U	3	4	2	3	4	16
Aluminium	4	5	1	2	2	14
Timber	1	2	4	4	3	14

- 5.2. The conclusion from this table is that there is little variance in environmental terms between timber and aluminium, but that PVC-U was more damaging to the environment.
- 5.3. The commitment of the plastics industry to recycling under the Vinyl 2010 programme has resulted in active recycling of used windows. This activity will have reduced the relative environmental impact of PVC.
- 5.4. Similarly the above assessment predates the introduction of the recent Hazardous Wastes and Landfill directives which have introduced additional impact from the use of timber.
- 5.5. In terms of cost, the variation due to the material selection is more marked. The table below, again taken from a paper prepared by consultants, shows the expected variation in unit cost for a standard window and for a standard external (rear) door.

Cost Comparison	1200 x 1200 casement window with one side hung opening casement		1981 x 762mm external two panel glazed door and frame.	
	Unit Price £	% Variation	Unit Price £	% Variation
White powder coated aluminium	380	23%	490	3%
Preservative treated stain finished softwood	366	18%	675	42%
White PVC-u	310	0%	475	0%

- 5.6. The table shows that there is a significant cost implication in specifying timber windows rather than plastic, and that aluminium windows are even more costly. The table also shows that the price differential for using aluminium doors in preference to PVC-U is not significant whilst using timber doors is.
- 5.7. Decoration of timber doors and windows will also be required on a regular basis and will cost in the region of £20 per unit (based upon current repairs schedule of rates).
- 5.8. Service of PVC-u windows presently costs £35 per visit.
- 5.9. The table below shows the costs that might be expected over the lifetime of the window for a typical house. For comparison it is taken

that there are 7 windows and 2 doors, and that the units are given proper care and attention.

	PVC-u	Timber	Aluminium
Supply windows	2170	2562	2660
Supply Doors	950	1350	980
Service	1750	n/a	300
Decoration	n/a	840	n/a
Total	4870	4752	3940

5.10. This comparison demonstrates that the cost difference between using PVC-u and Timber is marginal but both are significantly higher than the use of aluminium. Servicing costs should be increased for both timber and aluminium in the event that advanced function ironmongery is used.

6. Summary

- 6.1. The decision as to what material should be specified for replacement windows must remain subjective. Good quality products are available in all materials.
- 6.2. In selecting a material to use, consideration must be given to the maintenance requirements, and the likelihood of the required level of maintenance being given in practice.
- 6.3. There is evidence that the environmental impact of the use of timber in replacement window frames is lower than the impact of PVC_U. This situation is changing as recycling of PVC materials becomes more common.
- 6.4. There is little overall difference in environmental impact between PVC-U, aluminium and timber. The high energy cost of aluminium manufacture is offset by its recycling potential. PVC-U recycling is now available. Timber whilst renewable, requires energy in production, and coupled with the hazards associated with maintenance to ensure reasonable useful life, is not readily capable of re-use.
- 6.5. Lifecycle cost comparisons, made with the assumption that manufacturer's maintenance recommendations are implemented, indicate that over the product lifetime aluminium is the most cost effective material. Revision of the current practice of not providing routine maintenance of PVC-U windows will significantly alter the outcome of this comparison. Not maintaining plastic windows is

leading to premature failure of windows and increased replacement costs.

- 6.6. Residents have developed a clear preference for PVC-U window frames. This is because of their perception of warmth and no maintenance requirement. The need for regular redecoration renders timber less popular, and aluminium is associated with the public memory of cold metal window frames.
- 6.7. Within Brighton & Hove, conservation area considerations will require the continued use of timber windows.
- 6.8. PVC-U requires frequent maintenance if the product is to provide a satisfactory service life. The ability to replace defective parts becomes questionable as parts become obsolete. High performance specifications are required to deliver service life in the coastal environment.
- 6.9. Timber requires regular cyclical maintenance to achieve its service life. This requires access to properties and associated disruption to residents as well as considerable investment of resource. Local repair and replacement of failed components is practical provided early indications of failure are reported and acted upon.
- 6.10. Aluminium requires little maintenance. If components fail the frame can be damaged and repair of the frame is difficult or impractical.

7. Conclusion

- 7.1. The residents of Brighton & Hove City Council properties are satisfied with the use of PVC-U windows. Where PVC-U is not specified, for example in conservation areas, some residents initially resist the use of alternative materials, but are generally satisfied with the finished product when alternative materials are used.
- 7.2. Aluminium window frames are more costly to install, and are therefore infrequently specified. Officers have concerns about the life-span projection of aluminium frames due to the requirement for prompt and careful maintenance, and experience that early reporting of parts failure is not usual.
- 7.3. Timber frames will require full redecoration at regular intervals. The cost of this would significantly increase revenue spending. The prospective disruption to residents is recognised as unpopular.
- 7.4. Given that recycling of PVC-U is locally available it is recommended that the current specification of PVC-U as the prime material for replacement window frames should continue, subject to the

particularities of the project, with the requirement that used PVC-U frames shall be properly recycled.

8. Consultation

- 8.1. This report has been presented to the Repairs and Maintenance Monitoring Group.
- 8.2. The report will be presented to Housing Panels at their meetings to be held in July.

Meeting/Date	Housing Management Sub Committee / Housing Committee	
Report of	Director of Housing & City Support	
Subject	Selection of Material for Use in Replacement of Window Frames within the Housing Capital Repairs Programme.	
Wards affected	All	
Financial implications		
The Housing Planned Maintenance programme 2006/07 currently allows for £1. 416 m for replacement of windows. The works programmed assume replacement of PVC -U with the same. Should there be any change to timber or aluminium at a higher replacement cost, these costs would have to be managed within the overall HRA capital programme. <i>Finance Officer consulted: Monica Brooks Date. 3 May 2006</i>		
Legal implications		
The Council must take the Human Rights Act into account when proposing new developments but it is not considered that any individual's Human Rights Act rights would be adversely affected by the recommendations in this report. <i>Lawyer consulted: Alison Leitch Date. 04 May 2006</i>		
Corporate / Citywide implications	Risk assessment	
The decision on the material to be used in window replacement contracts would have city wide implications	Risks are assessed for each specific contract involving replacement windows. Principal risks are those of Performance in Fire, Thermal Resistance, Resistance to Unlawful Entry, Health & Safety of the Operator.	
Sustainability implications	Equalities implications	
Sustainability implications are discussed in the body of the report.	All projects carried out include full consideration of various equality issues and specifically the implications of the Disability Discrimination Act.	
Implications for the prevention of crime and disorder		
Physical security is a key output of the window renewal programme.		

Background papers

A large number of background sources were consulted in the drafting of this report.

Members are referred to the following prime sources:-

"Lifecycle Assessment of Polyvinyl Chloride & Alternatives". (Entec UK for DEFRA 2000)

"Recycling Your Window Waste, Good Practice Guide". (WRAP 2004)

"Options & Risk Assessment for Treated Wood Wastes". (TRADA / WRAP 2005)

"Support for Recovinyl PVC Recycling System". (WRAP 2005)

"Changes in Legislation and Policy Guidance in Relation to Refurbishment

Window Joinery for Local Authority Housing Stock" (Vail Williams 2006)

The above reports are lengthy and are held electronically by the contact officer below.

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