Managing Waste

from Welsh Housing Quality Standard Refurbishment

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Executive Summary

Constructing Excellence in Wales commissioned BRE to investigate the wastes associated with refurbishment of social housing properties to meet the Welsh Housing Quality Standard (WHQS). The purpose of the study was to identify the typical materials and products that will become waste during refurbishment, the average quantities of materials arising per house type and to investigate the available facilities or potential technologies that could be employed to divert these materials away from landfill disposal.

The study has demonstrated that significant quantities of waste are likely to be produced as a result of the WHQS refurbishment programme, with the majority likely to be disposed of as landfill at a cost of approximately £14million across Wales. Although some appropriate recycling facilities have been identified, their coverage may not extend to the whole of Wales. However, there should be scope for at least some of the waste to be segregated and recycled.

One of the main outcomes highlighted by this study is the importance of the selection procedures that are employed for the products and materials that are being installed into refurbished properties now. These will influence the nature and extent of the waste problem in the future, as cycles of refurbishment continue in order to maintain good quality homes.

This report provides a series of recommendations with the aim of improving the actual outcomes in Wales, compared to the predictions from the study. It is hoped that significant improvements will be realised and that the provision of quality, healthy homes for people in Wales will not be delivered at the expense of the environment.

Photo: Ade Rixon

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Introduction / background

The purpose of the study was to identify the typical materials and products that will become waste during refurbishment, the average quantities of materials arising per house type and to investigate the available facilities or potential technologies that could be employed to divert these materials away from landfill disposal. It is hoped that the guidance will be disseminated across Wales to other Registered Social Landlords (RSLs) and Councils that will be required to carry out similar refurbishment programmes, to bring about improvements in waste management practices once the scale and nature of the issue is better understood.

In order to meet the WHQS, many properties are being refurbished and modernised. The extent of the necessary works is dependent on the condition of each individual property, however the most common key requirements are replacement of kitchens, bathrooms and windows. The Standard also places upgrade intervals on these and other items, meaning there will be anticipated ongoing wastes over time. This will be discussed further in section 1.2. Other more general property repairs may be necessary during the refurbishment, but that would be considered by the Housing Association on a case by case basis.

Little data, if any, appears to exist on the nature and extent of waste associated with this kind of refurbishment, although it is common for all such waste to be mixed and disposed of to landfill. With such a large programme of works anticipated by not only Valleys to Coast (V2C) but all other Council regions across Wales, the waste volumes will be significant and Welsh Assembly Government (WAG) are keen that where possible appropriate alternatives are sought to landfill disposal.

In 25 years time the waste situation could actually be worse than it currently is

1.1 What is the WHQS?

The National Housing strategy for Wales[1] Better Homes for People in Wales was published in July 2001, setting out WAGs long term vision for housing. It states that all houses should be brought up to a 'good quality' by 2012. WAG subsequently developed the Welsh Housing Quality Standard, which sets out the physical performance standard and condition that existing housing must meet and maintain in Wales. It was particularly aimed at Local Authorities and social housing providers, who are obligated to assess their housing stock against the Standard. Requirements of the WHQS include:

- Being in a good state of repair
  - structurally stable
  - free from dampness
  - free from disrepair
  - includes walls, roof, windows, doors, chimneys, central heating boiler/gas fires and electrics. (Most of these elements have an anticipated lifespan of over 30 years. However, boilers are considered likely to need replacement every 20 years[2])
- Safe and secure
  - free from evident safety hazards
  - secured by Design for doors, windows and fencing
- Adequately heated, fuel efficient and well insulated
  - energy bills at affordable cost to the tenant
  - all heating installations and appliances checked and certified safe at least annually
  - hot water tanks effectively insulated and at least 200mm insulation in lofts
  - minimum Standard Assessment Procedure (SAP) also know as Energy Ratings must be achieved, depending on building floor area
- Up to date kitchens and bathrooms
  - kitchens - reasonably modern facilities and services, no more than 15 years old unless in good condition, meet space and layout criteria, facilities for washing, drying and airing clothes
  - bathrooms – reasonably modern facilities, no more than 25 years old unless in good condition, with bath and shower

- Well managed (for rented housing)
  - fairly and efficiently managed to address needs of tenants as part of a community
- Located in attractive and safe environments
  - areas in which tenants are proud to live
  - adequate fencing (minimum 1200mm high) provided between adjacent rear gardens
- As far as possible suit the specific requirements of the household (e.g. specific disabilities)
  - Lifetime Homes Standard used for reference
  - accommodate sufficient furniture, circulation space and storage space to meet needs of a family
  - necessary aids and adaptations to meet specific needs

WHQS ***Plus***[3], being promoted by i2i (inform to involve), aims to develop sustainable communities in association with the roll out of the WHQS, through the creation of jobs and opportunities at a local level to help with the delivery of the refurbishment programme. Although the focus of this initiative is on the provision of trades, contractors and fitters, there is also significant potential for job and business creation in the waste management sector, to deal with the wastes inevitably arising from WHQS refurbishment.

1.2 Issues associated with rolling out the WHQS

A cost study that was carried out for WAG in 2005[2] looked at the requirements of meeting the WHQS in Local Authority owned properties. The study estimated that over the 30 year planned period, 700,000 windows would need to be replaced, 200,000 doors, 200,000 boilers, 250,000 kitchens and 200,000 bathrooms (based on an assumed 160,000 dwellings). Due to the requirement for kitchens to generally be replaced every 15 years and bathrooms every 25 years, it is anticipated that two replacement cycles of each would be necessary during the 30 year period. Replacement of boilers would be anticipated every 20 years, with windows and doors replaced every 30+ years.

The document highlights that the demand for materials and resources to meet the quality requirements across Wales will be considerable. The refurbishment process will also result in significant volumes of waste associated with old products being removed. There will also be off-cuts and installation waste associated with the new products being fitted. Typically, these are 'difficult' wastes in relatively small volumes (per house), e.g. chipboard kitchen units, plastic bathroom fittings and the cardboard and plastic packaging from the newly installed items. Due to the relatively low waste volumes and

usually limited space available at properties, all materials are typically mixed and sent for landfill disposal.

There is currently no mechanism in place to allow the segregation of materials at source for reuse or recycling and so diverting them from landfill. On a 'per house' basis, this may not be seen as a significant problem. However, when scaled up to represent all houses undergoing refurbishment to meet the WHQS, it is unacceptable not to take actions to improve the waste management practices employed. When considered holistically, segregation and recycling options should become more viable.

The long term nature of the refurbishment programme means that this waste problem will perpetuate for many years if not dealt with appropriately now. Due to the replacement intervals anticipated on various items, similar wastes will continue to arise into the foreseeable future. Unfortunately, it is suspected that the necessary facilities to deal with the sort of materials arising do not currently exist or are not widespread enough in Wales to allow viable recovery solutions. It would be preferable to establish appropriate material handling facilities as soon as possible, to be able to deal with these ongoing wastes.

Another major issue is the risk of perpetuating the problem into the future by not giving due consideration to the new products and materials that are being installed now into the refurbished properties. One of the major problems currently is that many of the items being removed are difficult to deal with. It would make sense to take this into consideration now and look at the whole lifecycle impact of new products, rather than just considering them on a 'cheapest price' basis.

For example, if we consider baths, currently virtually all properties have steel baths that are being removed as part of the refurbishment programme. It is relatively easy to recycle metals, with potential recyclers widespread and steel currently having a good scrap value. Hence, it is likely that all such baths could be recycled, diverting them from landfill disposal and potentially offsetting a proportion of the cost that may be incurred by segregating metals from other wastes. The low cost option for a replacement bath is likely to be a composite material such as glass reinforced plastic (GRP). It is extremely difficult to recycle GRP, hence in 25 years time when the bathroom suites being installed now are due to be replaced, the waste situation could actually be worse than it currently is. With the current widespread interest and awareness in recycling and improving sustainability, there is a possibility that techniques to successfully recycle GRP may be developed in the future, but it is irresponsible to rely on such an unknown when currently specifying products. As it happens, feedback from Local Authorities

and Housing Associations (discussed in section 4.3) indicates that they are looking to either refurbish the existing steel baths or replace them with new steel baths, as they realise that they are much more robust and hardwearing than the alternatives. Fortunately then, it should still be possible to manage this waste stream responsibly in the future.

Additionally, the techniques employed for current installations may reduce the end of life options for materials or prevent the potential for upgrade and repair instead of replacement. For instance, a good quality, well installed kitchen could last long in excess of 15 years. However, it is accepted that in that time some units may become worn or damaged and work surfaces may no longer be at their best. With some consideration for the future, it may be possible to install new kitchens with removable work surfaces and/ or frontages so that they could be

Photo: Ade Rixon

replaced if necessary while extending the life of the 'intact' elements behind, rather than necessitating a full strip out and replacement due to a potentially small amount of wear or damage. This would also cause less disruption to tenants, who are generally not decanted from their homes during such works.

The fact that tenants are generally not removed from their homes during the refurbishment raises other important issues, mainly relating to health. Consideration should be given to the use of paints, coatings and other products containing solvents etc that may affect the short term health of the occupants. Many such products contain Volatile Organic Compounds (VOCs) that are known to be an irritant to some individuals, with the very young and the elderly being particularly prone to their affects. Products should therefore be selected with minimal potential health impacts.

2 Scope of the project

In light of the factors considered above, the scope of the project was to quantify and identify the likely materials arising from current refurbishment programmes, to investigate options for improved recycling and diversion from landfill disposal and to look to the future of the ongoing WHQS renewal programme to assess the suitability of the products and materials that are being installed now, both from a lifecycle and tenant health point of view. The work included:

- Carrying out pre-refurbishment audits
- Monitoring actual waste arising to get an uplift factor associated with packaging and installation
- Calculating average waste data per house type and work package
- Scaling up for each council region according to available statistics
- Identifying periodic renewals for refurbishment, to factor in future waste arisings (roofs, windows, kitchen, bathroom, boiler, etc)
- Once materials were identified, investigating local facilities to deal with waste. Where nothing was available, investigating the appropriate technologies that could be employed.
- Looking at current products used and assessing their lifecycle impacts, including waste associated with ongoing maintenance and ultimately their replacement

2.1 Establish waste arisings

V2C were in the process of refurbishing their housing stock in order to meet the WHQS, they agreed to let BRE survey a selection of their dwellings to ascertain the typical waste materials and quantities that were likely to arise. From initial discussions with V2C about their experiences with their refurbishment programme, it was anticipated that the nature of the waste from each property was likely to be similar. To verify this, pre-refurbishment audits were carried out on a range of properties of varying type (mainly comprising of 1 and 2 bedroom flats and 2 and 3 bedroom houses) that were due to be refurbished (at least kitchen, bathroom and window replacement). This allowed average waste quantities, according to material type, to be established for each house type.

In addition to wastes arising from the strip out phase of any works, additional materials would inevitably arise from the new installations. Additional surveys were therefore carried out during the installation of new facilities to verify the waste volumes anticipated during the pre-audit and to provide uplift figures to the pre-audit averages that would account for additional waste

materials such as packaging etc. Installation waste was established by monitoring a trade at a time while they worked across various properties (i.e. kitchen fitters and bathroom installers). The window replacement programme had already been completed by V2C before any surveys were carried out, so only the pre-audit (assuming a like for like replacement in future) was completed and we have made no assessment of the additional waste associated with window fitting. However, it is assumed that relatively little waste would arise from window fitting, mainly mastic sealant tubes and some minor debris. Once the overall strip out and fit out averages were established, these were then multiplied up according to the number of houses in the V2C (or any other) social housing area to give overall anticipated waste figures.

2.2 Ongoing/long term waste

The WHQS assumes that various features will be renewed and replaced periodically. The implications of this were investigated to assess the long term impact on waste arisings. Items include windows, kitchen, bathroom, roof, boiler, etc.

2.3 End of life outlets and options

The final phase of the project was to identify potential facilities to deal with the materials established during the refurbishment audits, in order to divert them from landfill disposal where possible. Recyclers often require minimum volumes of materials to make the process viable. Once the true extent and nature of the likely waste arisings is better understood, it is anticipated that alternatives to landfill may be more justifiable. For example, after calculating the cost of landfilling a known quantity of waste this can then be compared to the cost of alternative measures that may be necessary to recycle materials instead.

The life cycle impacts of new materials are also considered, to gauge their impact on the long term waste arisings associated with the ongoing programme of refurbishment and upgrade.

3. Findings

3.1 Predicted waste arisings

The survey work carried out established average strip out and installation waste values, by material, for a range of typical house types. These are shown in Table 1. These volumes are absolute, assuming no voids or spaces within products (i.e. baths, sinks and boilers are treated as the absolute volume of material they are made from, rather than the volume of space they occupy). This is therefore the space that would expect to be occupied in a landfill, due to materials being crushed or in-filled.

Table 1: Average material waste arisings during refurbishment of kitchens, bathrooms and windows, to meet the WHQ

Material	1 bed flat (tonnes)	2 bed flat (tonnes)	2 bed house (tonnes)	3 bed house (tonnes)	Overall average (tonnes)
Inert	1.606	1.717	1.639	1.808	1.693
Timber	0.047	0.072	0.080	0.100	0.074
Glass	0.021	0.018	0.033	0.026	0.024
Cardboard	0.006	0.008	0.007	0.007	0.007
Steel	0.003	0.003	0.003	0.003	0.003
Copper	0.001	0.001	0.001	0.001	0.001
Hard plastic	0.002	0.001	0.001	0.001	0.001
Plastic wrapping	0.003	0.003	0.003	0.003	0.003
Flooring *	0.009	0.008	0.010	0.012	0.010
Window frame *	0.022	0.022	0.034	0.031	0.030
Total	**1.72**	**1.853**	**1.811**	**1.992**	**1.846**

* Flooring and window frames have been left as generic products as it is anticipated that the materials used in these applications could vary significantly over time, with changing trends etc. However, they will inevitably add to the total wastage figures under other material categories, e.g. plastics for flooring, timber or metals for window frames.

There is a relatively small increase in the overall volume of waste arisings with increasing dwelling size. This is due to slightly larger kitchen requirements for more occupants and more windows per house. Approximately 65% of the waste generated is attributed to kitchens, 28% to bathrooms and 7% to windows, as shown in Figure 1.

Inert materials make the largest contribution to the overall waste, with the average for each material type shown in Figure 2. This includes general debris and rubble from various activities, including coring holes in walls for extractor fans and moving walls to relocate doors or units, as well as any ceramic waste from tiling or bathroom fittings. Timber is the second largest contribution, mainly from kitchen units. Windows and flooring have been left as generic products, mainly because the materials utilised may vary significantly over time due to changing trends.

Figure 1: Breakdown of average waste per house by percentage material type

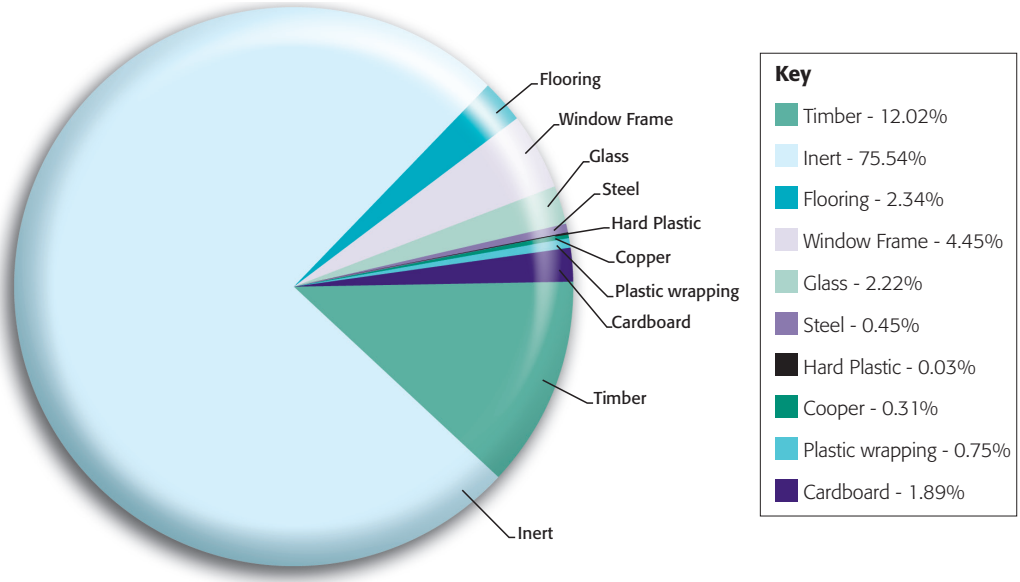
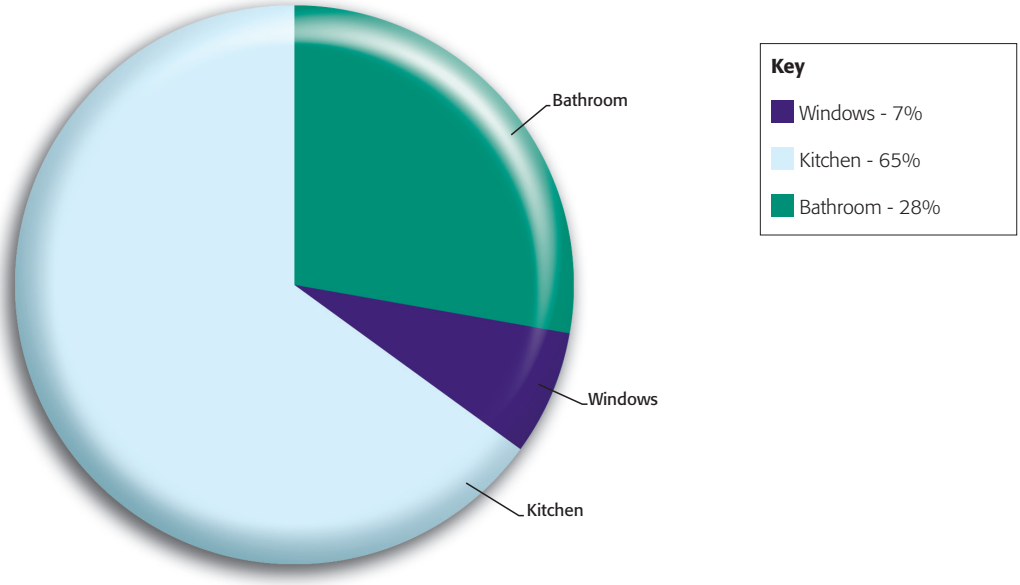


Figure 2: Approximate breakdown of waste per house from kitchens, bathrooms and windows



Statistics of Local Authority and RSL housing stock[4,5] have been used to establish the amount of waste arising from WHQS refurbishment across Wales. The distribution of the different house types has been estimated using the breakdown of RSL housing types[5], also applied to Local Authority properties. Results, per county and for the whole of Wales, are given in Table 2. The volumes are also represented by Authority area in Map 1.

The calculations are based on the density conversion factors accepted and used by DEFRA and the Environment Agency. The conversion factors make due allowance for voids present within material in the skip.

Based on the outcomes of the survey it has been calculated that without any intervention the cost in Wales of skip hire alone in relation to the work associated with WHQS will exceed £40,000,000.

Table 2: Total waste arising estimates for the social housing stock, per county and for the whole of Wales

Authority	Number of dwellings	Anticipated waste tonnes
Isle of Anglesey	4,467	16,326
Gwynedd	8,452	30,888
Conwy	5,977	21,844
Denbighshire	5,401	19,738
Flintshire	9,879	36,104
Wrexham	13,424	49,060
Powys	7,997	29,226
Ceredigion	3,626	13,252
Pembrokeshire	7,883	28,810
Carmarthenshire	11,969	43,742
Swansea	20,734	75,774
Neath Port Talbot	12,240	44,732
Bridgend	8,390	30,662
Vale of Glamorgan	6,123	22,378
Cardiff	23,847	87,152
Rhondda Cynon Taff	15,620	57,086
Merthyr Tydfil	6,200	22,658
Caerphilly	14,202	51,902
Blaenau Gwent	8,434	30,824
Torfaen	9,854	36,012
Monmouthshire	5,078	18,558
Newport	12,728	46,516
All Wales	**222,525**	**813,244**

† Skip prices quoted are based on personal communications with waste management contractors in South Wales in 2007.

Map 1: Anticipated cost of waste disposal per Authority area from WHQS refurbishment

Kitchens, boilers and bathrooms are likely to need replacement within a 30 year timeframe (15, 20 and 25 years respectively), with various other items (including windows) potentially needing replacement after approx 30 years. It may therefore be anticipated that within 35 years of carrying out the WHQS refurbishment on any properties, similar volumes of waste will be produced again. During this time, landfill space will become even more scarce, or not available and associated increases in landfill costs could be exponential. Also, the nature of the materials arising from the refurbishment may change from those predicted here, due to trends in materials installed now and over the coming years. It is therefore important to consider the end of life impact of any products and materials being installed now and plan for their eventual waste management.

3.2 Facilities to deal with waste

Investigations have been carried out into the availability and location of facilities capable of dealing with the materials highlighted above, as an alternative to landfill disposal. Facilities are shown on Map 2, with further details given in Table 3. In summary:

- The **timber** from these refurbishments is primarily chipboard. No facilities have been identified that would be able to accept chipboard for recycling. Incineration or composting are options that will be discussed further in section 4.1.4.
- **Inert** material can be recycled by a number of waste handlers. It should be relatively easy to find alternative disposal options across Wales for such waste.
- No dedicated schemes to recycle **flooring** have been identified within Wales.
- One facility has been identified that specialises in recycling **windows** in Wales. Windows and Plastic Recycling Ltd are based in Neath. They will also deal with the glass from windows.
- **Metals** currently have a good scrap value[ψ] and can be recycled by a number of scrap merchants across Wales. It should be relatively easy to find alternative disposal options across Wales for metal.
- Recover Plastics, based in Wrexham, have the facility to specifically deal with **hard plastics**, provided sufficient quantities are available. This should also include PVC windows.
- Several recyclers are capable of recycling **plastic wrapping** across Wales, although not all Authority areas may be appropriately close to such facilities.
- **Cardboard** can be recycled by a number of waste handlers, but again, not all Authority areas maybe appropriately close to such facilities.

[ψ] Sims Metals, South Wales, quoted £230 return per tonne of steel – July 2009

Map 2: Location of recycling facilities across Wales for materials identified from WHQS refurbishments

Table 3: C&D waste management facilities in Wales (see Map 2)

Company	Facility	County	Materials Accepted						
			Timber	Inert	Plastic	Glass	Masonry/	Metal Brick	Other
Amber Services	Transfer Station	Caerphilly	Yes	Yes	Yes	Yes	Yes	Yes	Packaging
Atlantic Waste Management	Transfer Station	Cardiff	Yes	Yes	Yes	Yes	Yes	Yes	Cardboard packing
TRJ	Construction Company/ Materials processor	Carmarthenshire	Yes	Yes	Yes	Yes	Yes	Yes	Packaging
Parle's Skip Hire	Transfer Station	Merthyr Tydfil	Yes	Yes	Yes	Yes	Yes	Yes	Packaging
Derwen Aggregates	Washing Plant	Neath Port Talbot	No	Yes	No	No	No	No	
Nolans Bridgend	Transfer Station	Bridgend	Yes	Yes	No	Yes	Yes	Yes	Cardboard packing
GD Environmental	Transfer Station	Newport	Yes	Yes	No	Yes	Yes	Yes	Packaging
Bryn Quarry	Material Processor/Quarry	Caerphilly	Yes	Yes	Yes	Yes	Yes	Yes	Packaging
Brisco Water Disposal	Transfer Station	Swansea	Yes	Yes	Yes	Yes	Yes	Yes	Packaging
Recover plastics	Specialist in PVC recycling	Wrexham	No	No	Yes	No	No	No	Large scale plastics recovery
Thornecliffes Building Supplies	Building Supplies/ Materials processor	Denbighshire	Yes	Yes	Yes	Yes	Yes	Yes	Packaging
AJ Recycling	Majority Civic Amenity	Ceredigion	No	No	No	Yes	No	No	Cardboard packing, Tyres
Potters recycling	Majority Civic Amenity	Powys	Yes	Yes	No	No	No	Yes	Cardboard packing
LAS Waste Ltd	Majority Civic Amenity	Ceredigion	Yes	Yes	No	Bottles	Yes	Yes	Cardboard packing
JLA Recycling Ltd	Majority Civic Amenity	South Powys	Yes	No	No	No	No	Yes	Cardboard packing
Cuddy group	Construction Company	Swansea	Yes	Yes	No	Yes	Yes	Yes	
WPR	Specialist in PVC recycling	Neath Port Talbot	Yes	No	Yes	Yes	No	No	uPVC windows
Williams A Williams Cyf	Transfer Station	Gwynedd	Yes	Yes	Yes	Yes	Yes	Yes	Packaging
Ash	Transfer Station	Broughton	Yes	Yes	Yes	Yes	Yes	Yes	Packaging

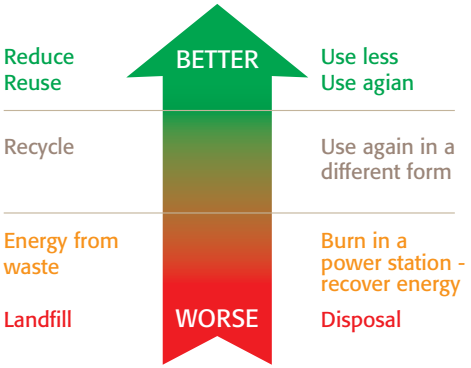
It is apparent from the map and Table 3 that South East Wales is served by a reasonable range of facilities, including some capable of dealing with more difficult wastes, such as plastics. There appear to be far fewer facilities across Mid and North Wales, suggesting that it may be more difficult to divert materials from landfill in these areas. If materials need to travel further to be recycled compared to their usual means of disposal, it may act as a barrier to recycling due to increased costs. The cost of waste management will need to be balanced against transportation costs to be shown to be viable. Therefore, if facilities are not sufficiently nearby, they may not be selected. Over time, as the rate of landfill tax charged increases, the cost argument for recycling will hopefully become more favourable, encouraging further recyclers into the market in the necessary locations.

4 Discussion

4.1 Management options according to the Waste Hierarchy

The Waste Hierarchy is an established means of prioritising waste management options according to their environmental impact. In the first instance, actions to reduce the amount of waste arising should be considered. Where feasible, products should be reused to extend their useful life. When waste is inevitable, actions should be taken to recycle materials where possible, then composting or incineration with energy recovery should be considered as a minimum alternative the landfill disposal of waste. This should always only be considered a last resort.

Figure 3: The Waste Hierarchy



4.1.1 Reduce

Rather than automatically replacing items at their 'designated' replacement interval, it should be ensured that items are only replaced when genuinely necessary. A pre-refurbishment survey should be carried out on all properties before work commences. If tenants are content with current fittings and they are still of sufficiently good quality to be functional, replacement should be postponed. Clearly, if it is estimated that the fittings are only likely to be suitable for another year or two, the disruption factor of returning to the property to do additional works will need to be taken into consideration and it may be decided that replacement should be carried out anyway. However, if estimated to be suitable for at least another three years, products should remain in use. Examples include complete kitchens and bathrooms.

The social implications of replacing kitchens and bathrooms should also be considered. If neighbouring properties are all having kitchens and bathrooms replaced, some tenants may feel aggrieved if they are 'passed over' due to their fittings still being in a reasonable condition. Tenant consultation is therefore clearly important. This presents another strong argument for the installation of fittings that can be upgraded easily, such as the replacement of kitchen worktops or unit frontages when the main structural components are still intact, as this should

satisfy tenants that they have had a 'new' kitchen. This will help to extend the lifespan of the majority of the components and reduce overall wastage.

4.1.2 Reuse

There may be occasions where it has been deemed necessary to replace items, but some components or fittings may still be serviceable and/or in good condition. Also, some new materials may be over ordered, resulting in left over items, e.g. tiles or flooring. It is suggested that, where possible, such items are catalogued and retained in case they could be used as donor items in other properties. The convenience of having items 'in stock' may help reduce turnaround times associated with ordering new products for maintenance or repair, or enable a good working item to extend its useful life if service parts are no longer readily available. Such simple measures could therefore extend the life of other fittings where appropriate and safe to do so. This obviously has implications on storage requirements, however it is not perceived that an endless supply of items would be retained – only those likely to find a short term use. Keeping some sort of up to date record or catalogue of the stored components would be useful to make people aware of items that are available, before new components are ordered. Examples include doors, taps and fittings, over ordered tiles and ceramic bathroom units that may be chipped or cracked while the rest of the bathroom is still suitable.

4.1.3 Recycle

It is possible to recycle many materials into useful products. However, cross-contamination of different materials can often reduce the scope of potential recycling options available. Separation of different material types at source is therefore the most preferable option in order to retain the highest possible value from materials. It is realised that this may be difficult on some refurbishment projects, due to the wide range of small volume arisings that may come from each property and limited space for storage of wastes. Centralised bulking up areas would be recommended, where all wastes are returned and sorted into separate receptacles depending on the material type, e.g. metals, cardboard, timber, plastics, etc. Each trade would need to take responsibility for their own wastes and implement some degree of small-scale separation while working, (although this is something that needs to be worked towards). Clearly it only makes sense to go to this effort if outlets for the segregated materials can be identified. However, appropriate recycling facilities may only come to the market in the knowledge that a suitable segregated material waste stream is being generated in sufficient volume.

Some materials are easier to find outlets for than others, as highlighted in Map 2 in the previous section. Those most likely to find recycling routes include:

- **Metals:** will be readily accepted for recycling and reasonable rates are usually paid. It will probably be necessary to separate different types of metal, i.e. ferrous and non-ferrous.
- **Cardboard:** will be accepted for recycling, though it is advisable to utilise compacting equipment to reduce the volume and aid transportation of the material.
- **Plastic packaging:** can also be recycled, but compacting and baling would likely to be essential to prevent the volume of material being handled from becoming a nuisance.
- **Inert materials:** such as rubble or ceramics, can usually be crushed and utilised as hardcore or fill material. Lower rates are usually charged for removal of such materials compared to mixed waste.

'Difficult' wastes

Windows can be recycled by specialist contractors, such as WPR in Neath. Similarly, specialist companies can recover and recycle carpets, although the likelihood of finding outlets for either of these materials locally may be limited.

Axion Plastics are working in conjunction with WRAP on an initiative to collect PVC flooring from a number of sites across the UK. The trials have involved collecting post-use material from over forty different projects including construction and demolition projects as well as collecting directly from flooring contractors and distributors.

Recovinyl is a European scheme that provides financial incentives to support the collection of PVC waste from the non-regulated PVC waste streams. Their aim is to ensure a steady supply of post-consumer PVC waste for recycling in Europe. They work with a wide range of partners, including consumers, businesses, municipalities, waste management companies and recyclers, as well as the European Commission and National and local governments.

Recovinyl will subsidise those who collect PVC waste and send it to accredited waste recovery companies and recyclers. The payment of this incentive helps to make up for the higher cost of recycling in comparison with other end-of-life options, such as landfill. The incentive system also aims to encourage the recycling of PVC products on an industrial scale.

4.1.4 Recover

Materials likely to arise during the refurbishment programme that are not so readily dealt with include chipboard and hard plastics. Arisings of chipboard waste will be high as a result of replacing kitchen units.

Chipboard is already a product of recycling other timber materials and, due to the bonding agents used and short length of fibres within the product, it is not easily possible to recycle it further. The most viable options are likely to be composting to recover organic matter and nutrients or incineration, to recover energy.

Composting

Studies have previously been carried out[6] to investigate the potential to compost wood panel and board products on construction sites. It was shown to be technically feasible to set up temporary composting facilities on site that would produce an acceptable material within approximately 13 to 19 weeks that did not generally cause problems of phytotoxicity in plants that may inhibit their growth. There are obviously many projects for which this on site process would not be appropriate, including social housing refurbishments. However, it demonstrated that larger scale, centralised composting facilities (such as Local Authority sites) should be able to produce a suitable compost with the inclusion of the wood panel waste. It is suggested that this is investigated further, with a local large-scale facility encouraged to trial the use of chipboard waste in their process.

Energy from waste

Appropriate energy-from-waste facilities may not yet be available in Wales that could deal with the bonding agents present.

Some carpets and other flooring types may be composted or incinerated with energy recovery if deemed inappropriate for recycling. Flooring is typically difficult to deal with and in the short term there may be limited alternative end of life options available.

4.1.5 Disposal

It is inevitable that it will not be possible to find alternative waste management options for some elements of waste, such as general debris, some plastics and possibly flooring. As a last resort, landfill disposal may be the only option. However, this should be minimised by trying to recover materials at a higher stage in the Waste Hierarchy wherever possible.

Any asbestos containing products that are identified will need to be treated by specialist contractors, as asbestos is deemed hazardous waste. As such, its end of life route is pre-determined and must be disposed of in dedicated mono-cells at a hazardous landfill site. Since the disposal of such items cannot be influenced, it is perhaps more important to make additional effort to divert other

materials from landfill where options are available, to compensate for the inevitable fate of asbestos products.

4.2 Influence of the existing refurbishment approach/ strategy

The V2C refurbishment programme is being carried out by two main contractors, each working in different areas of the county. Waste is managed separately by each contractor. The programme of work allows for kitchens, bathrooms and windows to be replaced by separate teams and is dependent on when they can gain access to each property. Although works appear to be carried out across 'estates', individual houses in the programme may be relatively scattered. i.e. works on a whole street may not necessarily be carried out in one go.

This means that it is often not practical to set up waste facilities in a particular location near to works that are being carried out at any given time. In any case, this may not be preferable, since it is noted that when skips are placed unattended within housing areas they are inevitably filled with waste from local residents. This would be cause for concern, as it would not necessarily be possible to monitor what had been placed within the skip to guarantee there was nothing harmful present. On larger jobs, such as kitchen refits, mini skips may be placed at a property on the assumption that it will be largely filled by the works and removed from site quickly.

In addition, each contractor has a waste area, usually just consisting of a single mixed waste skip and a hazardous waste store, within a lockable compound adjacent to the site office, which tends to be based within the estate where works are taking place. Space confinements in these locations limit the potential for separate skips for segregation to some extent, though it is possible that this practice could be improved upon.

Since the contracting teams are evidently required to collect some waste generated from each job and return it to these centralised locations, this provides an opportunity for segregation at that point. This would be beneficial and preferable for certain materials if outlets are available for reuse and/or recycling, e.g. windows, metals, packaging. However, without suitable recycling outlets, such measures would be redundant.

It is assumed that the approach taken to the refurbishment programme by V2C's contractors will be relatively consistent with that of all Local Authorities and Housing Associations in Wales. Therefore any feasible improvements should also be transferable.

4.3 The future of the WHQS refurbishment programme

It is accepted that the WHQS will require regular, cyclic replacement of products and fittings. However, with changing trends, requirements and product costs, the profile of materials becoming waste from refurbished properties could vary in the future compared to the findings of this study. The overall lifecycle and sustainability impacts of the products and materials being used in the current refurbishments should be considered.

A range of Welsh Local Authorities and Housing Associations were surveyed as part of this project to establish whether the findings from the V2C study were indicative of the trends for the whole of Wales. They were also asked what materials items were expected to be replaced with during the refurbishments. Responses were received from 17 out of 40 of those who were sent the survey (approximately 43%), although the absolute coverage of the housing stock that this represents is not known. However, the survey is seen to provide a strong representation for Wales, particularly since the majority of organisations reported the same majority wastes and new materials being installed, as indicated below in Table 4. (It must be noted that although 17 organisations responded, many indicated more than one material being removed or installed. The table records the occurrence of each material, hence there are often more than 17 items in each column.)

Table 4: Summary of survey responses of materials being removed and installed during WHQS refurbishment programmes

Kitchens			Baths			Windows		
Materials	Removed	Installed	Materials	Removed	Installed	Materials	Removed	Installed
Chipboard	17	15	Steel	16	17	PVC	10	17
MDF	0	2	Plastic	6	2	Timber	16	2
			Cast Iron	4	0	Metal	6	0
						Composite	0	1
Total	**17**	**17**		**26**	**19**		**32**	**20**

In general:

- Kitchen units to be removed are made from chipboard and are generally being replaced with further chipboard units. However, some reported replacement with MDF. New flooring would be non-slip to meet required safety standards of the WHQS.
- In bathrooms, primarily steel baths were being removed and more steel baths being replaced, due to their hardwearing nature. Six organisations indicated that they would be restoring some baths, particularly cast iron baths. Ceramic basins and w/c's would also be replaced like-for-like.
- Windows being removed are mostly timber, with some occasional metal and a reasonable amount of old single glazed PVC. Virtually all were installing new double glazed PVC windows, with a few looking to replace with high performance timber windows or composite windows, particularly in conservation areas.

4.3.1 Changes in types of material waste arisings

The lifecycle impacts of products used should be considered, in addition to cost and durability aspects. For instance, the end of life options for materials could have a significant influence. The cost of disposal of 'difficult' wastes to landfill in the future is likely to be significant. However, if materials that are known to be readily recyclable now are used, this should not present such a problem (or cost) when they reach their end of life.

Comparison of the current profile of waste materials to the likely future profile is given in Table 5 below. It is assumed that in 2007, all flooring removed was vinyl (soft plastic) and all window frames were wood. In the future, it is assumed that these items will have been replaced with PVC window frames and non-slip flooring both of which have been classed as hard plastic in this example. It is likely that much of the chipboard from kitchens will be replaced with MDF in time, however that will obviously still fall within the 'timber' category and is probably equally difficult to recycle at present.

In each scenario, it is likely to be the chipboard/MDF proportion of the timber (the majority) and the plastics that would be the most difficult items to find recycling options for. Hard plastics will have increased from 0.3% of the total waste per house in 2007, to 7.0% of the overall waste in the future. These values may seem relatively small, but this is because they have essentially been skewed by the significant amount of inert waste arisings. The majority of this is from the removal of internal walls and masonry to make rooms comply with minimum space requirements of the WHQS. However, once this is done in the first round of refurbishments, it will likely not need to be done again in the future. Hence, the inert waste contribution will be significantly

Table 5: Comparison of average material waste arisings from WHQS refurbishments now and in the future

Material	Overall 2007 average (tonnes)	Overall future average (tonnes)	Future average less demolition (tonnes)
Inert	1.693	1.693	0.033
Timber	0.101	0.074	0.074
Glass	0.024	0.024	0.024
Cardboard	0.007	0.007	0.007
Steel	0.003	0.003	0.003
Copper	0.001	0.001	0.001
Soft plastic	0.013	0.003	0.003
Hard plastic	0.001	0.029	0.029
Total	**1.843**	**1.834**	**0.174**

Tonnages for each material calculated using density convergence factors taken fromPAS 402:2009 from M3 data

reduced, to around 0.059 per house, as indicated in the last column of Table 5. Plastic waste will then become the second largest waste stream after timber, representing 27% of the overall waste arisings.

The issue of plastic waste may not be such a problem if recycling facilities are made more widely available for PVC windows or if it can be shown to be economically viable to transfer window waste to appropriate existing facilities, such as WPR in Neath or Recover Plastics in Wrexham. However, it is anticipated that plastics recycling will unfortunately never be as readily available as recycling facilities for other materials, such as metals or inert waste.

Promising studies are currently underway at Bangor University Bio-composites Centre into MDF recycling. A system has been developed to recover the fibres for reuse in alternative applications as well as to be recycled back into MDF board products[7]. Although the concept is still in its relative infancy, it could be a huge benefit to the waste management industry, particularly if facilities are set up within Wales. Therefore, the move from chipboard kitchen units to MDF could be a beneficial step from a future end of life/recyclability point of view.

4.4 Wider considerations for future refurbishment

4.4.1 Installing for upgrade/ replacement

As well as the lifecycle impacts of the materials used, the maintenance aspects of products should also be taken into consideration. Kitchens are a key example. The method by which kitchens are traditionally constructed does not lend itself to deconstruction or upgrade. Units are generally glued and nailed, making them harder to be taken apart than if they were screw fixed for example. Countertops are most likely to require replacement in kitchens, along with door frontages.

Fortunately, replacing doors is relatively easy, as long as standardised cupboard sizing is used, which can considerably extend the life of a kitchen suite. However, usually during the removal of countertops, the integrity of the surrounding units is compromised, necessitating replacement. If consideration were given upfront to the installation methods of countertops to allow for them to be removed with relative ease at a later date, overall wastage from kitchen units could be considerably reduced.

4.4.2 Responsible sourcing

It is important that some of the wider sustainability impacts of these refurbishments are taken into consideration. Indeed, the refurbishment strategy itself is a compromise between the environmental impact of significant volumes of waste arisings and the social aspect of sustainability, ensuring that everyone can live in safe, healthy and efficient homes. Clearly minimising waste wherever possible and improving recycling rates, both now and for future refurbishments, is essential and the lifecycle impacts mentioned above also contribute to longer term sustainability. However, the responsible sourcing of products and materials should also be ensured.

For example, timber use within properties is substantial, due to kitchen replacements. There are several widely recognised and respected schemes that are used to demonstrate that timber is responsibly sourced i.e. it comes from sustainably managed, legal sources. The Forest Stewardship Council (FSC) chain of custody scheme is one of the better known, with the other schemes such as the Programme for Endorsement of Forest Certification (PEFC) and the Sustainable Forestry Initiative (SFI) chain of custody scheme also being adopted. Kitchens use primarily wood products in their construction – mainly chipboard and MDF. There are now manufacturers of kitchens that can ensure a full FSC chain of custody for their products, such as Moores[8] and Rixonway[9]. Responsible procurement practices should be focussing on suppliers that can demonstrate such credentials.

For non-timber products, equivalent schemes unfortunately do not exist at present. However, the ISO 14001 Environmental Management Standard and the Green Dragon accreditation scheme in Wales show that companies are committed to improving their performance with respect to the environment. Businesses adhering to these principles should therefore be favoured over those that are not.

4.4.3 Impact on tenant health

Since tenants are often not decanted from their homes while WHQS refurbishments are carried out, products should be selected that will not adversely affect the health of residents. Volatile Organic Compounds (VOCs) are found in many products, including paints, varnishes and carpet backing. They may cause irritation to eyes, nose and throat or lead to headaches or nausea in some individuals. Their use should therefore be avoided where possible, to reduce the risk of health issues with tenants.

5 Conclusions

This study has shown that significant quantities of waste will inevitably arise from the WHQS refurbishment programme in Wales, both now and in the future. In the short term, this could bear a cost of approximately £14million.

There are currently a limited range of facilities in Wales that are able to deal with the materials identified to be arising from the WHQS refurbishments. Therefore, it is likely that the majority of this waste will currently end up in landfill. However, several of the materials identified could find alternative end of life routes, at least in some regions of Wales that are perhaps better served with recycling facilities. Contractors carrying out the refurbishment programmes should therefore look to set in place centralised waste collection facilities that allow for segregation of key materials that can be diverted from landfill disposal, with the aim of increasing materials recovery and recycling.

Although the Local Authorities and Housing Associations are giving some consideration to the installation of new products and materials from a durability and safety point of view, further actions could be taken to:

- Extend the lifespan of new and existing installations
- Improve the potential end of life management of materials through appropriate materials and product selection
- Ensure the responsible sourcing/ sustainability of products chosen
- Use products that have minimal affect on tenant health

While currently a significant proportion of the estimated waste arisings are inert materials, such as rubble and ceramics, this is not likely to be replicated in future refurbishments, as the necessary alterations resulting in these arisings should not be required again once carried out now. The profile of the remaining waste materials will inevitably change in the future compared to those currently identified, with an apparent move away from things like timber and metal windows and vinyl floor coverings towards PVC windows and non-slip safety flooring. It is also apparent that chipboard in kitchen units may be replaced with MDF. Therefore, recycling facilities for PVC windows, safety flooring and MDF/ chipboard should ideally be developed to reduce the end of life impact of such materials, which are currently difficult to deal with. Existing facilities involved in the recycling of windows and MDF are likely to be in widespread demand over coming years.

6 Recommendations

As a result of this study, a series of recommendations have arisen that would help to support the WHQS refurbishment programme and reduce the associated waste sent to landfill.

- Actions should be taken to improve the recovery and recycling rates of current wastes wherever possible. Refurbishment contractors should investigate waste handlers that will provide recycling for appropriate materials and attempt to segregate such waste streams in centralised waste collection facilities. If no such central waste store is currently utilised, one should be developed.
- Benchmarks should be developed for resource efficiency and waste minimisation for the WHQS works, based on the indicated waste levels ascertained in this report or other robust National Resource Efficiency data.
- Refurbishment contractors should be encouraged to monitor their waste arisings during the ongoing programme, to measure against these benchmarks. This will also help refine the estimates made during this study and derive 'real', evolving benchmarks for housing refurbishments over time. BRE's SmartWaste tools may be utilised, either by directly measuring waste volumes on site or by receiving information from waste management contractors.
- WAG should encourage the development of recycling facilities dealing with 'difficult' wastes appropriate to the WHQS. In particular, the potential for composting chipboard in Local Authority civic amenity facilities or other waste transfer stations should be explored, along with suitable facilities for incineration with energy recovery for 'undesirable' timber (i.e. timber that would not currently be accepted at biomass incinerators due to the presence of varnishes or bonding agents, etc).
- The progress of the MDF recycling research at Bangor University should be followed and, once developed, appropriate facilities encouraged across Wales.
- The sustainability issues and health impacts associated with products and materials being used now and in the future for WHQS refurbishments should be considered. A 'sustainable refurbishment guidance' document and methodology on how to improve the sustainable choices made during planned or responsive maintenance should be developed and disseminated to all Local Authorities and Housing Associations.
- The WHQS provides a huge additional opportunity to bring about further

efficiency measures to many homes across Wales, which can also be highlighted during the dissemination process.

- Clear guidance on standard contractual clauses and requirements that could be implemented to improve the environmental performance of the contractors undertaking refurbishment works should be provided to clients.

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BSI "PAS 402:2009 Waste Resource Management - Specification for Performance Reporting" available from BSI http://shop.bsigroup.com

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