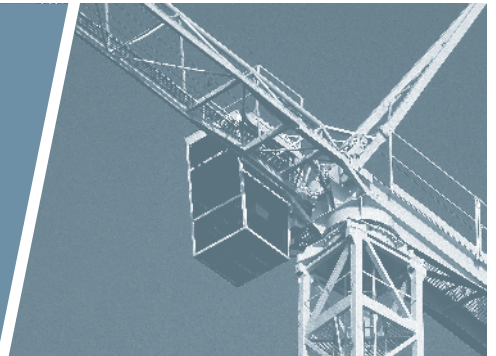




Cost of Building a 'Typical' Home

The impact of using PVC and alternative construction materials in house construction

Prepared for Vinyl Council of Australia



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1. INTRODUCTION

The Vinyl Council of Australia commissioned BIS Shrapnel to examine the additional cost of building a 'typical Australian home' without using PVC products.

This was a repeat of the exercise undertaken in 2002.

PVC is the market leader in the following applications in a typical house

- **Pipes** for sewerage, stormwater, drainage waste vent (DWV)
- **Electrical** cabling and Conduit

PVC is a major competitor in the following applications

- **Guttering**
- **Downpipes**

Additional PVC usage in and around the house could be:

- **Floor coverings.**

PVC does not command a large market share in Australia, as the most popular materials remain carpet, floating timber floors in its many variations, and ceramic tiles for wet areas, as well as family rooms. The use of vinyl floor covering is more prevalent in non-residential applications, but is increasing in popularity in houses.

- **External Walls**

Vinyl cladding is used rarely in new house construction, but still captures a small share of the renovation market.

- **Windows**

Somewhat surprisingly the market for PVC windows in Australia remains small, despite its popularity overseas.

2. METHODOLOGY

2.1 Desk Research and Builder Interviews

To carry out this research we undertook a combination of desk research, (using existing information on such things as costs of PVC and alternatives) and interviews with builders (to confirm such things as average volumes of materials used in 'typical' houses).

This report provides estimates of costs and usage volume of materials in a 'typical Australian home'. It defines the characteristics of this home, in terms of floor area, number of storeys, number of bathrooms, length of piping, roof size, etc. characteristics.

We have provided three (3) different 'typical homes', one single storey and two double storey houses.

For each of these 3 'typical homes' we have applied five (5) different cost and material scenarios, allowing for material substitution of varying degrees.

In order to estimate the cost of a typical house, we have drawn on information from a number of different sources, to meet the reporting requirements. These include:

- Rawlinsons Australian Construction Handbook, 26th edition, 2008. This is the major source of cost information for this report. This handbook outlines the cost, including labour, of a variety of materials, in each of the mainland states. While estimates of costs vary by state, we used the average of the average costs (that is, the sum of capital city costs, divided by 5) to determine the costs used in this report.
- While it is not in question that costs will vary for each individual project, using Rawlinsons Australian Construction handbook provides a point of reference and a consistency of pricing, which allows comparisons to be made with some degree of confidence.
- previous research from our series of studies *Building Materials and Fittings in Australia*, which quantifies the market for various building materials used in houses. From this research the "most popular" materials option is derived.
- publicly available information on the cost of the various PVC and alternative products typically used in house construction.

Combining all of the above with estimates of the volume of each material used in a typical house, we have been able to show the variations in costs of using a variety of materials.

Estimates on volumes and values used in this report were also confirmed during interviews and discussions with builders (including project home builders), plumbers, contractors, architects etc.

2.2 Typical House

2.2.1 'Constant' Building Applications

Each of the three different 'typical' houses was assumed to have a constant set of building applications, which were assumed to be unchanged throughout the process.

The following applications were assumed to have no popular or viable PVC alternative, and were therefore assumed to be constant for each different house type.

As a result of these applications being held constant, the costs associated with each remained constant and therefore irrelevant in terms of the cost impact on each alternative material cost scenario.

Application	Most common material(s)
Flooring (base)	Concrete for ground floor, timber sheet/strip for upper floor
Internal walls/ceilings	Plasterboard
Framing	Timber / steel
Windows	Aluminium/timber
Kitchen bench/cupboard	Laminates /timber cupboards or engineered stone / granite benchtops
Bathroom wall	Ceramic tiles
Roofing	Concrete tiles / steel sheet

Other factors common to each typical house were that each was set back 10 metres from the street and thus 10 metres from associated water, sewerage and electrical mains.

In addition, all costs accounted for both labour and materials.

2.2.2 'Variable' Building Applications

By assuming that the cost of those 'constant' building applications were irrelevant in terms of the impact on the final cost of the house, then the following 'variable' building applications are those which impact on the overall cost of each house.

2.2.2.1 Pipes

Potable Water: (20mm)

- Most common - Copper
- Alternatives - PVC

DWV: (100mm)

- Most common - PVC
- Alternatives - Polypropylene
- Polyethylene

Sewerage: (100mm)

- Most common - PVC
- Alternatives - Polypropylene
- Cast Iron

Storm: (100mm)

- Most common - PVC
- Alternatives - Polypropylene
- Polyethylene

Guttering, Downpipes

- Most common - Colorbond
- Alternatives - PVC

2.2.2.2 Electrical

Electrical Conduit

- Most common - PVC
- Alternatives - Galvanised Steel

Electrical Cabling

- Most common - PVC
- Alternatives - Polyethylene

2.2.2.3 Floor covering

- Most common - Carpet
 - Tiles (ceramic, slate etc)
- Alternatives - Vinyl
 - Lino / Marmoleum

2.2.2.4 External Walls

- Most common - Brick Veneer
- Alternatives - Vinyl Cladding

2.2.2.5 Insulation

- Most common - Glasswool Batts
- Alternatives - Polyester Batts

2.3 Quantities

The table below outlines the quantities of each of the variable materials, based on the following assumptions for each house:

House 1

- Single Storey
- 210 square metres (21m x 10m)
- 1 Bathroom
- 1 Laundry

The configuration of House 1 is identical to House 1 in the 2002 report.

The cost of the house in 2002, using the most popular materials was \$190,000, or \$905 per square metre.

The cost of House 1 in the 2008 scenario, using the most popular materials was \$276,570, or \$1,317 per square metre, an increase of nearly 46%.

House 2

- Double storey
- 290 square metres (14.5m x 10m)
- 2.5 Bathrooms
- 1 Laundry

The configuration of House 2 is identical to House 3 in the 2002 report.

The cost of the house in 2002, using the most popular materials was \$265,000, or \$913 per square metre.

The cost of House 2 in the 2008 scenario, using the most popular materials was \$381,930, again \$1,317 per square metre, an increase of 44%.

House 3

- Double storey
- 350 square metres (12.5m x 14m)
- 3 Bathrooms
- 1 Laundry

In order to reflect the increase in average floor area of houses since 2002, House 3 in 2008, was increased to 350 square metres, and cost \$460,950 to build.

A summary of the quantities assumed for each of the 3 houses is shown in the table below:

	Unit	House 1	House 2	House 3
		Quantity		
Floor Coverings (Total)	Sq M	210	290	350
Carpet	Sq M	140	200	240
Tiles/Lino/Vinyl	Sq M	70	90	110
External Wall (ex 15% Window)	Sq M	158	250	270
Insulation - Wall	Sq M	158	250	270
Insulation - Ceiling	Sq M	210	145	175
Plumbing - Potable	Lineal M - 20 mm	30	60	75
Plumbing - DWV	Lineal M - 100mm	60	105	125
Plumbing - Sewerage	Lineal M - 100mm	30	60	75
Plumbing - Storm	Lineal M - 100mm	50	75	75
Guttering	Lineal M	62	49	53
Downpipes	Lineal M	18	24	24
Electrical - Cabling	Lineal M	120	210	225
Electrical - Conduit	Lineal M	120	210	225

2.4 Cost / Material Scenarios

For each of the three (3) 'typical' house types, five (5) cost scenarios have been presented.

These cost/materials scenarios, (a), (b), (c), (d) and (e), allowed for the use of different materials in a number of these 'variable' building applications.

The five cost / material scenarios are as follows:

- Cost (a) Most Popular Material.** This cost scenario uses the most popular building materials for each application. The most popular materials were identified from our study "*Building Materials and Fittings in Australia, 1998 – 2001*" which sizes the market for building materials across all building sectors. These materials were confirmed with interviews with builders.

- Cost (b) PVC Alternative.** This cost scenario replaces all non-PVC leading materials, with a PVC equivalent.

- Cost (c) PVC Alternative, with brick veneer.** This cost scenario is as per cost (b), but reflects the fact that vinyl cladding is scarcely used, and so brick veneer has remained.

- Cost (d) Non-PVC Alternative.** This cost scenario replaces all leading materials, with a non-PVC equivalent.

- Cost (e) Non-PVC Alternative.** This cost scenario is another non-PVC scenario.

A summary of the materials used in each scenario is outlined in the table on the following page.

	a. Most Popular	b. PVC Alternative	c. Non-PVC Alternative	d. Non-PVC Alternative
Floor - coverings	Carpet Tiles	Nil (Carpet) PVC Cushion backed vinyl	Carpet Lino	Carpet Tiles
External Wall	Brick	Vinyl Cladding	Brick	Brick
Insulation – Wall	Glasswool Batts	Glasswool Batts	Glasswool Batts	Polyester Batts
Insulation - Ceiling	Glasswool Batts	Glasswool Batts	Glasswool Batts	Polyester Batts
Plumbing - Potable	Copper	PVC	Polyethylene	Polyethylene
Plumbing - DWV	PVC	PVC	Polyethylene	Polypropylene
Plumbing - Sewerage	PVC	PVC	Cast Iron	Polypropylene
Plumbing - Storm	PVC	PVC	Cast Iron	Polypropylene
Guttering	Colorbond	PVC	Colorbond	Colorbond
Downpipes	Colorbond	PVC	Colorbond	Colorbond
Electrical - Cabling	PVC	PVC	Polyethylene	Polyethylene
Electrical - Conduit	PVC	PVC	Galvanised Steel	Galvanised Steel

3. RESEARCH RESULTS

3.1 House 1

- single storey, 210 square metres

The Table on the following page shows the costs for House 1, associated with each of the 5 different cost / materials scenarios.

		% increase over total PVC option
Cost (a) – Most Popular Materials -	\$276,570	4.2%
Cost (b) – Total PVC -	\$265,366	least expensive option
Cost (c) – PVC with Brick Veneer -	\$271,686	2.4%

The total PVC option (b) is the least expensive option. In this option the largest savings occur in the following applications:

- External Walls - replacing brick veneer with vinyl cladding
- Internal Tiling - replacing ceramic floor tiles with PVC cushioned backed vinyl flooring
- Potable Water - replacing copper pipe with PVC
- Guttering - marginal saving by replacing Colorbond with PVC
- Downpipes - replacing Colorbond with PVC

Option (c) is also less expensive than the most popular materials option (a). This option is as per the total PVC option, but acknowledges that vinyl cladding is rarely used in new houses and so brick veneer has been costed into this option.

		% increase over total PVC option
Cost (d) – Non-PVC alternative -	\$279,760	5.4%
Cost (e) – Non-PVC alternative -	\$284,426	7.2%

In options (d) and (e) PVC was substituted by the following materials:

- External Walls - brick veneer
- Internal Tiling - lino / ceramic tiles flooring
- Potable Water - polyethylene
- DWV - polyethylene / polypropylene
- Sewer / Storm - cast iron / polypropylene
- Guttering - Colorbond
- Downpipes - Colorbond
- Electric Cabling - polyethylene
- Electric Conduit- galvanised steel

Summary – House 1

Actively seeking to minimise PVC in Options (d) and (e) increased the cost of House 1 by 5.4% and 7.2% in comparison to the least expensive option (b) the total PVC house.

House Number 1:	a. Most Popular Material			b. Total PVC Alternative			c. Total PVC Alternative (Brick Veneer)			d. Non-PVC Alternative			e. Non-PVC Alternative				
	Quantity	Unit	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$
Flooring - Coverings	140	Sq M	Carpet	78	10920	Nil (Carpet)	78	10920	Nil (Carpet)	78	10920	Carpet	78	10920	Carpet	78	10920
External Wall (ex 15% Window)	70	Sq M	Tiles	108	7560	PVC Cushion Backed Vinyl	53	3710	PVC Cushion Backed Vinyl	53	3710	Lino	74	5180	Tiles	108	7560
Insulation - Wall	158	Sq M	Brick	100	15800	Vinyl Cladding	60	9480	Brick	100	15800	Brick	100	15800	Brick	100	15800
Insulation - Ceiling	210	Sq M	Glasswool Batts	13	2054	Glasswool Batts	13	2054	Glasswool Batts	13	2054	Glasswool Batts	13	2054	Polyester Batts	17.5	2765
Plumbing - Potable	30	Lineal M	Glasswool Batts	9	1890	Glasswool Batts	9	1890	Glasswool Batts	9	1890	Glasswool Batts	9	1890	Polyester Batts	14.5	3045
Plumbing - DWV	60	Lineal M	Copper	45	1350	PVC	18	540	PVC	18	540	PVC	30	900	Polyethylene	30	900
Plumbing - Sewerage	30	Lineal M	PVC	57	3420	PVC	57	3420	PVC	57	3420	PVC	86	5160	Polypropylene	88	5280
Plumbing - Storm	50	Lineal M	PVC	57	1710	PVC	57	1710	PVC	57	1710	Cast Iron	100	3000	Polypropylene	125	3750
Guttering	62	Lineal M	Colorbond	33	2046	PVC	32	1984	PVC	32	1984	Colorbond	33	2046	Colorbond	33	2046
Electrical - Cabling	18	Lineal M	Colorbond	42	756	PVC	33	594	PVC	33	594	Colorbond	42	756	Colorbond	42	756
Electrical - Conduit	120	Lineal M	PVC	8	960	PVC	8	960	PVC	8	960	PVC	11	1320	Polyethylene	11	1320
	120	Lineal M	PVC	10.5	1260	PVC	10.5	1260	PVC	10.5	1260	Galvanised Steel	14.5	1740	Galvanised Steel	14.5	1740
Total Cost of Variable Materials					\$ 52,576			\$ 41,372			\$ 47,692			\$ 55,766			\$ 60,432
Total Cost of Constant Materials					\$ 223,994			\$ 223,994			\$ 223,994			\$ 223,994			\$ 223,994
Total House Cost					\$ 276,570			\$ 265,366			\$ 271,686			\$ 279,760			\$ 284,426

3.2 House 2

- double storey, 290 square metres

The Table on the following page shows the costs for House 2, associated with each of the 5 different cost / materials scenarios.

		% increase over total PVC option
Cost (a) – Most Popular Materials -	\$381,930	4.6%
Cost (b) – Total PVC -	\$365,095	least expensive option
Cost (c) – PVC with Brick Veneer -	\$375,095	2.7%

The total PVC option (b) is the least expensive option. In this option the largest savings occur in the following applications:

- External Walls - replacing brick veneer with vinyl cladding
- Internal Tiling - replacing ceramic floor tiles with PVC cushioned backed vinyl flooring
- Potable Water - replacing copper pipe with PVC
- Guttering - marginal saving by replacing Colorbond with PVC
- Downpipes - replacing Colorbond with PVC

Option (c) is also less expensive than the most popular materials option (a). This option is as per the total PVC option, but acknowledges that vinyl cladding is rarely used in new houses and so brick veneer has been costed into this option.

		% increase over total PVC option
Cost (d) – Non-PVC alternative	\$388,290	6.4%
Cost (e) – Non-PVC alternative	\$394,308	8.0%

In options (d) and (e) PVC was substituted by the following materials:

- External Walls - brick veneer
- Internal Tiling - lino / ceramic tiles flooring
- Potable Water - polyethylene
- DWV - polyethylene / polypropylene
- Sewer / Storm - cast iron / polypropylene
- Guttering - Colorbond
- Downpipes - Colorbond
- Electric Cabling - polyethylene
- Electric Conduit - galvanised steel

Summary – House 2

Actively seeking to minimise PVC in Options (d) and (e) increased the cost of House 1 by 6.4% and 8.0% in comparison to the least expensive option (b) the total PVC house.

House Number 2:	a. Most Popular Material			b. PVC Alternative			c. Total PVC Alternative (Brick Veneer)			d. Non-PVC Alternative			e. Non-PVC Alternative				
	Quantity	Unit	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$
Flooring - Coverings	200	Sq M	Carpet	78	15600	Nil (Carpet)	78	15600	Nil (Carpet)	78	15600	Carpet	78	15600	Carpet	78	15600
	90	Sq M	Tiles	108	9720	PVC Cushion Backed Vinyl	53	4770	PVC Cushion Backed Vinyl	53	4770	Lino	74	6660	Tiles	108	9720
External Wall (ex 15% Window)	250	Sq M	Brick	100	25000	Vinyl Cladding	60	15000	Brick	100	25000	Brick	100	25000	Brick	100	25000
Insulation - Wall	250	Sq M	Glasswool Batts	13	3250	Glasswool Batts	13	3250	Glasswool Batts	13	3250	Glasswool Batts	13	3250	Polyester Batts	17.5	4375
Insulation - Ceiling	145	Sq M	Glasswool Batts	9	1305	Glasswool Batts	9	1305	Glasswool Batts	9	1305	Glasswool Batts	9	1305	Polyester Batts	14.5	2102.5
Plumbing - Potable	60	Lineal M	Copper	45	2700	PVC	18	1080	PVC	18	1080	Polyethylene	30	1800	Polyethylene	30	1800
Plumbing - DWV	105	Lineal M	PVC	57	5985	PVC	57	5985	PVC	57	5985	PVC	57	5985	Polypropylene	88	9240
Plumbing - Sewerage	60	Lineal M	PVC	57	3420	PVC	57	3420	PVC	57	3420	PVC	57	3420	Polypropylene	125	7500
Plumbing - Storm	75	Lineal M	PVC	57	4275	PVC	57	4275	PVC	57	4275	PVC	57	4275	Polypropylene	91	6825
Guttering	49	Lineal M	Colorbond	33	1617	PVC	32	1568	PVC	32	1568	Colorbond	33	1617	Colorbond	33	1617
Downpipes	24	Lineal M	Colorbond	42	1008	PVC	33	792	PVC	33	792	Colorbond	42	1008	Colorbond	42	1008
Electrical - Cabling	210	Lineal M	PVC	8	1680	PVC	8	1680	PVC	8	1680	PVC	8	1680	Polyethylene	11	2310
Electrical - Conduit	210	Lineal M	PVC	10.5	2205	PVC	10.5	2205	PVC	10.5	2205	PVC	10.5	2205	Galvanised Steel	14.5	3045
Total Cost of Variable Materials					\$ 77,765			\$ 60,930			\$ 70,930			\$ 84,125			\$ 90,143
Total Cost of Constant Materials					\$ 304,165			\$ 304,165			\$ 304,165			\$ 304,165			\$ 304,165
Total House Cost					\$ 381,930			\$ 365,095			\$ 375,095			\$ 388,290			\$ 394,308

3.3 House 3

- double storey, 350 square metres

The Table on the following page shows the costs for House 2, associated with each of the 5 different cost / materials scenarios.

		% increase over total PVC option
Cost (a) – Most Popular Materials -	\$460,950	4.3%
Cost (b) – Total PVC -	\$441,806	least expensive option
Cost (c) – PVC with Brick Veneer -	\$452,606	2.4%

The total PVC option (b) is the least expensive option. In this option the largest savings occur in the following applications:

- External Walls - replacing brick veneer with vinyl cladding
- Internal Tiling - replacing ceramic floor tiles with PVC cushioned backed vinyl flooring
- Potable Water - replacing copper pipe with PVC
- Guttering - marginal saving by replacing Colorbond with PVC
- Downpipes - replacing Colorbond with PVC

Option (c) is also less expensive than the most popular materials option (a). This option is as per the total PVC option, but acknowledges that vinyl cladding is rarely used in new houses and so brick veneer has been costed into this option.

		% increase over total PVC option
Cost (d) – Non-PVC alternative	\$467,735	5.9%
Cost (e) – Non-PVC alternative	\$475,103	7.5%

In options (d) and (e) PVC was substituted by the following materials:

- External Walls - brick veneer
- Internal Tiling - lino / ceramic tiles flooring
- Potable Water - polyethylene
- DWV - polyethylene / polypropylene
- Sewer / Storm - cast iron / polypropylene
- Guttering - Colorbond
- Downpipes - Colorbond
- Electric Cabling- polyethylene
- Electric Conduit- galvanised steel

Summary – House 3

Actively seeking to minimise PVC in Options (d) and (e) increased the cost of House 1 by 5.9% and 7.5% in comparison to the least expensive option (b) the total PVC house.

House Number 3:	a. Most Popular Material			b. PVC Alternative			c. Total PVC Alternative (Brick Veneer)			d. Non-PVC Alternative			e. Non-PVC Alternative				
	Quantity	Unit	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$	Material	Unit Price \$ / Unit	Total Price \$
Flooring - Coverings	240	Sq M	Carpet	78	18720	Nil (Carpet)	78	18720	Carpet	78	18720	Carpet	78	18720	Carpet	78	18720
External Wall (ex 15% Window)	110	Sq M	Tiles	108	11880	PVC Cushion Backed Vinyl	53	5830	Lino	74	8140	Tiles	108	11880	Tiles	108	11880
Insulation - Wall	270	Sq M	Brick	100	27000	Vinyl Cladding	60	16200	Brick	100	27000	Brick	100	27000	Brick	100	27000
Insulation - Ceiling	175	Sq M	Glasswool Batts	13	3510	Glasswool Batts	13	3510	Glasswool Batts	13	3510	Glasswool Batts	13	3510	Polyester Batts	17.5	4725
Plumbing - Potable	75	Lineal M	Copper	45	3375	PVC	18	1350	PVC	18	1350	PVC	30	2250	Polyester Batts	14.5	2537.5
Plumbing - DWV	125	Lineal M	PVC	57	7125	PVC	57	7125	PVC	57	7125	PVC	86	10750	Polyethylene	30	2250
Plumbing - Sewerage	75	Lineal M	PVC	57	4275	PVC	57	4275	PVC	57	4275	Cast Iron	100	7500	Polypropylene	88	11000
Plumbing - Storm	75	Lineal M	PVC	57	4275	PVC	57	4275	PVC	57	4275	Cast Iron	100	7500	Polypropylene	125	9375
Guttering	53	Lineal M	Colorbond	33	1749	PVC	32	1696	PVC	32	1696	Colorbond	33	1749	Colorbond	33	1749
Downpipes	24	Lineal M	Colorbond	42	1008	PVC	33	792	PVC	33	792	Colorbond	42	1008	Colorbond	42	1008
Electrical - Cabling	225	Lineal M	PVC	8	1800	PVC	8	1800	PVC	8	1800	PVC	11	2475	Polyethylene	11	2475
Electrical - Conduit	225	Lineal M	PVC	10.5	2362.5	PVC	10.5	2362.5	PVC	10.5	2362.5	Galvanised Steel	14.5	3262.5	Galvanised Steel	14.5	3262.5
Total Cost of Variable Materials					\$ 88,655			\$ 69,511			\$ 80,311			\$ 95,440			\$ 102,807
Total Cost of Constant Materials					\$ 372,296			\$ 372,296			\$ 372,296			\$ 372,296			\$ 372,296
Total House Cost					\$ 460,950			\$ 441,806			\$ 452,606			\$ 467,735			\$ 475,103

4. CONCLUSION

In 2008, using all PVC products instead of the most popular materials could save consumers between 4.2% and 4.6% of their total construction costs.

By including brick veneer, the most common external wall cladding in Australia, consumers could still save between 1.2% and 1.8% on total construction, by using PVC over the most popular materials.

Consumers faced more expense if they actively sought to minimise PVC usage in building, adding between 5.4% and 8.0% to total cost over a total PVC house, and between 1.2% and 3.2% over the most popular building materials.

In comparison with the 2002 report percentage savings have increased. In 2002 consumers could save approximately 4% by using PVC instead of the most popular materials. Today that percentage has increased to over 4%.

In 2002, using all PVC products in comparison with minimising PVC, would save between 5% and 7%, compared with 2008, when minimisation can add as much as 8% to building costs.