Product Footprint Comparison

Produced For

The Antiques Trade

23rd August 2010

carbonclear

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The Antiques Trade

is represented by:

- Antiques Trade Gazette (antiquestradegazette.com)
- Antiques are Green (antiquesaregreen.org)
- International Antiques & Collectors Fairs (iacf.co.uk)
- The British Antique Dealers' Association (bada.org)
- LAPADA - The Association of Art & Antiques Dealers (lapada.org)
- Society of Fine Art Auctioneers and Valuers (sofaa.org)
- Online Galleries (onlinegalleries.com)
- Antiques.co.uk (antiques.co.uk)

Product Footprint Comparison Report

Author(s)

Paulo Lopes

Approved by

Anya Ledwith

Carbon Clear Limited

180-186 King's Cross Road

London

WC1X 9DE

Tel: +44 (0)845 838 7564

Fax: +44 (0)208 181 7872

www.carbon-clear.com

Company registered in England. No 557 5619. Registered office: 32 Dragon Street, Petersfield, Hampshire, GU31 4JJ.

EXECUTIVE SUMMARY

BACKGROUND

Carbon Clear was commissioned by the antiques trade as represented by Antiques Trade Gazette, Antiques are Green, International Antiques & Collectors Fairs, The British Antique Dealers' Association, LAPADA - The Association of Art & Antiques Dealers, Society of Fine Art Auctioneers and Valuers, Online Galleries and Antiques.co.uk to carry out a study into the relative carbon efficiency of antique furniture in comparison with new furniture.

Our study focuses on comparing the greenhouse gas emissions associated with manufacture, use and disposal of both antique and new furniture. It is our aim to answer the following questions;

Are antiques greener than new furniture? And if so, what is the difference between their carbon footprints?

As an independent consultancy specialising in carbon management and carbon accounting, Carbon Clear is well positioned to answer these question in an objective and robust manner. By following an international standard for the comparison of lifecycle greenhouse gas emissions and by publishing these results for external scrutiny we believe that we can demonstrate the validity of our analysis and conclusions.

PRODUCT FOOTPRINT COMPARISON

Our analysis compares two specific examples of chests of drawers; one constructed in 1830, and the other a modern piece. The latter is a good quality piece made to a standard comparable to the antique and currently available for sale from high street retailers. The items are similar pieces, both costing approximately the same to buy today, of a similar size and both serving the same purpose.

For the antique piece, our analysis covers the period from circa 1830 to 2025, a period in which the piece was assumed to have been restored and sold on two occasions. For the new piece, our analysis covers the period 2010 to 2025, the assumed lifespan of furniture.

Table 1 provides a comparison of the greenhouse gas emissions (in kg CO_2e) associated with both products. While the make-up of the carbon footprint of each product differs, the antique product has significantly lower carbon emissions during its lifecycle than the new piece.

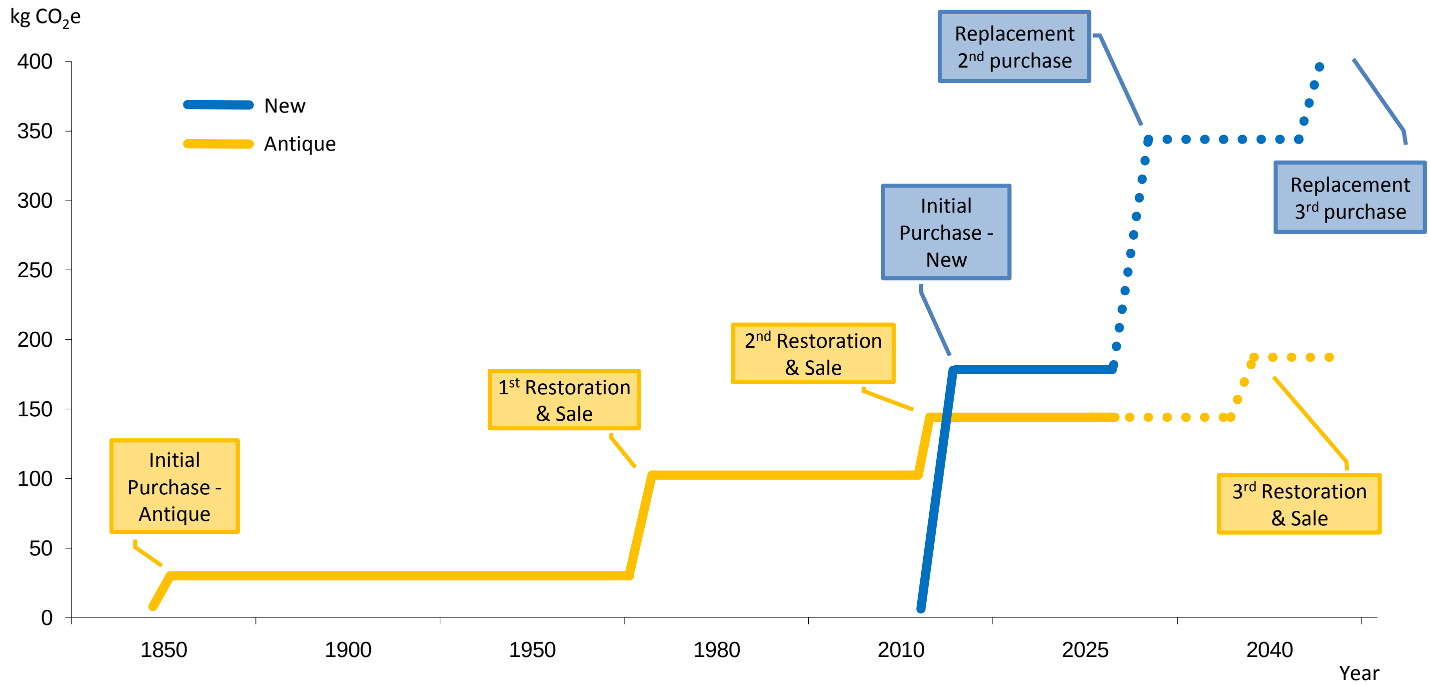
Table 1: Summary

	Antique		New	
	kg CO_2e	% of total	kg CO_2e	% of total
Raw materials	26.04	19%	60.81	36%
Production	0.00	0%	33.88	20%
Distribution	53.95	39%	36.04	21%
Storage	34.78	25%	28.17	17%
Restoration	24.83	18%	0.00	0%
Disposal	0.00	0.%	11.48	7%
Total	**139.60**		**170.38**	

COMPARISON OVER LIFESPAN

The absolute emissions of the antique product are lower than the new piece. The graph below compares the typical life cycle carbon impacts of the antique and new chest of drawers in absolute terms.

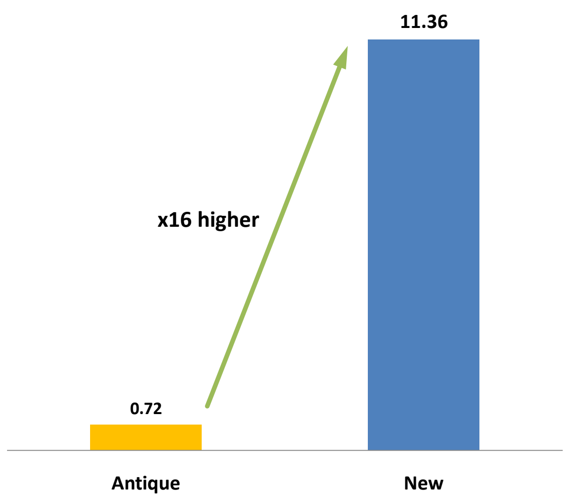
"Cumulative Emissions"



But this does not tell the whole story as we must also factor in the relative lifespan of one product versus the other. For the antique product, the carbon assessment covers a period of 195 years while the new product assessment covers only 15 years.

In order to compare the footprint of the products based on their lifespan, we calculated the carbon footprint per year of use. The antique product has an annual carbon footprint of **0.72 kg CO_2e**, whereas the new product has a footprint per year of use of **11.36 kg CO_2e.** This shows that a new chest of drawers will have a carbon impact sixteen times higher than a chest of drawers.

Emissions per year of use (kg CO2e)



We recognise that we have used assumptions and we have detailed and explained these assumptions throughout. While our analysis is sensitive to our assumptions, there is no potential to overturn the far lower per annum impact of the antique chest of drawers. It is, therefore, our professional opinion that the associated emissions for an antique chest of drawers are significantly lower than a modern alternative.

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INTRODUCTION

This report compares the life cycle greenhouse gas emissions of an antique chest of drawers compared to a new one.

Following established good practice for product carbon footprinting this assessment has focused on the following stages of the product lifecycle.

- Raw materials
- Manufacturing
- Transportation
- Disposal

In order to allow useful comparisons, the footprint of the two items is presented in absolute terms and also relative to their expected lifespan and weight of product.

METHODOLOGY

This assessment follows the international specification PAS 2050:2008[1], which has been developed in response to broad community and industry desire for a consistent method for assessing the life cycle greenhouse gas emissions of goods and services. Life cycle greenhouse gas (GHG) emissions are those that are released as part of the processes of creating, modifying, transporting, storing, using, providing, recycling or disposing of goods and services.

Carbon Clear uses PAS 2050 because:

- The standard has been prepared by the British Standard Institution (BSI) and thus represents the work of an impartial and expert third party
- The specification has international recognition for external stakeholders
- Provides a consistent method of assessment.

[1] BSI, PAS 2050:2008 – Assessment of the Life Cycle Greenhouse Gas Emissions of Goods and Services

Based on the PAS 2050 methodology, this research analysed the carbon impact associated with the following stages of the life cycle:

- Raw materials
- Manufacturing process
- Distribution/Retail
- Disposal

The greenhouse gases (GHG) emissions associated with the use of the product have not been included as these are considered minimal.

DATA SOURCES

Data was collected from various sources in order to create an emissions model.

The data and information relating to the antique was provided by Nigel Worboys from Antiques are Green and Richard Lewis from ATG Media.

Christopher Claxon Stevens[2] was also consulted for further details about the origin of raw materials, production methods and transportation in 1830.

Data and information for the new chest of drawers was researched by contacting manufacturers. However, as manufacturers proved reluctant to make full disclosures, Carbon Clear invited Delio Vicente[3], an expert in furniture product design and manufacturing processes, to contribute.

Emissions have been calculated using emissions factors from Defra[4], Bath University[5] and the Carbon Trust[6], and are given as an equivalent unit of carbon dioxide in kilograms of CO_2e.

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[2] Christopher Claxon Stevens from Norman Adams Antiques is an expert in antiques and co-author of "18th Century English Furniture – Norman Adams"

[3] Delio Vicente is a "Furniture and Product Designer" for TemaHome. Delio is an expert in production techniques, with several years of experience within the industry.

[4] Defra (2009) "Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting", UK

[5] Bath University (2008) "Inventory of Carbon & Energy", UK

[6] Action Energy - Carbon Trust (2003) - Energy Consumption Guide 19

The emissions factor for freight by horse & cart was estimated by Carbon Clear using data published by John Fry[7], Lisa Young[8] and from the Danish Institute of Agriculture[9].

The emissions factor for the animal glue was estimated by Carbon Clear using raw data from water boiling tests[10]. Further research explored the process used to produce animal glue, thus establishing the amount of wood used in the process and the respective carbon emissions using IPCC data[11].

All tables have had figures rounded to two decimal places unless otherwise specified. Thus some minor discrepancy in totals may occur.

Where accurate data was not available, assumptions have been based on expert opinion both for the antique and new chest of drawers. All assumptions have been clearly stated in the report.

[7] Fry, J. (1973) "Methane Digesters for Fuel Gas and Fertilizer", California, US

[8] Young, L. (2006) "London's Working Horses", The Globe & Mail, Canada

[9] Hensen, A. (2005) "Dairy farm CH4 and N2O emissions, from one square metre to the full farm scale", Volume 112, Issue 2-3, Danish Institute of Agriculture Sciences

[10] Carbon Clear (2009) "Water Boiling Test (WBT) – protocol v3.0"

[11] IPCC (2006) "IPCC Guidelines for National Greenhouse Gas Inventories"

ANALYSIS OF AN ANTIQUE CHEST OF DRAWERS

The life cycle analysis of the antique chest of drawers focussed on the origin of raw materials, distances travelled, types of transport used, production, restoration and reselling of the furniture. ATG Media collected historical data and invited an expert to provide further information in order to document the production process in 1830 and the origin of the raw materials.

The antique considered for this report is a chest of drawers manufactured in 1830 in England, weighing approximately 50 kg.

RAW MATERIALS

The chest of drawers was constructed with a pine carcass and a mahogany veneer which was widely available in 1830.

The weight of the pine is approximately 43 kg, representing 90% of the total weight of the chest of drawers. According to expert opinion, the pine was probably sourced from the Baltic; however around this period North America would soon become the major source of pine.

For this assessment, the pine is assumed to be from the Baltic which is transported by horse and cart to a port in one day. From there, the wood was freighted by sailing ship to the Port of London, where it assumed to have travelled 10 miles by horse and cart to the cabinet maker.

Mahogany for veneers was often sourced from the West Indies (possibly Cuba or Honduras). The mahogany is assumed to have been transported by horse and cart from a location outside Havana, Cuba, shipped to London and then transported 10 miles to the cabinet maker.

The brass fittings account for 1 kg of the product's weight and were probably made in Birmingham, cast or stamped out by specialist firms such as ones run by Matthew Boulton's. The analysis assumes that the brass fittings were transported by horse and cart from Birmingham to the cabinet maker.

The glue was probably made locally (from boiled hoof and horn), as was the polish (shellac varnish, with the shellac imported from the East). The emissions associated with the shellac are minimal and have not been included in this analysis.

Table 2 summarises the carbon impact associated with transport of the raw materials. Please note that these relate to modes of transportation in pre-industrial times before fossil fuels were used for transport.

Table 2	Transport		
	Type of transport	Weight (kg)	kg CO_2e
Pine	Horse & cart	42.5	0.191
	Ship (sail)	42.5	0.000
Mahogany	Horse & cart	4	0.018
	Ship (sail)	4	0.000
Brassware & locks	Horse & cart	1	0.005
		Total	**0.214**

*Note: Above table figures have been rounded to three decimal places

The ships were powered by wind and therefore generated no associated emissions. Transporting materials by horse and cart generates emissions (primarily methane) which have been calculated using the following assumptions: a two horse cart can pull 2.5 to 3 tonnes, with each horse emitting 2.814 kg CO_2e[12] a day; assuming that all the distances travelled will take one day, this resulted in an emissions factor of 0.0023 kgCO_2e per kg freighted per day[13].

Table 3 shows the embodied emissions in the raw materials.

Table 3	Embodied emissions	
	weight (kg)	kg CO_2e
Pine	42.5	13.98
Mahogany veneer	4	1.65
Brassware & locks	1	1.69
Animal glue	3	8.49
	Total	**25.82**

The embodied emissions data uses the Bath University research that analysed GHG emissions associated with current wood cutting and processing in the UK. For the antique piece, most of the wood would have been cut and processed by hand, resulting in an embodied emissions factor close to zero. However, to be conservative, this analysis uses a coefficient based on 70% of the new coefficient.

Total GHG emissions associated with the embodied emissions and the transportation of the raw materials amounts to **26 kgCO_2e**.

[12] Estimated by Carbon Clear based on livestock GHG emissions

[13] 0.0023 = (2.814kgCO_2e * 2 horses) / (2,500kg)

MANUFACTURING

Cabinet makers' workshops in 1830 were not generally powered and all the work was done by hand in daylight. Wood was burnt to produce and warm the animal glue and as a by-product it would also heat the workshop; these emissions have already been accounted for within the animal glue embodied emissions factor.

Thus no additional GHG emissions have been associated with the manufacturing process of the chest of drawers.

DISTRIBUTION & STORAGE

As was common at the time, the analysis assumes that the chest of drawers was initially sold locally and was transported to the customer by horse and cart.

As agreed with ATG, the report assumes that the antique is kept within the original customer's family before going through two sales processes; one sale between 1950 and 1980 and the second sale in 2010.

With the item being kept within the family, the report assumes that the GHG impact emissions associated with any move is minimal and therefore has not been included.

The GHG impact during the sales process includes the transportation and storage of the item, as summarised in Table 4. In a typical sale, the item is transported in a light van along with other items to the auctioneer, on to the dealer who buys it, to a restorer, back to the dealer. Finally, the customer will use a car to buy the item; this will produce more emissions than using a van that transports other items as well. The first sale occurred somewhere between 1950 and 1980 when vehicles emitted more GHG emissions than today as they were less efficient. Carbon Clear estimated the emissions of vehicles during that period[14].

[14] GHG emissions estimated using data from Environmental Protection Agency (2009) "Light-Duty Automotive Technology, carbon Dioxide Emissions, and Fuel Economy Trends: 1975 through 2009" and "Defra (2009) "Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting", UK

Table 4	Distribution		
	Distances (Miles)	Transport	kg CO_2e
From cabinet maker to customer	5	Horse & cart	0.11
1st sale			
To auctioneer	25	Freight - road	1.42
To dealer	40	Freight - road	2.27
To restorer	15	Freight - road	0.85
To dealer's shop	15	Freight - road	0.85
To consumer	50	Car – road	29.68
2nd sale			
To dealer	40	Freight - road	1.30
To restorer	15	Freight - road	0.49
To dealer's shop	15	Freight - road	0.49
To consumer	50	Car – road	16.49
		Total	**53.95**

In addition to being transported, the item would have been stored at each location (with energy considerations in each of the buildings). The number of days stored at each location can vary widely, therefore the estimations used mirrored the number of days used for the new chest of drawers where these are available. Typical energy consumption figures for storage[15] have been applied including an adjusted emissions factor for the first sale[16] which happened between 1950 and 1980. The emissions associated with storage at the restorer have not been included here, as it has been accounted for in the restoration section. The GHG emissions impact arising from storage are summarised in Table 5.

[15] Action Energy (Carbon Trust), 2003 - Energy Consumption Guide 19

[16] Storage emissions factor estimated using electricity data from International Energy Agency (2010) "Electricity Generation by fuel in the United Kingdom – 1971" and IPCC (2006) "IPCC Guidelines for National Greenhouse Gas Inventories"

Table 5 Storage	Days	kg CO_2e
1st sale		
At auction	2	2.09
At dealer's warehouse	5	5.23
At dealer shop	14	14.64
2nd sale		
At dealer's warehouse	5	3.37
At dealer shop	14	9.45
	Total	**34.78**

Total GHG emissions associated with the distribution and storage of the antique chest of drawers amounts to **89 kgCO_2e**.

RESTORATION

The restoration process can vary widely depending on the condition of the piece of furniture. This research assumes that the restoration phase takes five days and has undergone two restoration processes; however based on advice by the client it should be noted that in practice a major restoration would usually only be required every 100 years. However for the purpose of this study it has been assumed that a full restoration has taken place on each occasion the item has been sold.

Most of the restoration processes involved manual and small electrical tools (in workshops requiring heating and lighting). When calculating the energy used during this process, this research uses the emissions factor for "Light Manufacturing"[17] (the same coefficient factor as used for the manufacturing process of the new chest of drawers). While the restoration process is expected to use less energy than that implied by the "Light Manufacturing" coefficient, the use of this coefficient reflects a conservative accounting approach to this item. The GHG emissions associated with storage are included within the emissions factor for "Light Manufacturing".

In addition to the energy used during the restoration process, the analysis also includes emissions associated with primary materials, in this case polish and wax[18]. Again, the GHG emissions for the first

[17] Action Energy (Carbon Trust), 2003 - Energy Consumption Guide 19

[18] Bath University (2008) "Inventory of Carbon & Energy", UK

sale were adjusted to consider the higher emissions[19] from electricity generation during that period. The report assumes 1kg of finishing products, an amount similar to that used on new furniture products.

Table 6 Restoration	Days	Weight (kg)	kg CO_2e
1st sale			
Light Manufacturing process	5		8.55
Finishing products		1	5.38
2nd sale			
Light Manufacturing process	5		5.52
Finishing products		1	5.38
		Total	**24.83**

Table 6 shows a summary of the GHG emissions associated with the restoration process, which accounts for **25 kgCO_2e** of the total product footprint.

DISPOSAL

Due to the extended life expectancy of the antique, the report assumes that the item will be resold and not disposed off, therefore there are no GHG emissions for this stage.

[19] Electricity data from International Energy Agency (2010) "Electricity Generation by fuel in the United Kingdom – 1971" and IPCC (2006) "IPCC Guidelines for National Greenhouse Gas Inventories"

SUMMARY - ANTIQUE

The estimated life cycle emissions associated with the antique chest of drawers sums to **140 kgCO_2e** as itemised in Table 7 below.

Table 7 **Summary – Antique**

	kg CO_2e	% of total
Raw materials (inc Transport & embodied emissions)	26.04	18.7%
Production	0.00	0.0%
Distribution	53.95	38.6%
Storage	34.78	24.9%
Restoration	24.83	17.8%
Disposal	0.00	0.0%
Total	**139.60**	

ANALYSIS OF A NEW CHEST OF DRAWERS

The life cycle analysis of the new chest of drawers focuses on the origin of raw materials, freight distances, types of transport used, production processes and product disposal.

This analysis is based on a typical manufacturing process, with process information provided by Delio Vicente, an expert in the design and manufacture of furniture. Specific manufacturers were also contacted to provide the remaining information, although detailed data of the manufacturing process was not forthcoming.

The new furniture selected for review is a "Five Drawer Chest" manufactured in 2010 and weighing approximately 68 kg. This furniture is of high quality and has a similar price and features to the antique chest of drawers.

RAW MATERIALS

This study has made the following assumption:

The new chest of drawers is composed of Chinese birch, MDF, chipboard and walnut veneer.

All the raw materials originate in China, more specifically from the province of Guangdong, a region that is known for manufacturing most of the furniture for the western world. All materials were transported in bulk by articulated lorry to the manufacturing facility in Guangzhou. Without knowing specific locations within the province, it was assumed that the Chinese birch is sourced 100 miles away and the remaining raw materials approximately 25 miles away. The transport of all materials is summarised in Table 8.

Table 8 **Transport of raw materials**

	Transport	Distance (miles)	kg CO_2e
Chinese Birch	Freight - road	100	0.11
MDF	Freight - road	25	0.05
Chipboard	Freight - road	25	0.13
Walnut veneer	Freight - road	25	0.01
Matt lacquer	Freight - road	25	0.005
Glue	Freight - road	25	0.01
		Total	**0.32**

As with the antique, the embodied emissions within the raw materials have been calculated by referencing research by Bath University. These factors include the life cycle of raw materials from cradle to gate.

As shown in Table 9, chipboard weighs 37kg and accounts for 31% of the embodied emissions, whereas the glue has 33% of GHG emissions though only weighs 3.4kg.

Table 9 **Embodied emissions**

	weight (kg)	kg CO_2e
Chinese Birch	8	3.84
MDF	15	8.83
Chipboard	37	18.73
Walnut veneer	3	1.73
Matt lacquer	1.4	7.28
Glue	3.4	20.09
	Total	**60.49**

When considering both the embodied emissions of the raw materials and their transport to the manufacturing site, the total GHG emissions for raw materials rounded up amount to **61 kgCO_2e**.

PRODUCTION

The manufacturing process of a new piece of furniture may differ widely. From automated factories that require more energy but are faster and need less people to operate; to labour intensive that are less energy intensive but take more time and staff. For the purposes of this analysis the production process in Guangzhou for the new chest of drawers has been calculated using the following stages and energy requirements[20]:

- 1st week - Manufacturing Process

  Most of the energy used is electricity for machinery to cut the wood, and for fans to cool the workspace and reduce the amount of dust in the air.

- 2nd week – Finishing

  A spray lacquer is applied in an isolated room (with compressors powered by mains electricity or diesel generators). The drying process may require additional energy if climatic conditions are not favourable.

- 3rd and 4th weeks – Final

  The final stage takes approximately two weeks and involves last minute changes in the furniture and quality checks. The remaining pieces are assembled and the packaging process is concluded.

[20] Manufacturing process information supplied by Delio Vicente

The emissions factor for "Light Manufacturing"[21] was adapted using an electricity emissions factor from China[22] to reflect energy used during the manufacturing process including the energy consumption associated with storage. The report assumes that the piece remained on site (in production and storage) for 20 days.

As Table 10 shows, the GHG impact associated with the production process is **34 kg CO_2e**.

Table 10	Production	
	Days	**kg CO_2e**
Light Manufacturing	20	**33.88**

DISTRIBUTION

Once quality checked, the finished items of furniture are packaged for transport (with approximately 10 kg allowed for packaging and pallets).

Due to the large quantities involved, the furniture is freighted in bulk to the destination country. The items are transported initially by articulated lorry from Guangzhou to the nearest port, then by sea in large container vessels to the UK, after clearing customs they will be taken by articulated lorry to a distribution centre, before being sent on to a retail outlet. The report assumes that the customer travels to the store by car and purchases and collects the item that day (as opposed to being delivered by the store or its logistics provider).

Table 11 summarises the GHG impact of this transportation.

Table 11	Distribution		
	Distance (miles)	**Transport**	**kg CO_2e**
From production			
To port of departure	10	Freight –road	0.11
To port of arrival	11160	Freight – sea	18.37
To distribution centre	50	Freight – road	0.54
To store	50	Freight – road	0.54
To consumer	50	Car – road	16.49
		Total	**36.04**

[21] Action Energy - Carbon Trust (2003) - Energy Consumption Guide 19

[22] Defra (2009) "Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting", UK

Between these transportation stages, the furniture is stored awaiting distribution. The estimated number of days at each stage is shown in Table 12. The energy used in the warehouses, mostly for lighting and security purposes, is calculated by floor area used and time[23]. The GHG emissions arising from electricity generation are higher in China[24] than in the UK and this is reflected in higher emissions at the port in China.

Table 12 Storage	Days	kg CO_2e
Port of Guangzhou	7	7.25
Port of London	10	6.75
Distribution Centre	7	4.72
Store	14	9.45
	Total	**28.17**

The GHG emissions arising from the distribution phase (transport and storage) amount to **64 kgCO_2e**.

DISPOSAL

Supplied with a 12 month warranty, the product has a typical lifespan (estimated by expert opinion Delio Vicente) of approximately 5-10 years. For the purposes of the report, and to be conservative, this has been increased to 15 years. It is assumed the product will not be refurbished or resold.

Once the chest of drawers reaches the end of its usable life, it was assumed that it will be disposed at a landfill site near the consumer's house. Based on the weight of the product and the published emission factor for landfill waste[25] the GHG emissions in this phase result in **11.48 kgCO_2e**.

[23] Action Energy (Carbon Trust), 2003 - Energy Consumption Guide 19

[24] Defra (2009) "Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting", UK

[25] Defra (2009) "Guidelines to Defra / DECC's GHG Conversion Factors for Company Reporting", UK

SUMMARY - NEW

The life cycle emissions associated with the new chest of drawers totals to **170 kg CO_2e** as indicated in the table below.

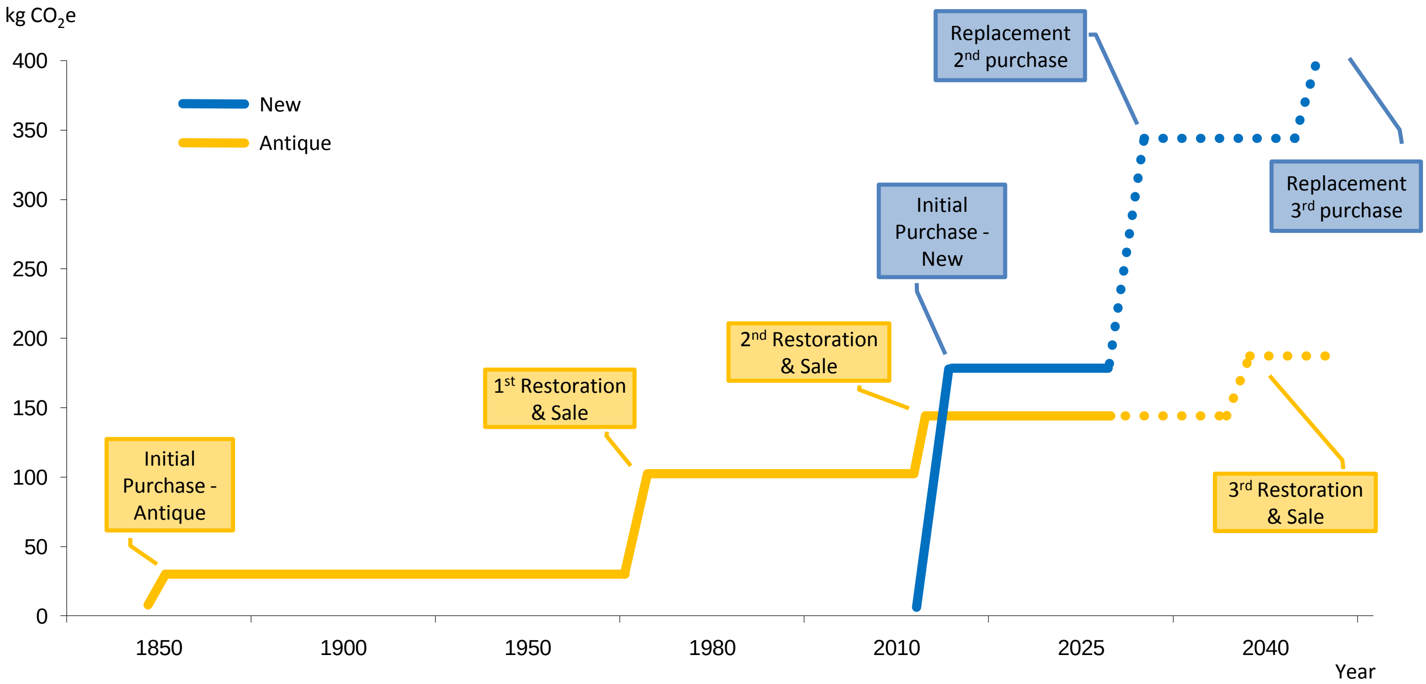
Table 13	Summary – New	
	kg CO_2e	% of total
Raw materials (inc Transport & embodied emissions)	60.81	35.7%
Production	33.88	19.9%
Distribution	36.04	21.2%
Storage	28.17	16.5%
Disposal	11.48	6.7%
Total	**170.38**	

COMPARISON OF ANTIQUE AND NEW

LIFE CYCLE COMPARISON

The following graph compares the typical life cycle emissions of the antique and new chest of drawers in absolute term indicating the GHG impact at different stages of the life cycle between 1830 and 2025.

Figure 4



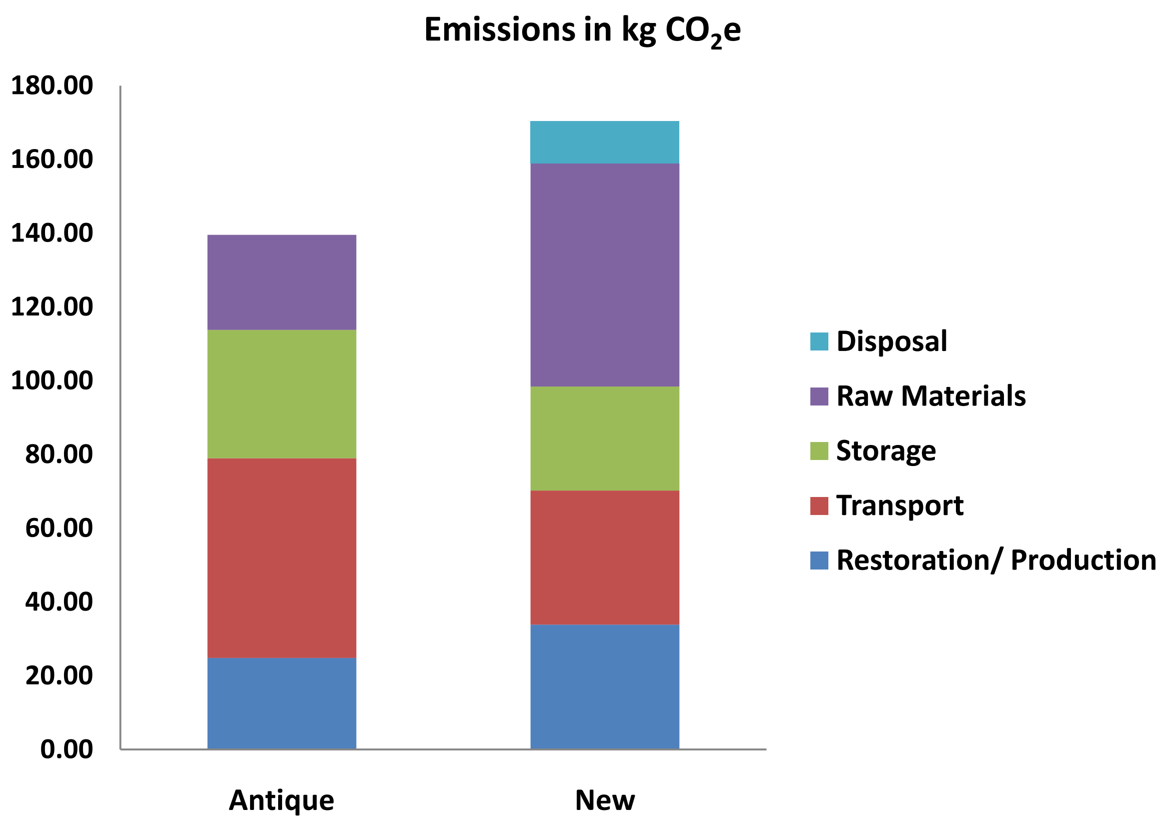
- 1830 - Initial purchase includes the embodied emissions of the wood, transportation of raw materials and of the chest of drawers to the final customer producing **26 kgCO_2e**. It is then used by and passed down through the same family.
- Between 1950 and 1980 – 1st Restoration & Sale of the antique, most of the GHG emissions are associated with the transport of the item to the auctioneer, dealer's shop and customer. This adds 71 kgCO_2e, bringing the total to **97 kgCO_2e**.
- 2010 – 2nd Restoration & Sale takes place, with emissions arising mainly from transportation. By 2010, the accumulated emissions impact is **140 kgCO_2e.**
- 2010 – The new chest of drawers is manufactured and purchased, with a GHG emissions impact of **170 kgCO_2e**, already greater than the antique's during its 180 years.
- 2025 – The new chest of drawers has reached its end of life. If it is to be replaced using the same process, the new product will produce an additional 170 kgCO_2e or a cumulative emissions impact of **340 kgCO_2e**.

- Beyond 2025 - The antique is sold again, renewing its cycle. The cumulative emissions impact is **180 kgCO_2e.** The second purchase of the new chest of drawers is reaching its end of life and need to be replaced by a third purchase adding another **170 kgCO_2e** bringing the total to **510 kgCO_2e**.

PRODUCT FOOTPRINT COMPARISON

The total life cycle emissions arising from the antique chest of drawers at 140 kgCO_2e are 18% less than those of the new chest of drawers at 170 kgCO_2e. A breakdown of the emissions from each stage is shown in Figure 5 below.

Figure 5



The new item compares unfavourably with the antique for the following reasons:

- The bill of materials for the new item includes more materials, and particularly more processed materials.
- The new item is manufactured using new manufacturing processes and facilities. In 1830, the antique would have been produced manually with "power" provided by animals and wood.

The antique compares unfavourably with the new item:

- The transportation emissions are greater for the antique because while the overall distance travelled is shorter it is moved in less efficient smaller vehicles during the restoration and sales phases (transit vans and small lorries).
- The new item is transported in bulk (shipping container and articulated lorry) with far greater efficiency per mile travelled.

EMISSIONS PER YEAR OF USE

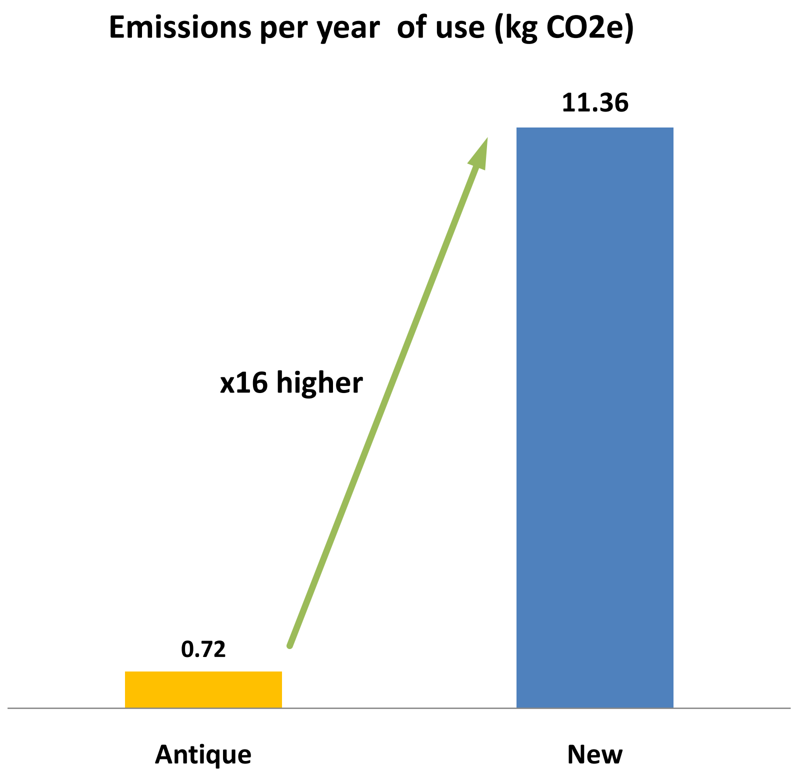
Given that the antique has a far greater expected lifetime, a comparison of average emissions per year provides the best benchmark for comparative analysis.

The new chest of drawers is expected to last 15 years (from 2010 until 2025) and has a footprint of 170 kg CO_2e, or average emissions per year of **11.36 kg CO_2e.**

The antique product was manufactured in 1830. As at 2025 it will have generated total emissions of 140 kg CO_2e, or emissions per year of **0.72 kg CO_2e.**

The following graph shows that the GHG emissions per year of life in use associated with a new chest of drawers are **16 times** higher than those of the antique.

Figure 7



SUMMARY - PRODUCT FOOTPRINT COMPARISON

The following table summarises the results of this analysis comparing both chests of drawers.

Table 14	Summary			
	Antique		**New**	
	kg CO_2e	**% of total**	**kg CO_2e**	**% of total**
Raw materials (inc Transport & embodied emissions)	26.04	18.7%	60.81	35.7%
Production	0.00	0.0%	33.88	19.9%
Distribution	53.95	38.6%	36.04	21.2%
Storage	34.78	24.9%	28.17	16.5%
Restoration	24.83	17.8%	0.00	0.0%
Disposal	0.00	0.0%	11.48	6.7%
Total	**139.60**		**170.38**	
Average emissions/ year[26]	**0.72**		**11.36**	

[26] Average emissions per annum are calculated using 195 and 15 years respectively for the antique and new items

CONCLUSION

In this study we set out to answer the questions "*Are antiques greener than new furniture? And if so, what is the degree of difference between the two approaches to furnishing one's home?*" If we use greenhouse gas emissions as our metric for which is the greenest product, then it is clear that antique piece of furniture is, indeed, greener.

The life cycle emissions from the antique chest of drawers amount to **140 kg CO_2e** and the new one account to **170 kg CO_2e.** In terms of absolute emissions, the antique chest of drawers produced approximately 20% lower emissions over the assessed lifecycle than the new product.

Taking into account the longer lifespan of the antique furniture, we see that the annual emissions for the antique product amount to **0.72 kg CO_2e** and a new piece to **11.36 kg CO_2e**. On a "*per year of use*" basis, a new chest of drawers has a GHG emissions impact **16 times** higher than the antique.

We recognise that we have used assumptions and we have detailed and explained these assumptions throughout. While our analysis is sensitive to our assumptions, the sensitivity does not have the potential to overturn the far lower per annum impact of the antique chest of drawers. It is, therefore, our professional opinion that the associated greenhouse gas emissions of an antique chest of drawers is significantly lower than a new alternative.

APPENDIX - GLOSSARY

Carbon dioxide equivalent (CO_2e): A metric used to compare the relative global warming potential of different greenhouse gases. For example, methane is 21 times more potent than CO_2 - making 1 tonne of methane equal to 21 tCO_2e.

Carbon footprint: The total greenhouse gas emissions (GHG) from an organisation or activity, expressed in tonnes of CO_2 equivalent.

Cradle to Gate: GHG emissions associated with raw materials, manufacture and distribution to business consumer of a product or service.

Cradle to Grave: GHG emissions associated with raw materials, manufacture, distribution/retail, consumer use, disposal/recycling or a product or service.

Embodied emissions: The GHG emissions associated with the manufacturing and processing of a material/ product based on its life cycle. For example the embodied emissions of wood include the energy use in cutting the wood in the forest and processing until it reaches a manufacturing site.

Emission coefficient: A number used to convert units of an activity or product into units of CO_2e that result from the activity or from the manufacture and/or use of the product. Emission coefficients are usually expressed as tonnes CO_2e/[unit of activity].

Emission reduction: The removal, limitation, reduction, avoidance, sequestration or mitigation of greenhouse gas emissions.

Global Warming Potential (GWP): The intensity with which a tonne of greenhouse gas (GHG) affects global warming relative to a tonne of carbon dioxide. Some GHGs stay in the atmosphere longer than others, so relative GWP changes with time. The GWP for the six GHGs covered under the Kyoto Protocol are as follows:

- Carbon dioxide (CO_2): 1
- Methane (CH_4): 21
- Nitrous oxide (N_2O): 310
- Hydrofluorocarbons (HFCs): 150-11,700
- Perfluorocarbons (PFCs): 6,500-9,200
- Sulphur hexafluoride (SF_6): 23,900
- Hydrofluorocarbons (HFCs): 150-11,700

Greenhouse Gas emissions (GHG): Any of the atmospheric gases that contribute to the greenhouse effect by absorbing infrared radiation produced by solar warming of the Earth's surface. This study has focussed on carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (NO_2).

Life Cycle Assessment (LCA): GHG emissions of a product or service from cradle to gate or cradle to grave.

PAS 2050: is a publicly available specification for assessing product life cycle greenhouse gas emissions, prepared by the British Standard Industry. It is an independent standard, developed with significant input from international stakeholders and experts across academia, business, government and non-governmental organisations (NGOs).