The climate benefits of ocean vs air transport of artworks

Case Study: Transport of Gary Hume artwork from London to the Matthew Marks Gallery, New York by Cadogan Tate

> Choosing ocean transport to move these artworks resulted in a carbon footprint **96% lower** than if air freight had been used. Almost **24 tonnes of greenhouse gas** were saved by this choice – the equivalent of 16,500 people driving 2 miles each way to visit an art gallery.

Background

Cadogan Tate currently offer both air freight and sea freight options for artwork transport. While clients are currently informed of the cost benefits of sea freight, they are not currently given information on the climate benefits. This is not unusual; at the time of writing, we are not aware of any art logistics company that yet offers this information to its clients.

With the recent increase in interest and concern about climate change - including amongst artists - Cadogan Tate now wishes to offer this information to its clients. This would help to encourage arts organisations to reduce their impact on the climate, and also help Cadogan Tate to continue to foster a positive relationship with its clients by providing them with logistics advice and support that meets their needs.

This case study provides a real-life example to demonstrate the lower climate impact of sea freight in relation to air freight. The information in this study can be shared with clients to help them make an informed choice on how to transport their artworks – and could also form the basis of tailored promotions or outreach to clients based on the climate benefits of sea freight over air freight.

The Case Study

Cadogan Tate organised the transport of 31 paintings and sculptures by Gary Hume, from a London gallery to the Matthew Marks Gallery in New York. The artworks were moved by road to the London Gateway port (88 km), then loaded onto a container ship to New York (7,378 km) before being moved again by road to their final destination (37 km). The pieces weighed 1,344 kg and were packaged in wooden frames and crates that weighed 914 kg.

This resulted in an estimated carbon footprint of 1,025 kg CO_2e, broken down as follows:

Table 1: Carbon footprint of transporting Gary Hume artworks by ocean

	Carbon emissions (kg CO_2 equivalent)	**%**
Road transport	133	13%
Ocean transport	335	33%
Packaging (manufacture and disposal)	557	54%
TOTAL	**1,025**	100%

If this art had instead been transported by air, it would have been taken by road to London Heathrow (44 km), then flown to New York JFK via Liege (6,372 km), and finally taken by road from JFK to the gallery (26 km). The pieces would of course have the same weight of 1,344 kg, but in addition to the wooden frames and crates it would have additional outer crates, increasing the weight of packaging to 1,632 kg.

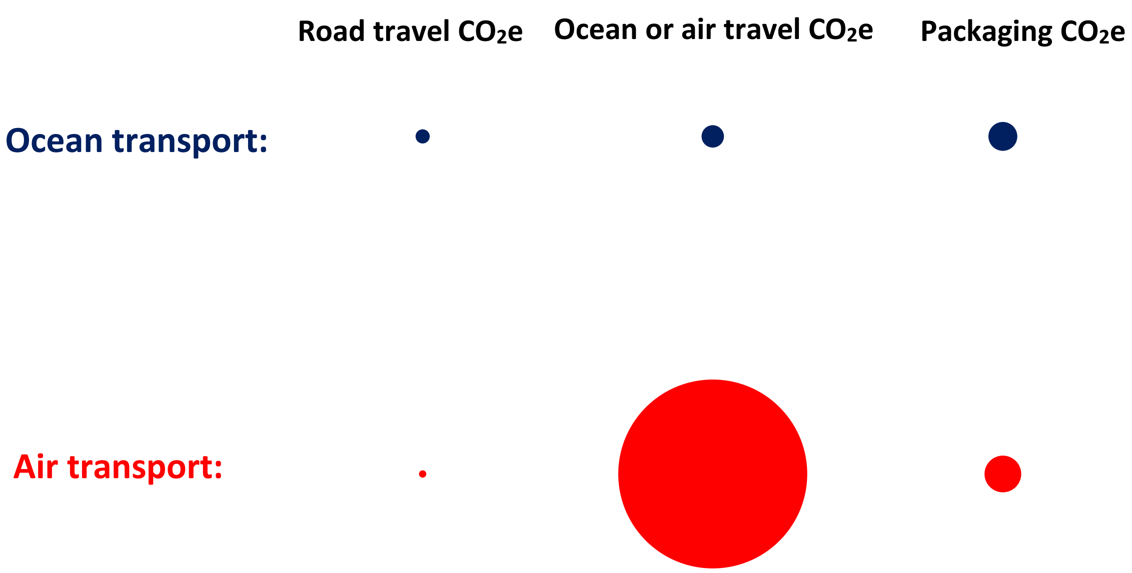
This would have resulted in an estimated carbon footprint of 24,747 kg CO_2e, broken down as follows:

Table 2: Carbon footprint if Gary Hume artworks had been transported by air

	Carbon emissions (kg CO_2 equivalent)	%
Road transport	36	<1%
Air transport	23,812	96%
Packaging (manufacture and disposal)	899	4%
TOTAL	**24,747**	100%

The very large difference between these totals makes it difficult to compare them visually, but this bubble chart should give an indication of the scale of the carbon saving:

Figure 1: Comparative carbon footprint of two transport scenarios (area of circles represents kgCO_2e)



Thoughts and analysis

Why is there such a huge difference between these two totals? There are three main reasons, which can be summarised as: speed, scale, and specific high-altitude impacts. Firstly, it takes a huge amount of energy to lift a large chunk of metal and fling it through the air at a high enough speed to not fall down. Secondly, a modern container ship can transport such an enormous amount of cargo that the amount of fuel used per tonne transported is, on average, surprisingly low. Thirdly, burning aviation fuel at high altitude causes extra chemical reactions in the atmosphere, creating a large amount of further warming on top of the plane's CO_2 emissions. Taken together, these three factors mean that moving a tonne of artwork by air can (as in this case) have a climate impact around 60 times bigger than moving it the same distance by sea.

On top of this, in this specific case study air transport requires around 80% more packaging to move the artwork safely. This doesn't just increase the carbon emissions from manufacturing and disposing of the packaging itself – it also increases the weight and volume being transported, meaning more transport fuel is required.

Of course, none of this means that sea freight is completely “clean”! Container ships use some of the dirtiest fuels in the world, and there is huge room for improvement in terms of their efficiency and their use of renewable alternatives to diesel in the (hopefully near) future. Everyone who uses container ships should be challenging their owners and operators on these issues, and pushing for them to reduce their own fossil fuel use as rapidly as possible. But right now, in the short term, there are huge carbon savings to be made by using ocean freight as a lower-carbon alternative to air transport.

One other small thing to note: the road transport footprint is lower in the air freight scenario. This is partly because of the shorter road distances, and partly because the air travel scenario assumes the use of larger, more efficient trucks (see Appendix).

Using these figures

The very nature of carbon footprinting means that the figures given in this case study should not be taken as 100% accurate. The calculations have been carried out based on average factors for the amount of greenhouse gas produced by different types of freight and packaging materials. This is a good enough method for studies like this that aim to produce estimated totals to compare different options, and allows us to say with confidence that ocean freight has a much lower footprint than air freight. However, we should avoid using the numbers in this report in a way that suggests a high level of precision - e.g. we shouldn’t say that transporting these artworks by sea produced “exactly 1,025 kg of CO_2e”. Instead, we should make it clear that the numbers are approximate, and use percentages where possible – e.g. “Transporting the art by sea produced around one tonne of greenhouse gas, while flying it would have produced nearly 25 tonnes – so choosing ocean travel had a climate impact around 95% lower than flying.”

About the author

Danny Chivers is a freelance environmental researcher and climate change consultant. Over the last twelve years, he has worked on sustainability projects for small and large businesses, national and local government, the education sector, NGOs, large public sector bodies, and the media. He was a lead analyst at the highly respected footprinting consultancy Best Foot Forward, working on a wide range of footprinting projects including electrical product manufacture, agriculture, food processing, local authority carbon monitoring, retailers, offices, and national government. He has acted as the lead external carbon consultant for Oxfam GB, Christian Aid, Trócaire and ActionAid. He has also carried out carbon footprinting work for Concern, CAFOD, Anthesis Ltd, DECSY, and the Guardian, among others. He is the author of the “No Nonsense Guide to Climate Change” (2011) and “No-Nonsense Renewable Energy” (2015) and writes a regular climate change column for New Internationalist Magazine. He holds a BSc in Environmental Biology, an MSc in Nature, Science and Environmental Policy and an MProf in Leadership for Sustainable Development.

APPENDIX: Methodology and Assumptions

Carbon Factors

The calculations in this case study use the August 2019 version of the *UK Government Greenhouse Gas Conversion Factors for Company Reporting.* These are publicly accessible at gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2019

The footprint totals include both the direct and indirect (Well-To-Tank) emissions of the transport.

Road Travel

For the ocean transport scenario, UK road travel distances were provided by Cadogan Tate, while US travel distances were estimated using Google maps.

According to Cadogan Tate staff, the artwork was transported from UK gallery to UK warehouse in an 18-tonne Mercedes Actros, and then from warehouse to port in a Scania R40 articulated truck. In the US, we assumed a similar articulated truck was used for transport to the gallery.

For the air transport scenario, road distances were provided by Cadogan Tate, and it was assumed that a Scania R40 articulated truck (or equivalent) was used in all cases.

Ocean Travel

The type and size of container ship (57,320 deadweight tonnes) and the route (London to Norfolk, Virginia to Philadelphia to GCT New York) were provided to Cadogan Tate by their contractor. The TEU (Twenty-Foot Equivalent Unit) value of the ship (4662 TEU) was then obtained from fleetmon.com, and used to determine the correct carbon conversion factor to use.

The distance travelled by the ship was estimated by entering the route into the distance calculator at searoutes.com.

Air Travel

The flight distances from Heathrow to Liege to JFK were estimated using the distance calculator at webflyer.com.

Packaging

Packaging weights were provided by Cadogan Tate. Air travel requires an extra layer of packaging (large outer cases).

It was assumed that the packaging was 95% wood and 5% plastic, by weight.

It was assumed that the wood was reclaimed and reused at the end of its life, while the plastic was landfilled.

Comparison calculation

For the comparison with “journeys to an art gallery”, these were assumed to be journeys in an average car burning average fuel, as categorised by the UK Government carbon conversion factors.