

The Quantitative side of Offsetting

Here is a calculation aiming to put a figure on the emissions associated with installing a Time and Tide Bell.

		CO₂ emitted
1. Casting		
Mass of bell	750 kg	
Specific heat capacity of bronze	0.435 kJ/kg °C	
Casting temperature	1,150 °C	
Heat required (100% efficiency)	375,188 kJ	
conversion factor	3,600 kWhr/kg	
i.e.	104 kWhr	
Estimate for losses, wastage, etc	80%	
Total energy embodied in bell	188 kWhr	
Emissions from grid electricity	43 kg/kWhr	
Total Co2 emissions from one casting	8,067 kg	8,067
2. Mounting		
Average weight	150 kg	
Assumed made of stainless steel		
Embodied carbon /kg	6.15 kg CO ₂ /kg	
Total embodied CO ₂	923 kg CO₂	923
2. Travel, installation costs, etc		
Visits to bell site	8	
Average distance round trip	200 miles	
Total distance	1,600 miles	
Assumed mpg	25	
Gallons of diesel	64 g	
litres	291 l	
CO ₂ embodied in diesel	2.68 kg/l	
Total CO ₂ emissions	780 kg CO₂	780
		9,769 kg CO₂

There are numerous assumptions here, and the result certainly has spurious accuracy. An interpretation in round numbers is:

Casting	8 tonnes
Mounting:	1 tonne
Other costs:	<u>1 tonne</u>
Total:	10 tonnes

For comparative purposes here is an outline calculation of the tree-planting implications of offsetting emissions from the average UK household couched in terms of CO₂ equivalent. It is adapted from the United Bank of Carbon website.

Domestic example: a large mature tree may contain as much as 1 tonne of carbon, so ultimately you need to achieve around 1 new mature tree for every 4 tonnes of CO₂e that you emit – because your tree will remove 1 tonne of carbon from every 3.67 tonnes of CO₂e (releasing the oxygen and other gases harmlessly back into the atmosphere).

To mitigate the UK current average individual footprint (of 11 tonnes CO₂e per year), you'll need to 'achieve' about 3 new large mature trees per year. (Remember that while your trees are reaching maturity, you'll be responsible for further emissions, so you need to make sure all your trees will grow to full size, and you'll also to invest every year to cover that year's emissions).

Don't forget that ideally each tree will be in a new, permanent forest – so it's replaced naturally by another, *ad infinitum*. Otherwise the carbon will just go back into the atmosphere when the last tree dies or is felled – and then either rots or is burned. But you can't just plant one tree and hope it will survive, most trees never make it to maturity, they die, or are damaged, or felled, or are crowded out by bigger trees. So to be sure of getting your 3 mature, naturally-regenerating trees, you need to plant five young trees for each mature one, so that's **15 trees** per year – IF your footprint is the UK average of 11 tonnes of CO₂e.

Peter Gingold
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