Kite Packaging

Carbon Dioxide Emissions Study

Study Report

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1 Introduction

Ove Arup and Partners Ltd (Arup) was commissioned by Kite Packaging to undertake a study of carbon dioxide (CO_2) emissions to support their environmental assessment for the 58 Hundred Project. The 58 Hundred Project involves changing the weight of stock cartons, which require fewer pallets and therefore fewer goods vehicles to deliver them.

This study assesses and evaluates the likely reduction in CO_2 emissions to be brought about by the above project, through reduced goods vehicle fleet movements.

This report details the methodology undertaken, assumptions made, results obtained and an evaluation of the results.

2 Background

2.1 Carbon Dioxide – Reasons for Study

Carbon dioxide is generally considered to be the most important atmospheric pollutant in terms of global climate change and the enhanced greenhouse effect. The major sources of CO_2 emissions are road transport, combustion through power generation plants and industry.

As a “greenhouse gas” CO_2 absorbs and radiates infrared radiation. At night time the ground loses heat, largely through infrared radiation, and cools. A proportion of this radiation is intercepted by carbon dioxide in the air and is reradiated upward and also back towards the earth. That which is reradiated back downwards prevents the earth’s surface from cooling as rapidly and it is thought that as carbon dioxide emissions continue to increase, that the earth’s temperature, as a result, will continue to increase.

The atmospheric concentration of CO_2 has increased from 280 parts per million (ppm) in 1750 to 367ppm in 1999[1]; an increase of 31%. Most of these emissions, particularly in the past 20 years, are as a result of the burning of fossil fuels.

This increase in atmospheric CO_2 levels and increase in global temperatures, may lead to a continued increase in extreme weather conditions, such as amplified flood events due to increased precipitation levels. There may also be stronger and more frequent storms and rising sea levels, amongst other effects. To stabilise the atmosphere, large cuts in CO_2 emissions are required and at present the UK is committed to a 60% reduction in emissions by 2050.

3 Methodology

The Design Manual for Roads and Bridges (DMRB)[2] screening software was used to calculate the regional impact of CO_2 emissions from the current scenario of Kite Packaging goods vehicle mileage and that of the new scenario.

3.1 The Two Scenarios

The CO_2 emissions calculations were based on the following data:

Current situation:

1. A Fully laden 44ft articulated lorry delivering an average pallet weight of 198 Kg (product) plus 15kg (wooden pallet) x 46 pallets per delivery over a total 7437.55 miles (11967Km) in one year.
2. A returning empty 44ft Articulated lorry over 7437.55 miles (11967Km) per year
3. A Kite 7.5 Tonne lorry delivering an average pallet weight of 198 Kg (product) plus 15kg (wooden pallet) x 20 pallets per delivery over a total 5306.46 miles (8538Km) in one year.
4. A returning empty Kite 7.5 Tonne lorry over 5306.46 miles (8539Km) per year.

[1] Climate Change 2001: Working Group 1 The Scientific Basis, Intergovernmental Panel on Climate Change
[2] Design Manual for Roads and Bridges (Version 1.02), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 1 Air Quality, Highways Agency, November 2003

New Situation:

1. A Fully laden 44ft articulated lorry delivering an average pallet weight of 198 Kg (product) plus 15kg (wooden pallet) x 46 pallets per delivery over a total 5218.62 miles (8397Km) in one year.
2. A returning empty 44ft Articulated lorry over 5218.62 miles (8397Km) per year.
3. A Kite 7.5 Tonne lorry delivering an average pallet weight of 198 Kg (product) plus 15kg (wooden pallet) x 20 pallets per delivery over a total 3794.67 miles (6106Km) in one year.
4. A returning empty Kite 7.5 Tonne lorry over 3794.67 miles (6106Km) per year.

3.2 Model Inputs

Required inputs into the model include link length, annual average daily traffic flows (AADT), annual average speed, road type and percentage of light duty vehicles and heavy duty vehicles. The necessary data were provided by Kite Packaging.

For both current and new scenarios, link lengths were input as total kilometres travelled per year by one 44ft articulated lorry delivering products, total kilometres travelled per year by one 44ft articulated lorry returning empty, total kilometres travelled per year by a 7.5 tonne lorry delivering products and total kilometres travelled by a 7.5 tonne returning empty (kilometres travelled per year were converted from miles per year as provided by Kite Packaging).

Annual average daily traffic flow was set as 1 for the purposes of this assessment. For example representing x1 44ft articulated lorry delivering, x1 44ft articulated lorry returning, x1 7.5 tonne lorry delivering, x1 7.5 tonne lorry returning.

In the DMRB software it is required to state what type of vehicles are travelling on each particular link in order to define traffic composition. Road types are defined thus: A = motorways and A roads, B = urban roads which are neither motorways nor A roads, C = all other roads, D = traffic composition on link is known (i.e. the breakdown of the types of light duty vehicle and/ or heavy duty vehicle). In this instance road type was set as “D”.

Percentage of heavy duty vehicles was set as 100% articulated HGVs for the two link networks concerning the 44ft articulated lorries and 100% rigid HGVs for the two link networks concerning the 7.5 tonne lorries.

Model inputs are shown in Tables 1a and 1b below.

3.3 Assumptions

Annual average speed data across the delivery network was estimated to be 72km/h (45 mph).

Table 1a: DMRB Regional Impact Assessment Inputs – Current Scenario

Link Number	Link Title	Link Length (km)	AADT	Annual average speed (km/h)	Road Type	% Rigid HGVs	% Articulated HGVs
1	Outbound Network x1 44ft	11976.00	1	72	D	0	100
2	Inbound Network x1 44ft	11976.00	1	72	D	0	100
3	Outbound Network 7.5t	8538.00	1	72	D	100	0
4	Inbound Network 7.5t	8538.00	1	72	D	100	0

Table 1b: DMRB Regional Impact Assessment Inputs – New Scenario

Link Number	Link Title	Link Length (km)	AADT	Annual average speed (km/h)	Road Type	% Rigid HGVs	% Articulated HGVs
1	Outbound Network x1 44ft	8397	1	72	D	0	100
2	Inbound Network x1 44ft	8397	1	72	D	0	100
3	Outbound Network 7.5t	6106	1	72	D	100	0
4	Inbound Network 7.5t	6106	1	72	D	100	0

4 Assessment Results and Conclusions

The CO_2 emissions predicted for the current scenario and new scenario by the DMRB screening assessment are presented in Table 2 below.

Link Number	Link Title	CO_2 (tonnes/ year) Present Scenario	CO_2 (tonnes/ year) New Scenario
1	Outbound Network x1 44ft	4,667	3,273
2	Inbound Network x1 44ft	4,667	3,273
3	Outbound Network 7.5t	1,831	1,309
4	Inbound Network 7.5t	1,831	1,309
-	**Total**	**12,996**	**9,164**

It is possible to see from the results that there is a considerable reduction in CO_2 emissions as a result of the new operations at Kite Packaging. From a total predicted CO_2 output of 12,996 tonnes/ year from x1 44ft articulated lorry and x1 7.5t lorry across the total network travelled in a year under present operating conditions to a predicted 9,164 tonnes/ year under the new operating conditions. It is possible to say, therefore, that the new methods of operation are likely to bring about reductions in CO_2 emissions of nearly 30%.