Carbon-Footprinting Audit of Kush Shellfish,

Ardgroom, Co.Cork.

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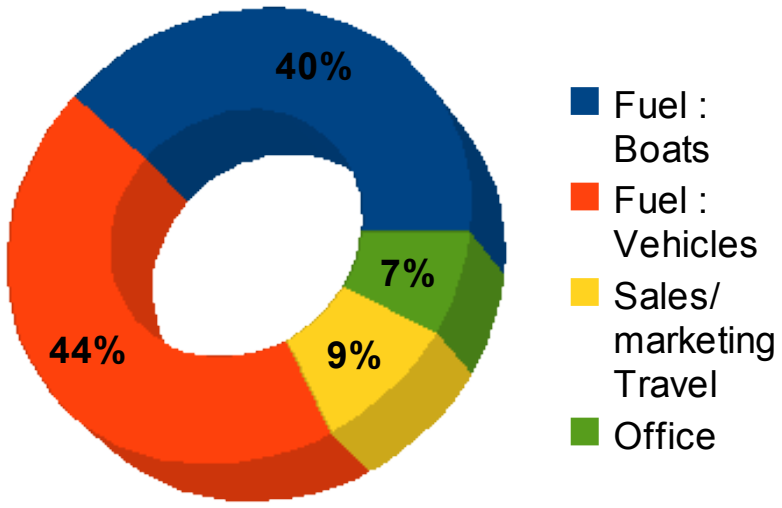
1 Executive Summary

The carbon footprint for Kush Shellfish Ltd, Ardgroom, Co.Cork is 23.3 tonnes CO2e for 2007. Given a production of 700 tonnes of mussels for 2007 this equates to a carbon footprint of 33.2g CO2e per one kilo serving of mussels.

The breakdown is as follows:

Activity	Emissions	% of Total
Fuel : Boats	9208 kg CO2e	40%
Fuel : Vehicles	10227 kg CO2e	44%
Sales/ marketing Travel	2186 kg CO2e	9%
Office	1650 kg CO2e	7%
Total	**23271 kg CO2e**	**100.00%**



2 Introduction

Kush Shellfish Ltd. is interested in examining the ecological and carbon impacts of its mussel farming operations in Ardgroom Co.Cork. They have commissioned this initial study to obtain a baseline against which they will develop a strategy for reducing their carbon footprint.

Carbon footprinting has been successfully internationally used to assess and represent the environmental impact of an activity, e.g. a product, a city, a country or even a lifestyle. A carbon footprint is a "measure of the impact a given activity can have on the environment in terms of the amount of green house gases produced, measured in units of carbon dioxide"[i]

The unit of measurement for the carbon footprint is "kg CO2e", i.e. kilogrammes of carbon-dioxide equivalent. This is the internationally accepted metric for carbon-footprint measurement and allows carbon-footprint of dissimilar activities to be added to give a single combined figure e.g. electricity usage, fuel usage, materials usage.

The emissions covered in this report are considered “Scope 1 & 2” emissions according to the Greenhouse Gas Protocolii and “Direct and Energy Indirect” emissions according to ISO 14064:1iii. This covers direct fuel usage and all electricity/gas usage.

Other emission sources related to the manufacture of materials used, e.g. boats/cars/barrels, are considered optional under the Greenhouse Gas Protocol or ISO 14064:1. As such they are not included in the total emissions figures detailed in section 1 and 4. These emissions have been measured and are detailed in section 5.

Note that this report is subject to revision. The most recent revision is available from info@carbontracking.com. Only the most recent revision should be used as a data source.

3 About Carbon Tracking

Carbon Tracking Ltd. is a sustainability consultancy specialising in carbon-footprinting analysis and the definition of carbon management strategies including emissions reduction, energy-management, carbon-offset procurement and emissions trading.

Carbon Tracking Ltd. provides relevant analysis of current and projected legislation at national and EU level to allow companies to assess potential impact and pro-actively manage that impact.

Carbon Tracking Ltd. adhere to internationally recognised standards for carbon accounting with particular reference to

- The GHG Protocol Corporate Standard[ii] as defined by the World Resources Institute and the World Business Council for Sustainable Development
- ISO 14062, Parts 1/2/3 : 2006[iii]

4 Data Collection

The data presented in the following sections was provided by Kush Shellfish Ltd.

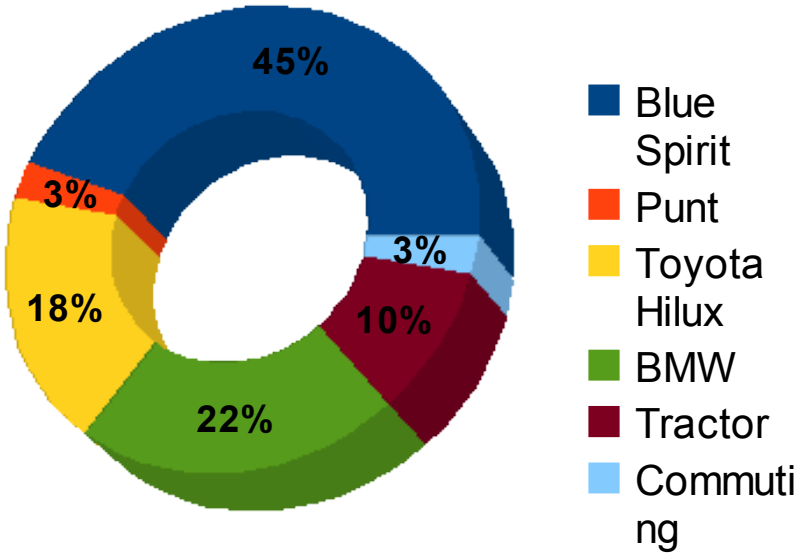
4.1 Fuel Usage

The fuel usage of the boats and land-vehicles used directly by Kush Shellfish are presented in the table below.

Further to the fuel used by the company vehicles, a portion of the fuel used by employees for commuting to work is allows allocated to the company. This is consistent with international carbon-footprinting standards.

The three employees concerned commute 6200km/year. If 3100 km is allocated to Kush Shellfish, and using an average of 160gCO2e/km[iv] we arrive at a figure of 496 kgCO2e.

Fuel Type	**Usage**	**Quantity**	**Emissions**
Diesel	Blue Spirit	3306 litres	8695 kg CO2e
Petrol	Punt	223 litres	513 kg CO2e
Diesel	Toyota Hilux	1364 litres	3587 kg CO2e
Diesel	BMW	1605 litres	4221 kg CO2e
Diesel	Tractor	731 litres	1923 kg CO2e
Petrol/Diesel	Commuting	estimated	496 kg CO2e
Total			**19435 kg CO2e**



4.2 Non-production related transport

In the course of a normal year, a number of trips are made for sales/marketing/management purposes. The carbon-footprint of these trips is detailed below.

4.2.1 Flights

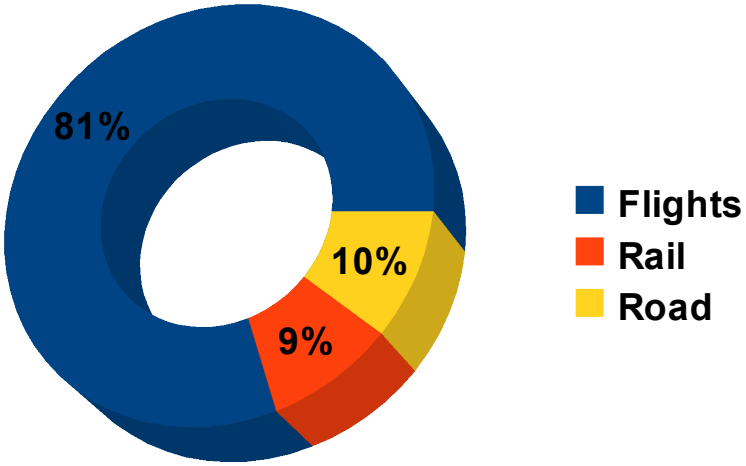
Details	No. of return trips	Emissions
Marketing : Shannon-Nantes return trip	2	536 kg CO2e
French food fair : Shannon-Nantes return trip	2	536 kg CO2e
Faranfore-Dublin : Regular meetings	6	708 kg CO2e
Total		**1780 kg CO2e**

4.2.2 Rail

Details	No. of return trips	Emissions
Killarney-Dublin	8	**198 kg CO2e**

4.2.3 Road

Details	No. of km	Emissions
Car rental during French trips	1300	**208 kg CO2e**[v]



4.3 Office related

Kush Shellfish Ltd. Occupies a small office space in Kenmare, Co.Kerry. The annual energy bill is €240 including night-storage electricity heating. It is assumed that half of the energy bill relates to heating and half to the usage of lighting/office-equipment.

Usage	Cost/kWh	Annual cost	kWh total	Emissions factor	Total Emissions
Heating	€0.07	€120	1739 kWh	0.65	1130 kg CO2e
Lighting/Office Equipment	€0.15	€120	800 kWh	0.65	520 kg CO2e
Total	**€0.22**	**€240.00**	**2539 kWh**	**0.65**	**1650 kg CO2e**

5 Optional Scope 3 emissions.

If Scope 3 emissions are included then the carbon footprint rises to 34.2 tonnes CO2e for 2007. Given a production of 700 tonnes of mussels for 2007 this equates to a carbon footprint of 48.9g CO2e per one kilo serving of mussels.

5.1 Boat and land-vehicle manufacture

Kush Shellfish operates two boats made from aluminium, steel and stainless steel. It also operates three land-vehicles. Each vehicle has a carbon-footprint associated with its manufacture as well as its fuel consumption.

5.1.1 Boats

The Blue Spirit was commissioned in 2007 from the MPG Construction shipyards in France. The following materials were used in its construction:

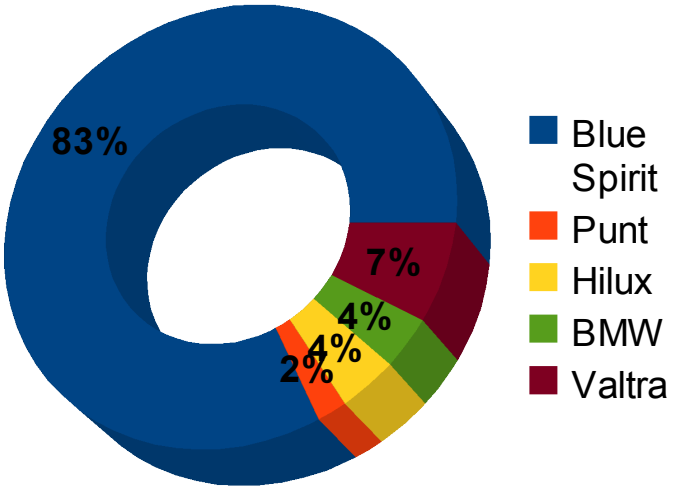
Material	Quantity	Usage	Annual Emissions, based on 20 year life
Aluminium	18 tonnes	Main structure	2700 kg CO2e
Steel	9.325 tonnes	engine, davits, frame, etc	420 kg CO2e
Stainless steel	4.1 tonnes	Machinery	185 kg CO2e
Total			**3305 kg CO2e**

A punt is used for shore-transfer to/from the Blue Spirit.

Material	Quantity	Usage	Annual Emissions, based on 20 year life
Aluminium	500 kg	Main structure	75 kg CO2e
Steel	30	15hp Yamaha outboard	4.5 kg CO2e
Total			**79.5 kg CO2e**

5.1.2 Land Vehicles

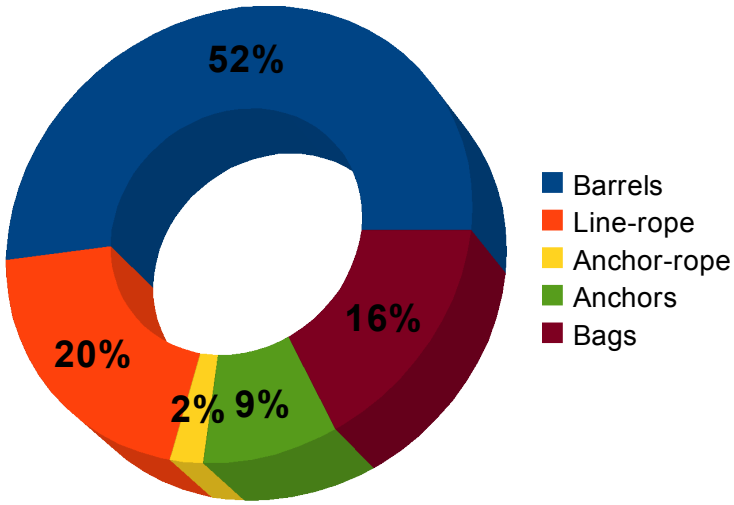
Vehicle	Weight	Useful life	Annual Emissions, assuming 90% steel
Toyota Hilux	1710 kg[vi]	10 years	153.9 kg CO2e
BMW 536	1585 kg[vii]	10 years	142.6 kg CO2e
Valtra N91	4650 kg[viii]	15 years	279 kg CO2e
Total			**575.5 kg CO2e**



5.2 Farm material

This section covers the material used in the mussel-farm directly related to production.

Material	Total Weight	Emissions Factor	Lifetime	Annual Emissions
Barrels (polypropylene)	10kg * (2250 + 540) = 27900 kg	1.3[ix]	10 years	3627 kg CO2e
Line rope (polypropylene)	20460 meters of 32mm @ 0.9g/cm^3 = 16447 kg	1.3	15 years	1425 kg CO2e
Anchor rope (polypropylene)	1800 meters of 38mm @ 0.9g/cm^3 = 1836 kg	1.3	15 years	159 kg CO2e
Anchors (concrete)	180 tonnes	0.07	20 years	630 kg CO2e
Bags (polyethylene)	25000 * 45g/bag =	1.3	1	1125 kg CO2e
Total				**6966 kg CO2e**



6 Opportunities for Reduction

Having defined a baseline figure for 2007, i.e. 23.3 tonnes CO2e for 70 tonnes mussels produced we arrive at an emissions figure of 33.2g CO2e per 1 kg serving of mussels.

The secondary aim of this report is to allow the definition of reduction goals. The different steps towards reducing the carbon-footprint can be summarised in the following steps:

- Reduce : Reducing the energy/materials requirements of the company. The major contributors to the carbon-footprint have been identified and must be assessed to see if efficiencies can be improved.
- Replace : Once efficiency improvements are in place, then the option of replacing high-carbon fuels/materials by lower carbon equivalents can be assessed e.g. Replacing a portion of the diesel usage by bio-diesel.
- Replenish : Once the Reduce and Replace steps are completed, an optional step is to study the possibility of using carbon-offsets to "negate" the impact of the emissions generated.

The details required for the above steps is beyond the scope of this report.

7 Assumptions and Calculations

7.1 Emissions factors for steel/Aluminium/Stainless Steel

The method for calculating the lifecycle emissions for steel,aluminium and stainless steel uses the following values:

- EM_{raw} :Emissions factor for 1 tonne of material from raw material, i.e. tCO2E/tonne
- EM_{rec} :Emissions factor for 1 tonne of material from recycled material. i.e. tCO2E/tonne
- REC_{input} :Percentage of material recycled as input to production, e.g. 0.06 for 6%
- REC_{output} :Percentage of material recycled at the end of the product life. e.g 0.06 for 6%

The calculation of the lifecycle emissions is based on the premise that the material recycled at the end of the product life can be considered a carbon-credit since it displaces an euivalent amount of raw material. i.e. the carbon credit per tonne recycled is $Em_{raw} – Em_{rec}$

The total lifecycle emissions for a product of weight T tonnes is then

$T * REC_{input} * EM_{rec} + T * (1-REC_{input}) * EM_{raw} – T * REC_{output} * (EM_{raw} – EM_{rec})$

Factor	**Aluminium**	**Steel**	**Stainless Steel**
EM_{raw}	12[x]	2.75[xi]	2.75[xii]

EM_{rec}	$Em_{raw}/24 = 0.5$	$EM_{raw}/5 = 0.55$[xiii]	$EM_{raw}/5 = 0.55$[xiv]
REC_{input}	39%[xv]	42%xi	42%xii
REC_{output}	39%	42%	42%
Life Cycle Emissions	3 tonnes CO2E/tonne	0.9 tonnes CO2E/tonne	0.9 tonnes CO2E/tonne

Note : If the REC_{output} were to increase then the Life Cycle Emissions would decrease accordingly.

7.2 Emissions Factor for Diesel/Petrol

Fuel	**Emission Factor**
Diesel	2.63[xvi] kg CO2e/ltr
Petrol	2.3xvi kg CO2e/ltr
Bio-diesel	0.57[xvii] kg CO2e/ltr

7.3 Emissions Factor for concrete

The emissions factor for cement is 700 kg CO2e / tonne[xviii]. Assuming that concrete is 10% cement by weight this gives 70 kg CO2e /tonne. This figure ignores the carbon footprint associated with the production/transport of sand/gravel/water.

7.4 Fuel Calculations

Fuel emissions calculations were calculated based on fuel costs provided by Kush Shellfish Ltd. as follows:

Marine Diesel	Petrol	Diesel	Green diesel
€2,723.26	€290.72	€3,531.36	€512.28

Marine diesel and Green diesel were costed at €0.70/ltr, petrol at €1.30/ltr and diesel at €1.10/ltr. 15% of the marine diesel and diesel costs for the Toyota Hilux were due to subcontracting work carried out by Kush Shellfish Ltd. and are not considered the responsibility of Kush Shellfish Ltd. for the purpose of this audit.

i http://en.wikipedia.org/wiki/Carbon_footprint
ii http://www.ghgprotocol.org/standards/corporate-standard
iii http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=38381
iv Assuming 160gCO2e/km (Irish average)
v Assuming 160gCO2e/km for rented car (French average)
vi http://www.toyota.ie/models/specifications/default.aspx?model=965D9A88-E096-456F-9CF8-64F3AAF54ED6
vii http://www.bmw.ie/ie/en/index_narrowband.html?content=http://www.bmw.ie/ie/en/newvehicles/5series/sedan/2007/allfacts/engine/engine_data.html
viii http://www.valtra.com/Products/tractors/Nserie/techspec/1_1.htm
ix http://www.scientificjournals.com/sj/lca/Abstract/ArtikelId/4744 : Note these are averages which depend on the electricity makeup, using 0.5 kWh/kg
x http://worldaluminum.org/iai/publications/documents/lca.pdf , pg 42
xi http://www.iddri.org/Activites/Ateliers/ife-iddri_braathen_steel.pdf pg 4, averaged over different production types, starting with the averaged figure of 1.84 including 42% scrap and then taking the premise that recycled steel requires 80% less emission that steel from ore , http://www.wasteonline.org.uk/resources/InformationSheets/metals.htm we then calculate that recycled steel is 550kgCO2/tonne and raw steel is 2.75 tonnes/tonne
xii http://www.iddri.org/Activites/Ateliers/ife-iddri_braathen_steel.pdf pg 4, averaged over different production types
xiii http://www.wasteonline.org.uk/resources/InformationSheets/metals.htm
xiv http://www.wasteonline.org.uk/resources/InformationSheets/metals.htm
xv http://www.recyclemetals.org/whatis.php
xvi www.**defra**.gov.uk/environment/business/envrp/pdf/conversion-**factors**.pdf
xvii http://www.biodiesel.org/pdf_files/fuelfactsheets/LifeCycle_Summary.pdf
xviii http://www.theclimategroup.org/reducing_emissions/case_study/lafarge/