Carbon Footprinting the Supply Chain

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### Climate Change

#### Global concentration of CO2 in the atmosphere

<table>
<thead>
<tr>
<th>Parts per million (ppm)</th>
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<tbody>
<tr>
<td>260</td>
</tr>
<tr>
<td>280</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>320</td>
</tr>
<tr>
<td>340</td>
</tr>
<tr>
<td>360</td>
</tr>
<tr>
<td>380</td>
</tr>
</tbody>
</table>

**Source:** UNEP

#### Variations in global near-surface land temperature

<table>
<thead>
<tr>
<th>Temperature variation in degrees C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
</tr>
<tr>
<td>0.4</td>
</tr>
<tr>
<td>0.6</td>
</tr>
<tr>
<td>0.8</td>
</tr>
<tr>
<td>1.0</td>
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</tbody>
</table>

**Source:** Hadley Centre

### Stern Report

**Eventual Temperature change (relative to pre-industrial)**

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C</td>
<td></td>
</tr>
<tr>
<td>1°C</td>
<td></td>
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<tr>
<td>2°C</td>
<td></td>
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<tr>
<td>3°C</td>
<td></td>
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<tr>
<td>4°C</td>
<td></td>
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<tr>
<td>5°C</td>
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**Food**

- **Falling crop yields in many developing regions**
- **Severe impacts in marginal Sahel region**
- **Rising number of people at risk from hunger (25 - 60% increase in the 2080s in one study with weak carbon fertilization), with half of the increase in Africa and West Asia**
- **Rising crop yields in high-latitude developed countries if strong carbon fertilization**
- **Yields in many developed regions decline even if strong carbon fertilization**
- **Entire regions experience major declines in crop yield (e.g., up to one third in Africa)**

**Water**

- **Small mountain glaciers disappear worldwide – potential threat to water supplies in several areas**
- **Greater than 30% decrease in runoff in Mediterranean and Southern Africa**
- **Significant changes in water availability (one study projects more than a billion people suffer water shortages in the 2080s, many in Africa, while a similar number gain water)**
- **Sea level rise threatens major world cities, including London, Shanghai, New York, Tokyo and Hong Kong**
- **Coral reef ecosystems extensively and eventually irreversibly damaged**
- **Possible onset of collapse of part or all of Amazon rainforest**
- **Large fraction of ecosystems unable to maintain current form**

**Ecosystems**

- **Many species face extinction (25 - 60% in one study)**

**Extreme Weather Events**

- **Rising intensity of storms, forest fires, droughts, flooding and heat waves**

**Risk of rapid climate change and major irreversible impacts**

- **Risk of weakening of natural carbon absorption and possible increasing natural methane releases and weakening of the Atlantic THC**
- **Onset of irreversible melting of the Greenland ice sheet**
- **Increasing risk of abrupt, large-scale shifts in the climate system (e.g., collapse of the Atlantic THC and the West Antarctic Ice Sheet)**
How bad is it going to get?

Gradual warming: sea level rise, increasing drought, declining agricultural yields, land becoming uninhabitable, more severe storm damage, loss of biodiversity / extinction of species

Crossing ecological tipping points:

- Warming of tropical rain forest: *switch from CO₂ sink to source*
- Melting of Arctic / Antarctic / Greenland ice-sheets: *sea-level rises by several metres*
- Thawing of the Siberian tundra – *release of methane*

We are not to blame / it has happened before / it will be self-correcting / it is a political - economic - scientific conspiracy..

There is a problem but we should concentrate on other priorities

Huge problem requiring urgent response. The necessary change is manageable within existing economic and political frameworks

Mankind’s greatest challenge. There is still time, but it will require draconian changes to our way of life

It’s too late. Try to preserve our civilisation in an era of runaway climate change

climate change denial

apocalyptic vision
Climate Change Policy: Emission Reduction Targets

Aim to keep global CO₂ level below 450 parts per million
Temperature rise over period to 2100 limited to 2° C

‘Stabilisation at 450 ppm CO₂e is already almost out of reach, given that we are likely to reach this level within ten years and there are real difficulties of making the sharp reductions required with current and foreseeable technologies’ (Stern Report, p. xv)

EU Climate Change Target: 20% reduction in CO₂ by 2020
UK Climate Change Bill: 60% reduction in CO₂ by 2050
Scottish Climate Change Bill: 80% reduction in CO₂ by 2050

Million tonnes of Carbon (UK)

<table>
<thead>
<tr>
<th>Year</th>
<th>Carbon (Million)</th>
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<tbody>
<tr>
<td>1990</td>
<td>162</td>
</tr>
<tr>
<td>2006</td>
<td>153</td>
</tr>
<tr>
<td>2050</td>
<td>65</td>
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Possible under-estimation of required CO₂ reduction:

UK – 80-90% reduction in CO₂ level required by 2050?
Carbon footprint

“The carbon footprint is a measure of the exclusive total amount of CO₂ emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product” (Wiedmann & Minx, 2007)

Degree of disaggregation:
- country
- sector
- supply chain
- company
- process
- activity
- product
Estimates of UK’s Carbon Footprint

Kyoto calculation excludes UK external transport links, overseas business interests and embedded carbon in imported goods

UK’s contribution to external GHG emissions

Source: Helm, Smale and Phillips, 2007
Off-shoring of Manufacturing and the Upstream Supply Chain

supplier
warehouse
processing plant
retail distribution centre

Export of carbon-generating activities reducing UK’s ‘carbon footprint’

Embedded carbon in imported products

UK contributing to the growth of CO₂ emissions in exporting countries
Comparative CO₂ Emissions: Life Cycle Analysis of ‘food miles’

**Importing of food from New Zealand to the UK**

Much food production is more energy efficient in New Zealand

![Graph showing CO₂ emissions for different food items from New Zealand to the UK.](chart.png)

- **Dairy produce**
  - New Zealand: 125 kg of CO₂ per tonne
  - UK: 3000 kg of CO₂ per tonne

- **Lamb**
  - New Zealand: 125 kg of CO₂ per tonne
  - UK: 3000 kg of CO₂ per tonne

- **Apples**
  - New Zealand: 125 kg of CO₂ per tonne
  - UK: 3000 kg of CO₂ per tonne

- **Onions**
  - New Zealand: 125 kg of CO₂ per tonne
  - UK: 3000 kg of CO₂ per tonne

*Includes transport by deep-sea container 17840 kms*

*Source: Saunders, Barber and Taylor, 2006*
Trade-offs between production, transport and other elements - minimising one element does not necessarily mean minimising the total carbon footprint.

Source: Carbon Trust
Individual Company’s Carbon Footprint
Newspaper / Magazine Wholesaler

Buildings
- Warehousing/Order Picking
- Offices
  - MHE (LPG vehicles)
  - Electricity (including green sources)
  - Gas

Transport
- TRANSPORT (from the suppliers)
- TRANSPORT (to the retailers)
- PERSONAL TRAVEL
  - Own delivery vehicles
  - Contractor vehicles
  - Short-term hire
  - Personal travel
  - Business miles in private cars
  - Air travel
  - Rail Travel
  - Magazines – office papers
  - Magazines – newspapers
  - Recycling – magazines
  - Recycling – office papers

Waste/Recycling
- TRANSPORT (to recycling point/landfill)
  - General waste-landfill-recycling

Source: Maja Piecyk (Heriot-Watt)
Company Carbon Footprints

Manufacturer
Cadbury Schweppes

Retailer
Woolworths

Source: Charatan 2007

### EcoTransIT Environmental Load Calculation

**Origin:**
- Railway station: [ ]
- City district: [ ]

**Destination:**
- Railway station: [ ]
- City district: [ ]

**Transport Modes:**
- Load weight: [ ]
- Train type: [ ]
- Emission class: [ ]
- Energy type: [ ]
- Electrically: [ ]

**Cargo weight:**
- Tons: [100]

**Energy Unit:**
- Megawatt: [ ]

**Calculate**
Choice of Approach

Top-down approach  
(input – output methodology)  

Bottom-up approach  
(process analysis)

High level estimates of energy consumption
	disaggregation

Validation

Specific energy ratings of equipment and processes
	aggregation

CarbonView
Supply Chain Carbon Auditing at Product Level

Tesco May 2008
Carbon labels on own-brand varieties of orange juice, potatoes, energy-efficiency light bulbs and detergent

Amount of time and effort in analysing CO₂-intensity at SKU level?
To what extent will CO₂ labelling influence consumer behaviour?
Will it mainly influence corporate buying behaviour?
Practicalities of putting a carbon rating on the label?
Pre-requisite for carbon trading at corporate and consumer levels?

Use of carbon labelling to commit companies to reducing CO₂ emissions by target amounts
Influence of CO₂ labelling on consumer behaviour?

When making a buying decision, would you value information on a product’s carbon footprint?

- Yes: 56%
- No: 27%
- Don’t know: 17%

If you had reliable information on the carbon footprint of the products and services you buy, would you…

- Switch to a product with a smaller carbon footprint that was not your first preference: 44%
- Switch to a product with a smaller carbon footprint but from a less convenient retailer: 20%
- Pay more for a product with a smaller carbon footprint: 15%
- None of the above: 18%
- Don’t know: 25%

Source: LEK Carbon Footprint Report 2007
Reporting standards and validation

Available standards include:
- BSI + Carbon Trust – PAS 2050
- ISO 14064
- Global Reporting Initiative
- World Business Council For Sustainable Development
- DEFRA, Environmental KPIs

Methodologies for measuring carbon footprints are still being developed.

Defining company boundaries in allocating responsibility for CO₂ emissions

Need for an elaborate system of validation and checking
Carbon Anomaly

Global Round Trip for Prawns

17000 mile round trip from Scotland to Bangkok to England

- Switch from machine to hand-peeling to improve quality
- 600 tonnes per annum to Bangkok
- Thai labour cost: 60p per hour (10% of Scottish wage rate)

Carbon audit of two supply chain options (using Carbon Trust methodology):
Decision to de-shell in prawns in Thailand is ‘carbon neutral’ (+/- 200tC / ann)

How is this possible?
Issues

Biases in the monitoring of CO\textsubscript{2} emissions: mechanical versus labour inputs

Co-products: by-products of production used for another commercial purpose

Sharing of capacity: on vehicles, in warehouses, at freight terminals etc.

Backloading: allocation of CO\textsubscript{2} between outbound and return journeys

Reverse logistics: allocation of CO\textsubscript{2} credits for recycling

Seasonality: sourcing from different suppliers / locations at different times of year

seasonal variations in capacity utilisation

Risk of multiple counting across the supply chain
What CO₂ price should companies factor into the appraisal of carbon reduction measures?

### How much is a tonne of CO₂ worth?

<table>
<thead>
<tr>
<th>Source</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEFRA estimate (Dec 2007)</td>
<td>£26.50</td>
</tr>
<tr>
<td>Implicit CO₂ price in fuel duty</td>
<td></td>
</tr>
<tr>
<td>EU average</td>
<td>£130</td>
</tr>
<tr>
<td>UK</td>
<td>£177</td>
</tr>
<tr>
<td>Shadow cost of CO₂e: Assuming stabilisation below 550ppm</td>
<td></td>
</tr>
<tr>
<td>DEFRA estimate (Dec 2007)</td>
<td>£26.50</td>
</tr>
<tr>
<td>Emissions Trading</td>
<td></td>
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<tr>
<td>European Emissions Trading Scheme</td>
<td></td>
</tr>
<tr>
<td>Phase 1 (December 2007)</td>
<td>£0.15</td>
</tr>
<tr>
<td>Phase 2 (March 2008)</td>
<td>£15.50</td>
</tr>
<tr>
<td>CO₂ offsetting price</td>
<td></td>
</tr>
<tr>
<td>British Airways website</td>
<td>£14.60</td>
</tr>
<tr>
<td>Stern Report: <strong>assuming business-as-usual trend</strong></td>
<td></td>
</tr>
<tr>
<td>Social cost</td>
<td>£72</td>
</tr>
</tbody>
</table>
Economic Justification for Carbon Abatement Measures

- European Emission Trading Scheme phase 2: £15.50
- DEFRA: £26.50
- Stern (2006): £72
- Carbon offset: £14.60

£ per tonne of CO2 saved

Measures 1 to 7 are compared based on their costs and benefits.
Some speculations……

Carbon mitigation will not simply be another short-term business fad: it will be an enduring managerial priority

Transport and logistics will eventually be included in emission trading schemes giving companies a financial incentive to cut the carbon footprints of these activities

Carbon intensity will become a major criterion in the selection of suppliers and logistics service providers

Product-level carbon auditing and labelling is unlikely to become widespread

Personalised carbon budgeting and trading are unlikely to prove practical

Low carbon supply chains will be cheaper to operate and more competitive

Many companies will try to gain environmental kudos for improving efficiency……
Low Carbon Logistics
One-day Executive Seminar
Edinburgh Business School
7th May 2007

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